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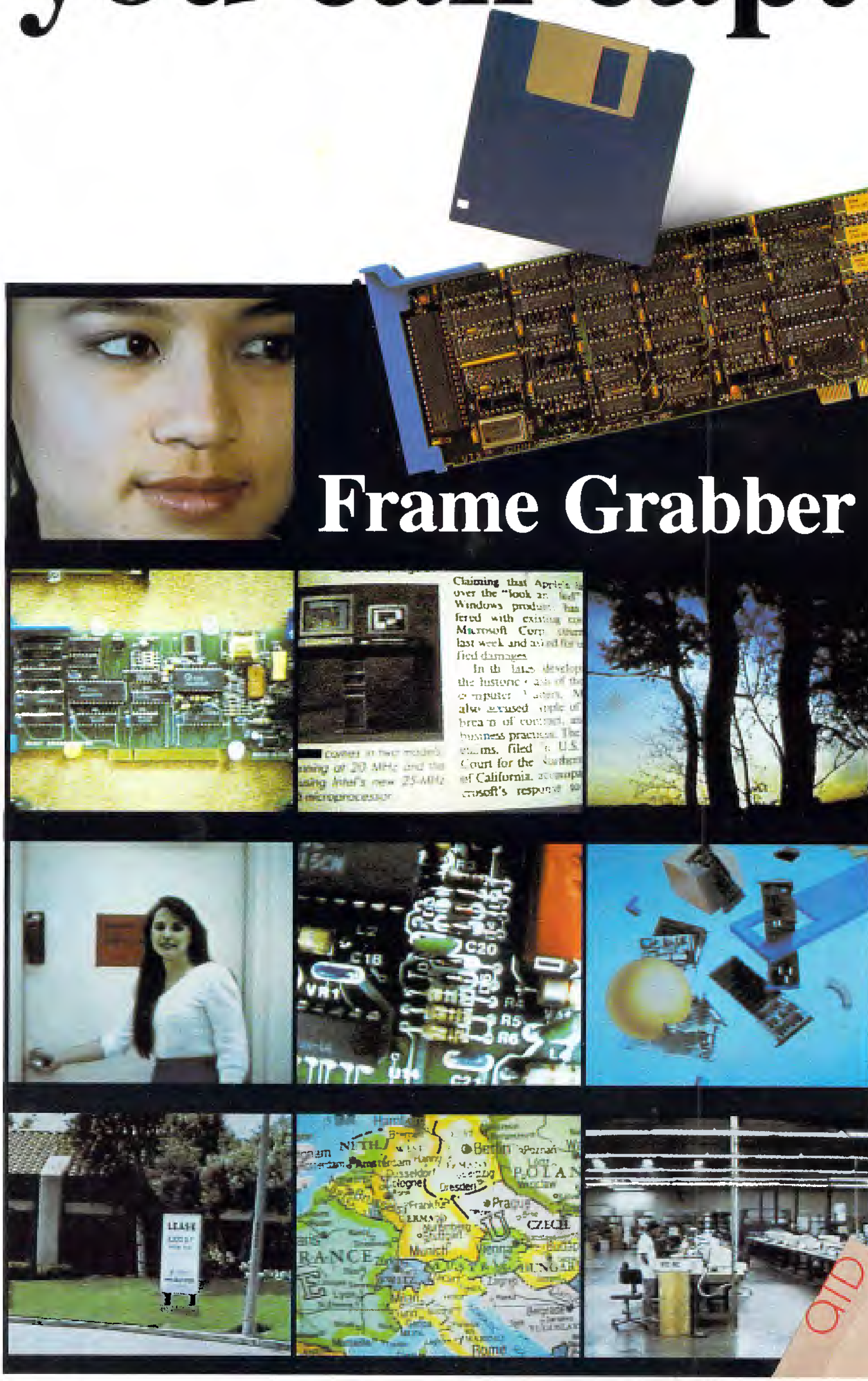

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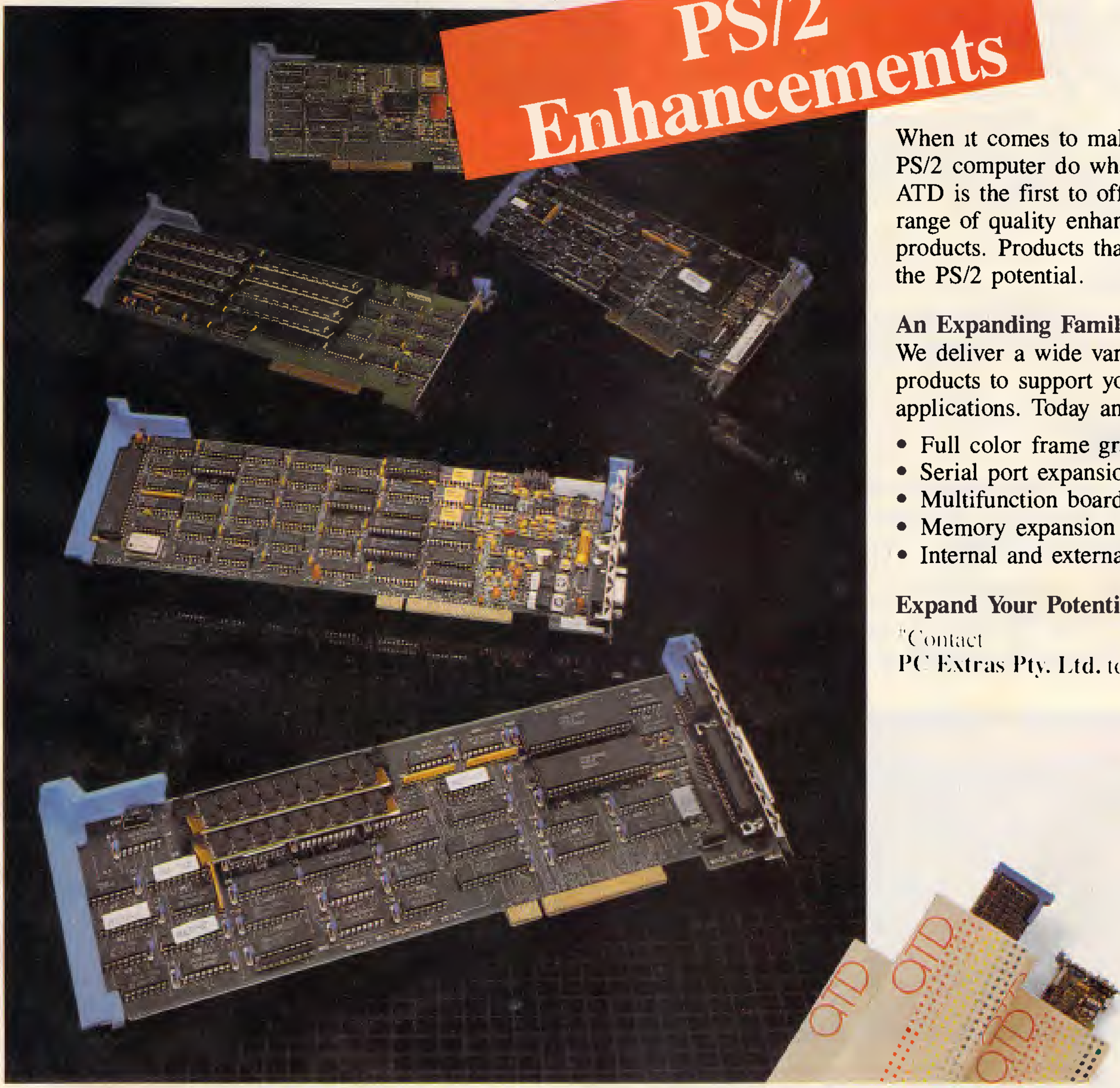

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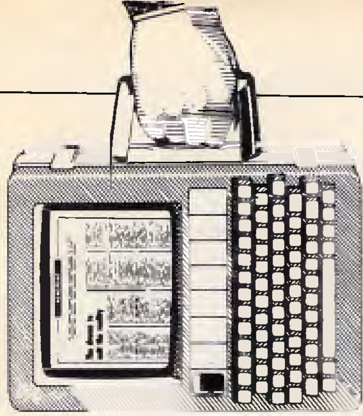


NEWSPRINT

This month's micro report from Guy Kewney and associates includes details of Dell's PS/2 compatible, a report from the West Coast Computer Faire, IBM's insistence on back payment of royalties from PC XT and AT cloners, a decision from Lotus to remove copy protection from existing copies of 1-2-3 and an erasable optical disk which is due here as early as next month.

The end is nigh for MS-DOS

There is a big, fat red slug of colour on my PC screen, and it shouldn't be there. DesqView put it there, and it shouldn't have.

To tell the truth, I feel a bit like a yuppie who has moved into a tough neighbourhood in the hope that it would become all bourgeois and gentrified — only to discover that planning blight means that nobody else is going to follow me, and I'm surrounded by muggers and pimps. And the police just can't quite cope.

The problem isn't with DesqView — it's the barbaric programs it must try to manage.

Only a year after I first saw DesqView 2 demonstrated (at IBM's PS/2 launch in New York) I have finally managed to get a system which uses it — and am positively rolling around in bliss because of my ability to switch between any one of seven concurrently running applications.

Is this the answer to those who say we need OS/2? That's the operating system which will give people with '286 and '386 systems multi-tasking.

I've been doing my own hands-on work to find out, and strangely, I rather think my money is on OS/2, after all.

Not that this system doesn't work — it does, very well.

While I write this, my 80386-based, 3Mbyte computer is busy downloading a large program from a public database. A word processor [illegible] a large file in another window. And another word processor is printing some documentation in a fourth. Ready at all times is a file search program (Gofer) which was, until a minute or two ago, searching through all files on drive D: in the hope of finding my notes on a software package which I'm sure I stored here six months ago. And finally, in yet another window, my 'teledex' database is waiting to take more new names and addresses.

The difference between operating like this, and the normal system, is so startling that I've already learned to ignore most of the problems. Well, within reason. I'm not too happy about having to rewrite the 1000 word report I produced on Olivetti's new range of hardware, just because the system decided to throw it away yesterday . . .

There are less dramatic problems. The supplier of DesqView confirms that there are some programs which simply won't work. Others, irritatingly, work but give you funny colours on the screen. Others make their characters flash when they shouldn't.

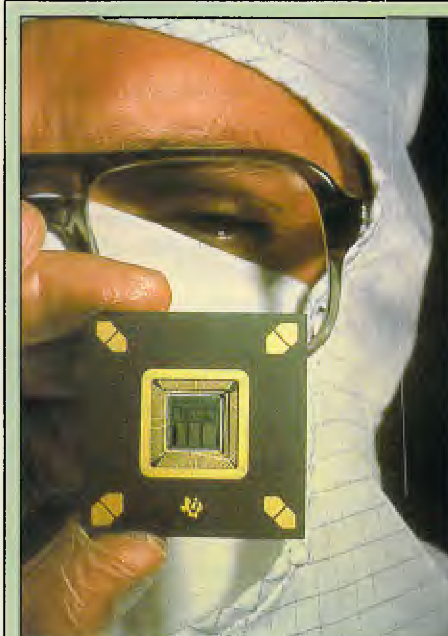
By far the biggest problem with trying to run multiple concurrent DOS programs is that they all make unjustified assumptions about how much memory there is in the system, and what sort of state the display is in.

The result is that quite often DesqView looks away for a moment to check what other programs should be doing, and just misses a few characters on the screen which should be deleted — for example, when scrolling. Somehow, the scrolling is being done by a processor which DesqView can't control. And it has assumed that the screen is showing 25 lines, when it is actually showing 43. Crash — BRS time — again (BRS = Big Red Switch). I thought an 80386 chip was protected from things like this.

That said, the performance is impressive. Previously, I could achieve something like this by using TSR programs, things like PC Outline and Mirror and SideKick and Gofer. With a squeeze, I could fit three, and sometimes four of these into the same machine, and switch between them.

The improvement of genuine concurrency is enormous, and yet, as I have suggested, I'm more convinced than ever that, like it or not, the days of OS/2 are coming.

No, I'm not saying that OS/2 is going to be wonderful. Latest versions of OS/2 complete with prototypes of Presentation Manager (OS Windows) seem enormous — I guess there are at least 5Mbytes of code on the disk, and probably about 1.5Mbytes in memory. Is it only a year since I quoted someone who proved that Unix would never catch on because it occupied so much



Texas Instruments claims that its new numeric processor chip can crunch numbers faster than anything else on the block. The impressively-named ACT8847 can reportedly rip into calculations at a rate of 33 million floating point operations per second (megaflops). The ACT8847, which copes with both floating point and integer operations, is aimed squarely at the numeric coprocessor market for high-end PCs and workstations. Because of its monumental megaflop rating, the chip can deal with numeric processing for both conventional complex instruction set (CISC) and the newer reduced instruction set (RISC) processors.

space on disk and in memory?

But like it or not, you can't hope to civilise these barbarians, the DOS EXE programs. They won't live together in peace.

They are superstitious. They believe that this 3Mbyte monster contains only 640k. They will not keep their coal in the cellar, preferring to put it in the bath in absolute memory locations, and the whole system crashes around them. And they fight, fight, fight all the time.

Managing a multi-tasking system is not something that just happens, either. You have to keep your wits about you, and you have to know what you're doing. Before you can run a program, you have to introduce it to the system, tell the system how much memory it's going to use, and whether it's house-trained enough to be left alone with the display.

Finally, you find that your mouse has gone. Oh, the system knows it's there, but the applications can't find it. Or vice versa.

I've just spent a happy morning watching a colleague trying to run SideKick Plus in this environment. His version seems to have taken on the role of keyboard policeman, and won't let anybody else look at it without snatching it away. going over it with the fingerprint powder, and sending samples back to headquarters for forensic reports. The result is that nothing gets done.

I'm deeply impressed by the power of multi-tasking, and DesqView is actually the simplest version to use that I've seen. But I want to live in a nicer neighbourhood.

Guy Kewney

Michael Dell stands proudly over the first publicly announced PS/2 clone to be seen with fully-operational Micro Channel and on-board VGA graphics

More erasable compact disks

CVA Computer and Peripherals, the Australian distributor of Maxtor products, will launch two erasable optical drives locally in July, beating Tandy to the punch by well over a year. The drives combine the large storage capacity of optical disks with the ease of use and erasability of magnetic hard and floppy disks, said Maxtor officials. They let users erase unwanted data and then re-write new data on removable, cartridge-based disks.

Tandy last month announced an erasable optical disk, called the THOR-CD *(See May APC, page 6)*, which is compatible with existing CD-ROM players but not expected to reach the market until 1991. Unlike THOR-CD, the Maxtor drives cannot be used with current CD-ROM players. The Maxtor drive — a 5.25in, one-gigabyte offering called Tahiti 1, and a 3.25in, 160Mbyte drive called Fiji 1 — are designed differently from Tandy's 550Mbyte THOR-CD.

Exclusive: hands on the new Dell

Michael Dell announced his PS/2 compatibles complete with Micro Channel architecture last month in the US *(See the May issue of APC, page 5). The two models announced were the Model 400 (a PS/2 Models 50 and 60 clone) and the Model 500 (a PS/2 Model 80 clone).*

Both machines feature full Micro Channel architecture, eight Micro Channel slots, on-board VGA and 1.44Mbyte 3.5in floppy disk drives.

The final production machines will not be available until later this year (and Dell has yet to appoint an Australian distributor, though the company intends to), but the development Model 500 we saw was obviously well advanced. In true Dell tradition both systems look set to offer considerable performance improvements over their respective IBM competitors. The Model 400 looks particularly interesting in that it offers 20MHz 80286 performance. The original chip set for the Models 50 and 60 was only rated for a maximum of 12MHz operation.

Considering that the new Dell machine we saw was six months away from production, it was practically devoid of patch wires and performed well. The main motherboard is smaller than that on the PS/2 and has a chip count of almost 50 per cent less. Also, the Chips & Technologies Micro Channel chip set was obviously a well-developed prototype, or perhaps the finished product. The on-board VGA emulation was also provided by Chips & Technologies but this may change on the final version.

Along the rear of the motherboard run eight 16-bit Micro Channel slots; the final version will, of course, incorporate 32-bit slots.

Positive proof that the Micro Channel was indeed working was provided by the genuine IBM disk controller sitting in this prototype. If anything is going to exploit the special capabilities of the Micro Channel, IBM's disk controller will, and it was working perfectly in the prototype. Windows and OS/2 ran faultlessly on the System 500, and both made use of the on-board VGA.

Dell also announced its customised version of OS/2 Release 1 Standard Edition. The major enhancement concerns the access of hard disks: Dell's version of OS/2 identifies Dell's hard disk or any other ESDI disk drive and gives a performance benefit of anything between 50 per cent and 300 per cent. Even on IBM's own PS/2 system, running Dell's version of OS/2 results in a disk performance increase of around 50 per cent.

Another feature of Dell's implementation is the ability to boot either OS/2 or MS-DOS from the same logical disk drive and Xenix from a second logical drive.

Guy Kewney

Colour comes to PostScript

Printer company QMS has broken with traditional thought about colour laser printers, and has (it claims) become the first to produce a full-colour PostScript machine.

Normally, printers (the people) don't want laser printers to produce full-colour pictures. In order to duplicate a colour page, you need three or four (or even more) different masters, each of which will be printed on paper using a different colour ink.

The QMS printer does it all on the same piece of paper, using a wax transfer process. If you want to have that paper duplicated, you have to get the printer (the human) to make colour separations, and proceed with the multiple masters.

However, it is becoming clear that a lot of people don't intend doing anything more with their colour output than having a single copy.

High on the list, of course, are people doing colour presentations. Up to now, they've taken a 35mm camera (or a Polaroid equivalent) and focused on a screen. Some have cameras with their own, flat and in-focus screen built in. Click! and they have a slide for their presentation.

The QMS ColorScript 100 printer will print direct on

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overhead transparent plastic, which is a major breakthrough.

They say it is fast — with a 68020 chip and 8Mbytes (count it) of memory! — and it can handle a full 11in x 17in page of colour PostScript text and graphics. And they say it can print this in slightly less than two minutes.

As you would expect, it's expensive. The company doesn't even bother mentioning the price. This is not a home toy, nor is it likely to be for years.

But you can get details from AWA, the local distributor for QMS products.

Guy Kewney

Disk data

By coincidence, two software experts have, in the same month, announced systems to produce disks that will work in both Amiga and Atari ST machines.

The first is the system invented by Jez San of Argonaut, which is used primarily for protecting games.

The Argonaut system produces a disk which simply can't be read by standard Amiga or ST software. You put it in the drive, turn on the power, and it loads a special program which asks the machine what sort of hardware it is, and then loads the appropriate software.

The second system is from Rob Northern Computing. Rob's system uses an Amiga to format a disk with a special track, which "combines 11 Amiga sectors and 10 Atari sectors on the same track."

But with his system, he claims that all the files can (if required) be manipulated — copied, changed, for example — by the appropriate machine. "To an ST, it looks like a 392.5k disk and the directory comes up normally. And to an Amiga it looks a bit small, with 451k, but again you can look at the directory and work with the files," said Northern.

It's mainly for software houses who want to distribute data as well as software for both machines, he claims — they will be able to put it on the same disk and in the same packaging.

IBM and a host of other manufacturers didn't like what AT&T was doing with Unix (that is, making it user-friendly as above), so set up their Open Software Foundation to take Unix in a different direction. See 'Yet another industry standards committee'

End to the chip debate?

Spoilsports at market research firm, IDC, have attempted to ruin one of the best-loved slanging matches in the business — is the Motorola 68000 family better than Intel's 80x86 family, or is the Intel stuff more powerful?

The researchers went out to find people who were expert in using both chips, and asked them how they rated them against each other.

The really interesting thing about the results is not which machine won (mostly the Motorola 68000) but the fact that market pressures have made these two families the ones to assess.

On performance grounds, there are much faster chips already in the market than either of Intel or Motorola's best. And in the near future, there will be a lot more.

The surge of new silicon which is being cooked up in tiny research laboratories today, will be out in the market this year.

The reason is the evolution of software for designing chips.

These computer-tools which design silicon cells, link them together, test how they will perform and assist the designer to optimise the layout, mean that the gap between a machine's first "Hey, I got this great idea for a 20 million instructions per second signal processor" through to the final "I can ship you 25 next week" is less than a year.

You don't have to think hard to see that this means a big revolution next year.

The 68000 design was started back in the late 1970s. People were telling me how wonderful it would be in 1978. It *is* wonderful compared with the 8080 chip, but compared with something really advanced like some of the RISC processors around, it is old-fashioned, clumsy, unreliable and slow. And compared with what will appear this time next year, based on ideas finalised next month, it is positively quaint.

The survey, by the way, was more of an exercise in statistics than an argument about the merits of the two chip families.

By that, I mean that several categories tested were more like a vote than a measurement. So, for example, 17 of the group thought the 80386 was faster than the 68020, 35 of them thought the 68020 was faster, and 43 gave them equal ratings.

But the statistics were conclusive in one respect. On every single point tested, the two chips were close, but the Motorola 68020 always came out ahead.

And since Motorola is already shipping the 68030, and threatening to offer the 68040 before 12 months are over, while Intel is only now muttering inconclusively about the 80486, Motorola must be fairly satisfied with the survey.

But at the end, it is a tribute to one simple fact: if you want a program written, you need a programmer who understands the language. And most programmers know the language of Intel and Motorola, and relatively few can play with the likes of Sun SPARC, or the Transputer, or the ARM.

Guy Kewney

Money-hungry IBM

IBM has once again thrown the PC clone industry into turmoil, by demanding that makers of PC, XT and AT compatibles pay for the use of IBM patents on both future and past sales. In a master stroke of big business 'thuggery', IBM is requiring that any clone company seeking to enter the PS/2 market must first license IBM's PC, XT and AT patents at royalties of between one and five per cent of sales. This represents at least $28 million from Compaq alone!

To enforce its edicts, IBM is in some cases demanding that competitors turn over product designs, sales figures and specifications as part of the licensing procedure.

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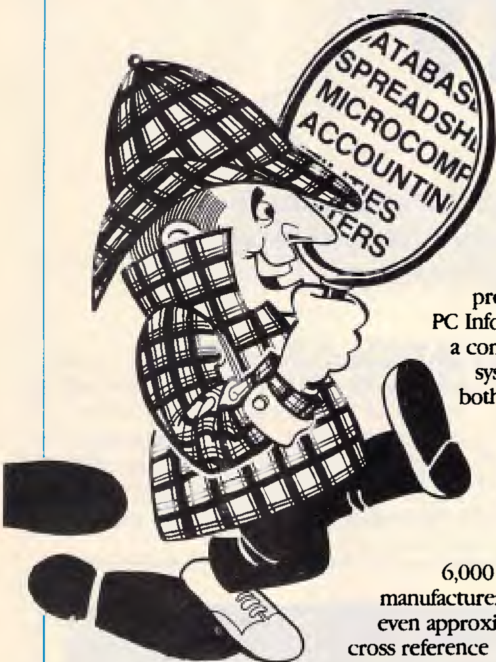

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systems, an area in which the absence of a compiler has been a severe handicap to dBASE developers, who have bought Clipper (a true compiler) and FoxBase (a pseudo-compiler) in significant numbers.

As you might expect, the nature of the competition has contributed significantly to the shape of dBASE IV. As far as the ordinary user is concerned, the basic user image has been completely overhauled, with access to the package through the 'Control Center'. This allows the user to navigate through creation of files, design of screen forms for data amendment and display, design of printed reports, and entry, updating and printing entirely with menus and lists (and without resorting to programming, even where several data files need to be handled at the same time).

The data relationships are still not enshrined with the data definition, but can be stored with each routine which accesses related files. Once set up, such tasks can be grouped together as an application, driven by user-defined menus, again through menu-driven dBASE IV tools.

For more complex applications, additional user-written dBASE programs can be included — you don't have to start from scratch to get one unusual feature. Once an application is complete, it can be passed to the compiler — actually a pseudo-compiler (but still much faster than the present interpreter), — and hence executed. And for developers, there is an enhanced version of dBASE IV which, among other goodies, includes a royalty-free run-time program. So when an application has been developed, you can distribute it together with a copy of the run-time program. The application can then be used without the user having to have a copy of dBASE IV. And for those using large mainframe databases, and thus reared on the query language SQL, there is an SQL facility within the standard version of the new package. This is to be the basis of dedicated database servers which should speed data access dramatically on larger networks.

On the face of it then, Ashton-Tate has provided an answer to most of the criticisms of dBASE III Plus, without making fundamental changes to the way the product handles data relationships. Now for a detailed look at the individual aspects of the package.

Constraints

In addition to the data types already supported, (fixed point numeric, character, logical and date), dBASE IV now has

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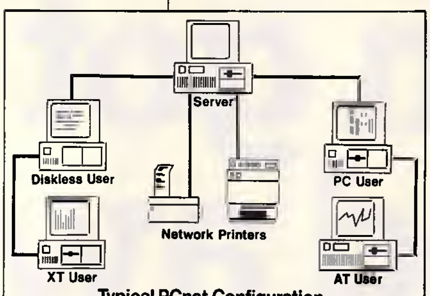

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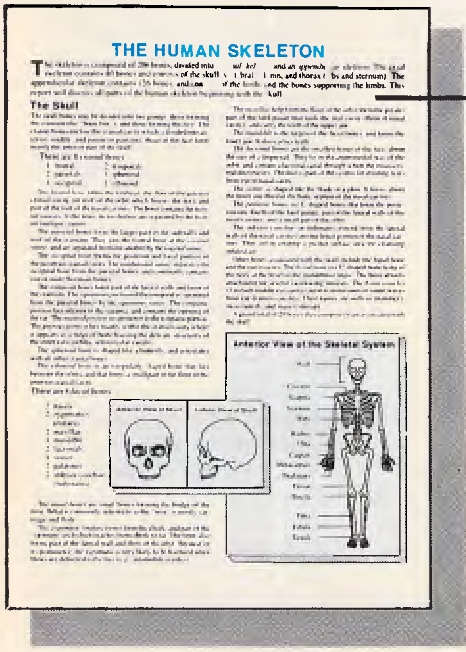

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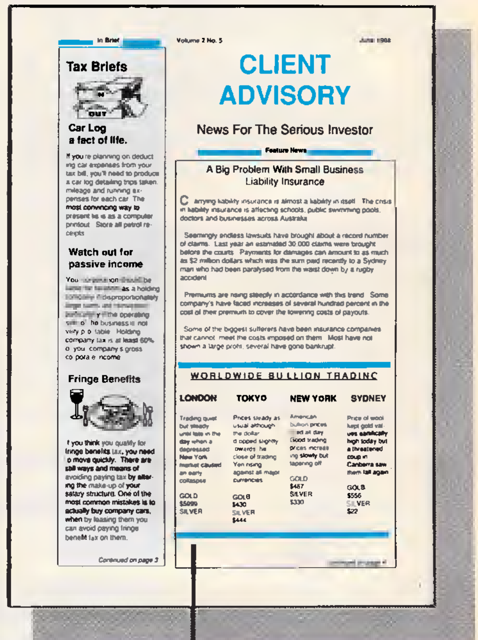

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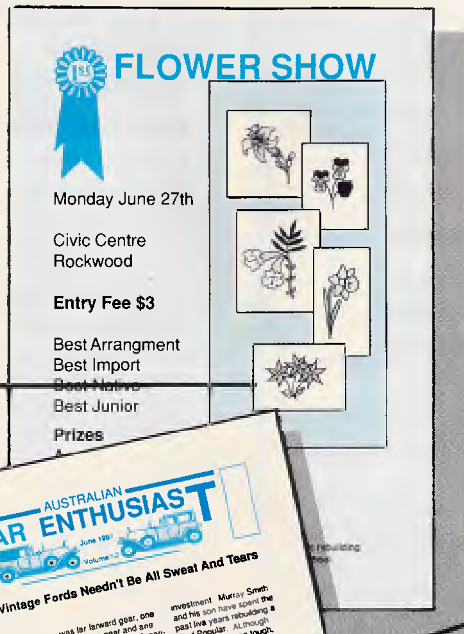

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Includes a data-base of all past draws. With the Prizes option you select any 6 nos. or system entry (7-15), the program checks against the database, tallying up all prizes they would have won over the history of lotto. Other options includes **Evaluate, Graph, Random**.
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Comes with an extensive handbook on using Lottocheck, winning strategies and math theory of LOTTO. You can try before you buy: A DEMO disk is available for $15, refundable against purchase.

Comments from purchasers of Lottocheck:
'I think you have an excellent program in Lottocheck.' J. Remess, TAS.
'It is very encouraging to see an Australian company taking such pride in their product.' Peter Nicholas Pharmacy, Hermit Park, QLD.
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Most DOS Managers are a *shell* that aim to isolate the PC user from all MS/DOS commands. Yet many competent DOS users and some new PC users don't want a shell *instead* of DOS. But they do want a *visual map* of the directory tree from time to time. They do want to be able to delete and copy selected files in bulk. SeeTree displays a visual map of both, your disks (multiple) directory (ie. Tree diagram) and space taken by each directory (ie. bar chart). Users can easily select from the trees, a new *current directory*, then return to DOS, *or* stay a while and delete or copy bulk files. Corporate licences are available.

```
C\ROOT            354K 12
C├─ 123           972K 43f
C├─ MOUSE          43K 5f
C├─ DBASE         842K 19f
C├─ TURBOC        312K 4f
C│  ├─ INCLUDE     65K 25f
C│  └─ LIB        695K 8f
C├─ WP            955K 45f
C   └─ MM         452K 15
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NEWSPRINT

"We are not going to enter into new PS/2 patent-licensing agreements with companies that have refused to recognise past [licensing] liabilities to IBM," said Michael Starks, a spokesman at IBM headquarters in New York. "We have been talking to PC-compatibles makers about retroactive payments."

This means that the increasing number of compatible manufacturers planning to bring out PS/2 clones have the choice of either scrapping those plans, paying up for previous PC sales, or going ahead without licensing agreements and testing the mettle of IBM's legal department.

Yet another industry standards committee

In a concerted retaliation against the recent AT&T/Sun agreement on Unix development, seven major Unix systems suppliers have announced the formation of an alternative international foundation to develop a totally open software environment. The so-called Open Software Foundation (OSF) plans to develop a new Unix-like operating system, based on the X/Open and POSIX specifications. Initial funding for OSF, to the tune of $US90 million, was provided by IBM, DEC, Apollo, Hewlett-Packard, Nixdorf and Siemens. However, OSF membership is open to any organisation, according to OSF officials.

A major complaint regarding the development of Open Look *(See screen shot, this page — Ed.)* and future versions of Unix by Sun and AT&T was that those suppliers have a competitive advantage in getting new releases first. OSF, on the other hand, pledges to 'provide all members early and equal access to the development process.'

The new operating system will use core technology from a future version of IBM's AIX implementation of Unix, according to the OSF statement, although it will support current Unix System V applications.

Olivetti denies Micro Channel

Only two months after everybody heard the whisper that Olivetti had scooped the world by getting a licence from IBM to build imitations of the new PS/2 machines, Olivetti spent a vast sum of money to tell us that it hasn't.

The announcement was pried out of the Italian giant at what it planned as a mega-launch in Paris of a few new 386-based IBM AT clones.

It turns out that the Micro Channel bus — the thing which makes PS/2 machines uncopyable — has not been discussed between IBM and Olivetti. Filippo Demonte, vice-president of the PC division of Olivetti explained: "We need no licence to do a PS/2 compatible machine. We have cross licensing on a much broader field than just Micro Channel."

Pressed, however, he admitted that he just didn't know what would happen when, sometime just before December, Olivetti does release its Micro Channel machines. He didn't even know if the Micro Channel were patented.

Olivetti also gave a thoroughly baffling presentation on systems software. Reduced to its simplest absurdity, this boiled down to "We have all the standards and will support them all."

This is just silly. Olivetti showed a prototype of Presentation Manager, the version of Windows that will ship (we hope) with OS/2 Extended, before the end of 1988. It also announced Windows/386, Windows 2.0 and two versions of Unix.

Put all these on one network, whether you use the two standards adopted by Olivetti or the impressive Token-Ring (which "we also support") and watch the net-

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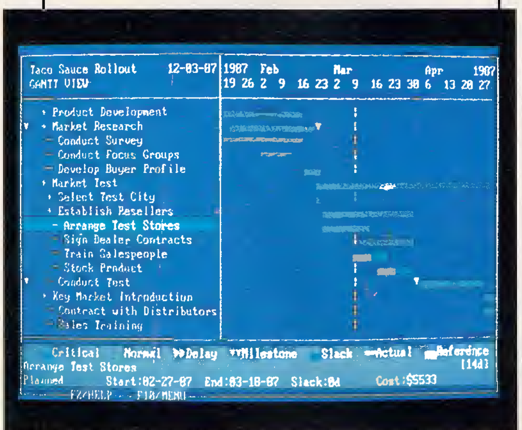

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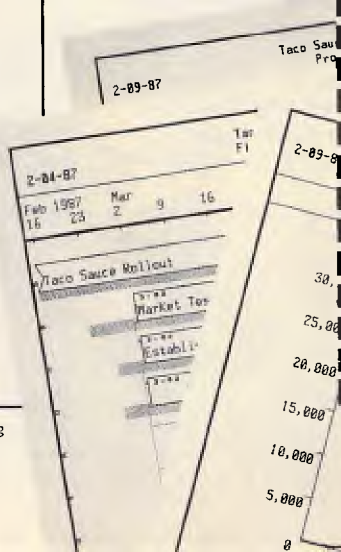

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work choke. Which program will run under which system?

Olivetti (in my opinion) is sitting on the fence. It hasn't told us which horse it is backing because it doesn't even know who the runners will be, yet. So it is enthusiastically announcing support for every four-legged beast in the paddock, much to the horror of one or two hedgehogs.

Lotus unlocks 1-2-3

If you can't beat them — join them. Or so Lotus has decided, after finally distributing a utility that has been available on bulletin boards around the country for years — a patch that removes the copy protection from 1-2-3.

The Value Pack disk, which includes the 'unprotect patch', along with other utilities, will be available early this month for around $25.

The Lotus routine removes the protection and replaces it with a 'copy deterrent' facility, which embeds the owner's name into the product. In cases where piracy is suspected, the registered user name identifies who the software was copied from.

The Value Pack disk also includes PostScript support, along with support for 43-line VGA and 25-line EGA modes. In addition, the disk includes the recently-released Lotus add-ins Speedup (which improves worksheet recalculation times) and Learn (a macro facility).

But it just won't store . . .

It is an extraordinary thing, but true, that the people who are making laser disks for data storage are producing things that cannot be read using compact-disk players. Atari hopes to have a solution to this problem, perhaps as soon as the end of the year.

The two technologies for laser disks are totally different. Compact discs are produced by a process similar to printing. Write-once

The West Coast Computer Faire

The first West Coast Computer Faire held back in April 1977 was fantastically successful with just under 13,000 people attending. In the following years it expanded rapidly, becoming the number one computer show for hobbyists and hackers. More recently, as the personal computer industry has become big business, the Faire has done less well. It never lost the feeling of being a show just for computer users, and huge trade shows like Comdex perhaps took away some of its audience.

This year's West Coast Computer Faire was held at the Moscone Centre in San Francisco from 7-10 April. Compared with the trade shows, attendance was quite small, about 40,000.

Most of the visitors were ordinary computer users, although many were obviously company-based rather than home computer users. IBM PC machines and software predominated, with only the Apple Macintosh and an extremely rare Amiga or Atari ST providing any variety. A few of the games and public domain software companies had products for non-IBM or Macintosh computers, but usually they had no machines to demonstrate on.

The exhibitors were a very mixed bunch. The biggest of the big, IBM, was there but with a fairly modest stand. So were a few of the other major compatible manufacturers, like Kaypro, Tandon and Zenith, but again with very small stands.

Some of the software companies were also represented, but only WordPerfect from among the giants. Many shareware companies were present, like Quicksoft which produces PC Write and Brown Bag, along with a number of producers of cheaper software like Paperback Software and a lot of utility software companies. The other big groups were from cheap compatible manufacturers selling machines; dealers; user groups; and, public domain libraries.

New products

Another sign of the times was how little new there was at the Faire, especially from major companies. Prodigy, the impressive viewdata service from Trintex, was being given its first public showing, although it was announced a while ago. Trintex is backed by Sears (an American Grace Bros. equivalent) and IBM.

Prodigy is based around proprietary communications software. This is currently available for IBM PCs and compatibles and was being demonstrated on Apple IIs with Macs to follow shortly. Any Hayes-compatible modem operating at 1200 or 2400 baud can be used, but Hayes has manufactured a special idiot-proof modem for the service. The Hayes Personal Modem 1200 is an external modem, including cables to attach it to the computer and a phone socket. It measures 2.75 x 3.5 x 1.75ins and weighs under half a kilogram.

The software for Prodigy converts incoming instructions to build up the graphic display. Most of the graphics are built into the program, so text frames, bars, borders and some pictures and maps do not need to be transmitted. More unusual graphics are transmitted, along with textual information. The operator has a choice of controls, all of which are easy to use. The service is built around a building metaphor, with different buildings for reference, shopping, and so on. Different floors and rooms then further divide categories. An ordinary menu is available and an index as well as a quick GOTO system. Prodigy is also very configurable, so users can customise the service to their own requirements.

Currently Prodigy supplies a wide range of services including shopping, reference, financial advice, online experts, news, weather and entertainment. There is even an online version of one of the best-selling computer games in the US, 'Where in the World is Carmen SanDiego?'.

At present, the Prodigy service will cost a flat rate of $US10 per month (besides the telephone bill).

Other new items at the show were the sudden proliferation of information about 'virus' programs as well as a rush of different 'vaccination' programs. A company called FoundationWare released a program actually called Vaccine and demonstrated it working on a current 'virus' program know as the 'Lehigh Virus'. Paul Mace Software, well-known for its utility software for the PC, also announced a virus killer program.

Current estimates are that there are about six fairly common virus programs in the US. These include a version of the arcade game 'Zaxxon' which asks for a number of players and then erases all the disks on the system at the time. More subtle viruses 'infect' other disks during a variable 'incubation' period and then activate, causing whatever 'illness' was programmed into them.

An example of this is the 'Israel' virus which copies itself onto all the disks with which it comes into contact. This is set to erase all floppy or hard disks on which it resides on Friday 13 May 1988, the 40th anniversary of the end of Palestine as a sovereign state. If you have been 'infected' by this virus, you will know by now.

One of the more interesting pieces of software at the West Coast Computer Faire was being demonstrated by a very small company called Pacific Rim Connections. This was a Chinese word processor. You

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disks, however, use a technique of coating the surface of the disk with a dye, which the laser damages.

The result is that an ordinary CD-ROM player cannot read the dye-abrasions.

Atari is working with a software company on the west coast of America, hoping to come up with a solution which will remind some of the old visible-record computer.

In the VCR, the storage medium was a magnetic stripe along the top of a printed form. The information on the stripe was printed together with the data. You put an ordinary record card into the machine's hopper, and the machine could read it.

With Atari's little machine, there will similarly be two devices in the same box. One will be the sort of laser that reads CD disks, the other the sort that reads write-once disks. Software will detect which you have put in, and change format instructions accordingly.

Shiraz Shivji, head of R&D at Atari, says he believes that first samples can be ready for testing before December.

Only somebody who had never met anyone from Atari would take this as a forecast, of course. What it might mean is that the technology will be a lot further on. It might mean that by then, they'll have a better idea of what the problems will be — and if there were no new problems, then indeed it could be ready by December.

But it certainly does mean that nobody will be using a WORM (write-once, read-many) disk to read CD-ROMs until then. And I absolutely agree with Shiraz that a WORM disk drive that can't read CD-ROMs is hopelessly handicapped.

Guy Kewney

The West Coast Computer Faire

Continued from previous page

type in standard romanised Chinese 'Pinyin' (standard English spellings for Chinese words) on the keyboard and Chinese script characters (Hanzi) appear on the screen. The conversion rate is fast enough for someone who can type 50 wpm to average 108 script characters per minute. You will probably have to proofread the results, but this system is substantially quicker than previous ones. The program requires a special board for the IBM PC, a PC with 512k and a graphics card. Fields can be imported from other programs like Lotus 1-2-3 and Multimate. It costs $US600.

Pacific Rim also has a clever and beautifully programmed piece of software called 'Chinease' for teaching Chinese calligraphy. This is also for the IBM PC and costs $US67.50.

The most interesting part of the Faire didn't take place in the exhibition hall but in the surrounding meeting rooms. American computer shows — in particular, the Faire — put on lots of speeches, discussions and seminars. Elsewhere these might be limited to trade attendees, but at the Faire they are open to the public. Every day of the Faire had between nine and 16 conferences as they were called. The subjects under discussion ranged from 'The Future of Standard Computing' to detailed topics like 'Disk Cacheing and Memory Management Tools'. Also included in the line-up were some exhibitions by leaders in their fields on computer-aided art, music and video, and special effects.

Large audiences turn up for these meetings, especially the keynote speeches and exhibitions. Any member of the audience is welcome to ask questions and discuss the subject with the speakers, who are usually very highly qualified. Many come from companies specialising in the subject under discussion or are the designers of the products mentioned.

The speakers included Gordon Campbell, president of compatible chip set makers Chips & Technologies; *APC's* US correspondent, Tim Bajarin; Neil Harris of Atari; George Morrow; Adam Osborne; Jim Warren, founder of the West Coast Computer Faire; and Ted Nelson, the inventor of hypertext.

Trintex can be contacted in the US on (914) 993 8000. FoundationWare can be contacted in the US on (216) 932 7717. Pacific Rim Connections can be contacted in the US on (415) 697 0911.

Novell's Mac NetWare

It seems that third-party companies are determined to drag PC and Macintosh users closer together, no matter how much they kick and scream. Even Novell plans to announce the long-awaited version of its NetWare LAN software for the Apple Macintosh about the same time as this issue hits the streets (June 8). Local Novell distributor Data Peripherals will have the product in stock soon, although local pricing has not yet been determined.

After a year of development, NetWare for the Mac will let users connected to an AppleTalk LAN (running AppleShare software) link to a PC network file server running Novell's Advanced NetWare 2.1 operating system. The NetWare file server connects to the Apple network with an AppleTalk PC card.

The new software will make files on the NetWare server look to Mac users as if they originated locally. Mac users will be able to access data on either the NetWare server or an AppleShare server connected to the network. Users can also transfer between networks files created with applications software supporting protocols common to both environments, such as Excel or PageMaker.

Even faster VGA driver

Video Seven has announced a new, even faster VGA graphics driver for high-resolution PC screens.

It prompts me to correct the assertion (made last year by a representative of the Sigma Design VGA display card) that its rivals are guilty of 'misinformation' when they claim that VGA cards need to be 'register compatible' with the IBM original. Sigma says that its VGA card, which is BIOS-level compatible, is quite good enough.

So it is, unless you are doing something which requires fast response from the screen — at which point, I'm afraid, my own experience of the card clearly proves that the Sigma is just too slow to tolerate.

As time goes by, you will find other problems. De Luxe Paint, for example, is a wonderful program. It has arrived back on the PC, having been launched commercially by Electronic Arts as an Amiga program.

On the PC, it addresses the VGA registers. If they aren't there, it won't work. BIOS compatibility becomes just another catch-phrase of no relevance.

The Video Seven claim is simply that the new card is the fastest on the market. The company also states that it's the only card available which will offer IBM's high-detail monochrome state.

Guy Kewney

Japs devise roll-your-own processor

What is the best way to make clone 80386 and 68020 chips when neither Intel nor Motorola will license their designs? Simple — create a

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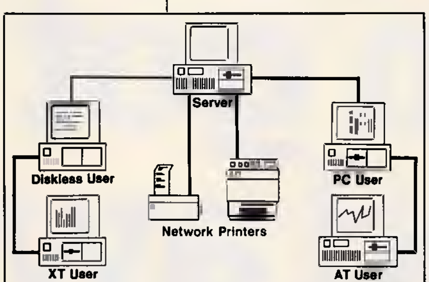

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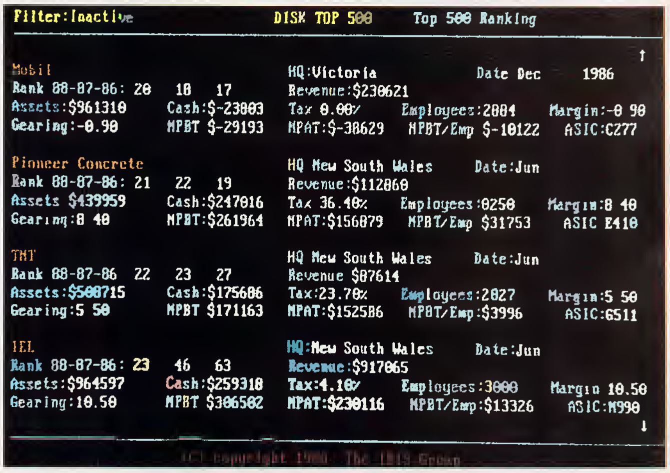


blank 32-bit processor that can be filled with the microcode of any popular CPU. That's the approach being taken by VM Technologies, a Tokyo-based joint venture between Mitsui, ASCII Corp, and several other Japanese PC interests. The company is designing a breakthrough microprocessor which can emulate other industry standard CPUs. The so-called VM8600S chip is being developed in an effort to get around the microcode licensing problems currently being experienced by NEC with its V20/V30 range of clone CPUs.

The VM8600S is expected to ship in sample quantities before the end of this year, and is claimed to operate at similar or faster speeds than the chips it emulates. VM Technologies claims to have pioneered a technique, based on programmable logic arrays, whereby emulation microcode can be downloaded into the VM8600S, allowing it to execute instructions in an identical manner to the 32-bit CPU being cloned. This means that besides emulating commercial CPUs, user-defined microcode sets can be loaded, to create custom 32-bit processors.

Now that you've bought yourself the PC, the printer and the word processing package complete with mailmerge, all you need is some decent names. But where can this power mailing list be found? Ibis Business Information has solved the problem, by preparing a disk-based listing of Australia's Top 1000 companies from a survey recently undertaken for *Australian Business* magazine.

Corporate data stored on the disk includes revenues, profits, employee numbers, addresses, phone numbers and contact names, and custom lists can be easily filtered out and printed. A mailing list generation facility supports various word-processor formats, including WordPerfect, Multimate, WordStar and plain ASCII.

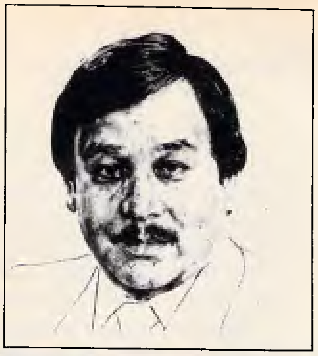
Operation of Disk Top 1000 is via a menu selection interface, with online help available at all stages. The Disk Top 1000 program is available for $495, while a scaled-down Disk Top 500 version (containing data on the 500 largest local companies) costs $395.

END

Stop Press

As this issue went to press, Ed Esber, the Chairman of Ashton-Tate, confirmed that dBASE IV is expected to be delayed.

"The probability of shipping [dBASE IV] by July 1 is next to none," he said. A late September or early October now seems a more likely release date for the package.



STATESIDE

Starting this issue, long-time US correspondent, Tim Bajarin, steps-up his coverage of computing in the States with his own regular column.

A strong competitor for Steve Jobs' NeXT computer: the Sun 386i workstation

NeXT in line for business power

Over the last few months, I have talked about the comings and goings of Steve Jobs and his NeXT computer, suggesting what the new machine might be like and when it might come out.

Sources say that no NeXT machine has appeared yet because of continued problems with the development of hardware and software. It was originally predicted that he would launch the machine in February but that date slipped by and the announcement was rescheduled for April. Now we hear that the date has gone back yet again and the odds are now on June 1. Sources say that the machine is actually in beta sites.

The NeXT is reportedly based on the Motorola 68030 processor and will use a customised version of Unix with a Mac-like interface developed by a subsidiary of an Australian company. It will include many powerful features, such as Ethernet on the motherboard, and almost any peripheral interface, but its key strength is in its Pixar accelerator card-based graphics. In fact, we understand that Evans and Sutherland, the major computer simulator programmers, have even developed a program for the NeXT machine. Because its graphics capabilities are so awesome, the company could produce a version of its simulation program — which normally runs on machines that cost upwards of $US55,000 — on Jobs' new computer.

The most stunning feature though is its price — supposed to be less than $US10,000 for the complete unit, including the graphics card. A year ago, a similar machine would have cost from $US25,000.

The biggest question is where the machine will be positioned in the market. Jobs has said that it is an educational machine, but it's well known that you cannot get rich selling to the education market.

H Ross Perot, the billionaire investor who sits on Jobs' board, suggests that it should be a military and government computer and plans to use his influence to lobby for its acceptance in these markets.

But a growing number of industry professionals believe that the NeXT machine may actually become the next power-user machine in the general business market. Already Sun and Apollo are making low-priced versions of their workstations and planning to position them in this market. And, Apple's Mac II is quickly growing into a workstation, and is already in the general office environment.

Anyone who is familiar with Jobs knows he is interested in making money — lots of it. So our guess is that the NeXT computer will be the 'Next Generation PC' with a very broad-based marketing program and a huge media event for a computer launch.

A penchant for party pieces

During the first week of June, IBM will gather all of its dealers, industry analysts and media types to Dallas for a big birthday party to celebrate the first anniversary of its PS/2 line.

IBM is expected to announce many new products at this event, the two key ones being the long-rumoured PS/2 Model 70, a desktop version of the 80386-based Model 80, and a Model 55, an expandable '286 desktop similar to the Model 50.

Two new laptops are also thought to be in the offing — 80286 and 80386-based machines with MCA architecture and similar in appearance to the Toshiba 5100. These will sport gas plasma screens, but observers familiar with the project say IBM will also make available a low-powered high resolution Epson screen known as a pneumatic supertwist.

But the most important announcement at the party may be the new prices for the PS/2 range. IBM had originally said that the cost of the PS/2 Model 50s would probably fall as low as $US1350 by the end of the year. Sources close to the company say IBM has felt a lot of pressure from dealers since this statement was made and believe IBM will move to at least cut prices of the PS/2 Model 50, as well as other models, by 21 per cent.

Other products, like a new laserprinter and other high-end systems products, are scheduled for the show.

Punch card to digital paper

In the early days of computing there was the punch card.

This form of entering and storing information in computational devices was very popular for many years. But, with the advent of hard disk drives, the punch card quickly went out of favour. Hard disk storage itself has also progressed, though as late as the mid-50s it took as many as 50 hard disks just to store 5Mbytes of information, but now this amount of storage can easily fit into a very thin laptop.

We can now store up to 550Mbytes on a desktop CD-ROM, and 200Mbytes on a standard hard disk is not unusual. But the story is going the full circle, and research labs in Japan and the US are experimenting with a storage concept called digital paper.

The digital paper is said to be able to store up to 10Mbytes of characters in one square inch, and will cost a thirtieth of the equivalent of hard disk storage. At this storage density it will be possible to hold as much as 800Mbytes on an A4-sized piece of digital paper.

Although the technology has not yet been perfected, many experts see this as the cheapest and most efficient method of storing data.

The way digital paper works means that it is more a medium for archiving than instant access, but it could have a strong future where low-cost storage is important.

Right BIOS for a long, long life

Although the PS/2 is set to become a major standard in personal computers, this does not mean that the original PC line will quickly go away. Indeed, most market observers believe that the original PC standard and its BIOS will survive at least another five years.

One of the keys to the longevity of the original PC, especially the clones, is its ability to add functionality at the BIOS level.

Even though you cannot actually turn the original BIOS into an MCA architected box at the motherboard level, you can get the original BIOS customised for you if you are a manufacturer, systems house or VAR.

A good example of this comes from US car dealer VAR. The company has asked Phoenix Software to customise it a new BIOS that includes 3.5in drive support, the SCSI interface and RLL, as well as faster speed. The VAR then has a real competitive advantage over similar VARs and can provide greater functionality in its computers.

Intel is expected to introduce an MCA card for the original PC line, but this is likely to be quite expensive and in use will disable the original BIOS.

The 15 million IBM PCs and clones already on the market could soon be getting a BIOS facelift to extend their life.

CA key to clone war

Well it's official. After months of heavy speculation, IBM has finally said that it will allow the utility patent cross licences to extend to the PS/2 Micro Channel Architecture (MCA).

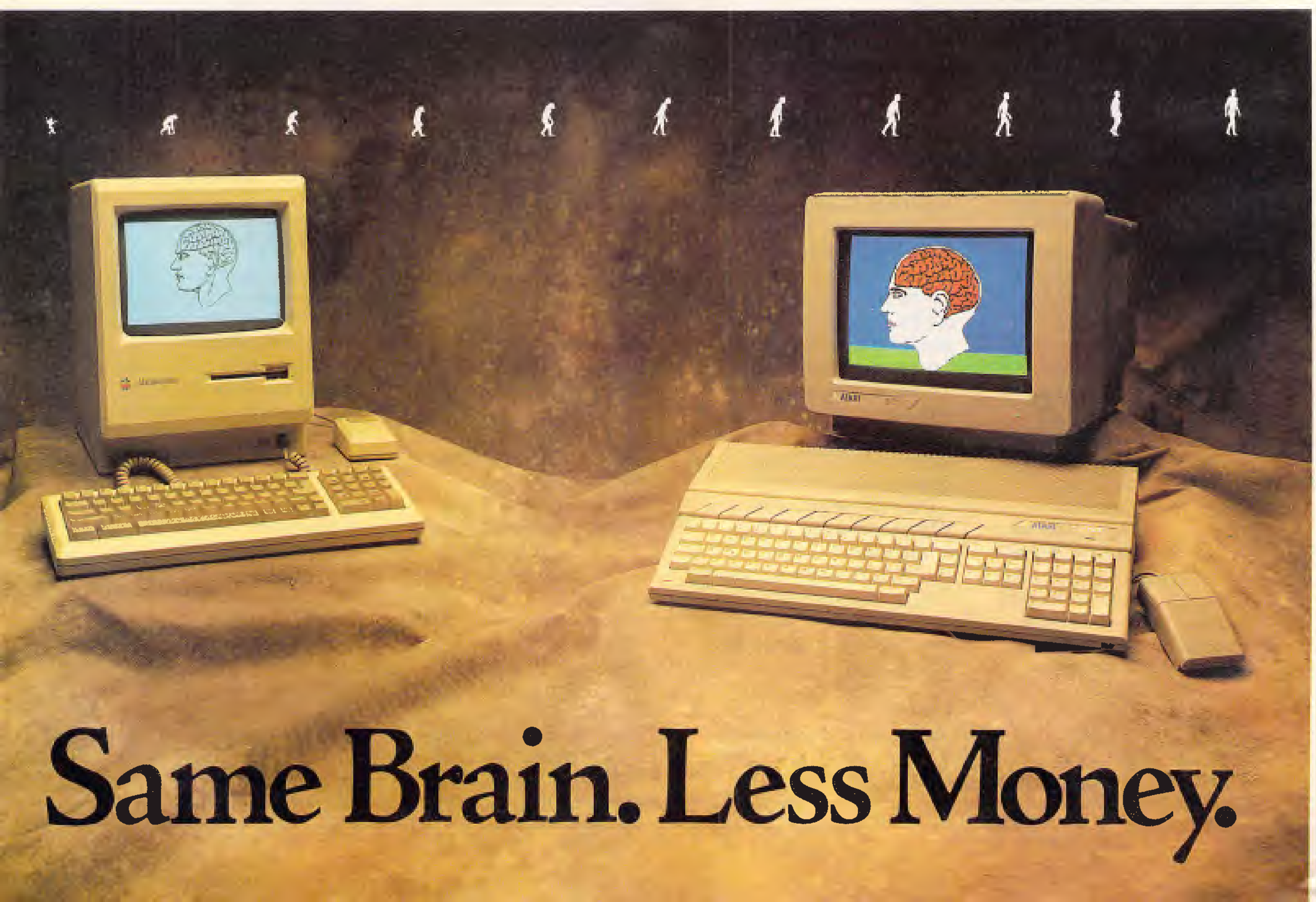
You still cannot rip off the chips via a direct reverse engineering program, but if you get the chips and BIOS from a 'clean room' supplier (a company where the workers have had no direct contact with IBM), IBM will consider including your product under its cross-licensing agreement.

The background to this is a classic example of an internal war between engineering and marketing. In talks with Chet Heath, chief engineer and designer of MCA, it became clear that he and his group were completely against giving away the family jewels. As far as they were concerned, MCA was proprietary IBM architecture and belonged solely to IBM.

But the people on the marketing side were coming under great pressure to get MCA out as a standard and control the threat of rampant cloning.

There were heated discussions between the two groups, and the marketing group won the battle.

In many ways, however, the



final outcome was a foregone conclusion. First, Chips & Technologies perfected the MCA chips set much sooner than IBM anticipated. And, the Phoenix MCA BIOS has been ready since the beginning of the year.

Add to this the fact that IBM's own PS/2 MCA computers have not actually caught on in the market and we had the perfect set-up for IBM to respond with an agreement to cross-licence the technology. In essence, it was boxed into a corner by various marketing pressures from the outside, and responded in the only logical way it could. But it held out for as long as possible before announcing the policy.

The big break came at the beginning of April when Computer Associates, from whom IBM licenses some of the MCA architecture, decided to grant a cross licence on this technology to Canon and an unnamed Taiwanese manufacturer.

Additionally, IBM had received advanced warning of imminent MCA clones from Tandy, Dell Computing and Kaypro.

The Kaypro and Dell boxes were Model 50 clones, but Tandy leap-frogged both of them and on April 21 planned to introduce a Model 80 clone based on the Intel MCA chip sets. Dell actually stole some of Tandy's thunder by introducing its machines on April 18, but the Model 80 move by Tandy really surprised IBM who thought it would take chip and BIOS manufacturers at least two years to emulate what it had done.

Consequently, with serious competitors about to throw down the gauntlet, on April 8 IBM moved to lay out its licensing intentions and act from a pro-active stance rather than a reactive one.

It is now virtually certain that IBM's PS/2 MCA architecture will become the next major standard in office computing, and IBM will be in the driver's seat.

The company will charge all the clone manufacturers a royalty fee for use of its technology, and at the same time will move very aggressively to reduce its own prices so that anyone can own a genuine IBM-labelled box.

The odd man out is Compaq. It has become rich by copying IBM, but Compaq's CEO Rod Canion recently said that Compaq "will not have a PS/2 clone out in 1988." The reason is that instead of looking to outside firms to develop its 'clean room' BIOS and chips, Compaq has set out to do this itself.

According to sources close to Compaq, the company has failed dismally with this engineering project, and as a result has backed away from a PS/2 product line. But it may have to put together a Compaq offering very soon if it wants to be a player.

The fact that IBM will charge as much as five per cent of wholesale cost means that there may be less clone manufacturers chasing the MCA dream.

According to Phoenix, over 300 OEM customers got the original PC BIOS from them. But with the competition much stiffer and IBM calling more of the pricing shots, it appears that cloning of MCA products will not be as rampant as it is with the original PC.

With IBM's licensing agreements of PS/2 architecture on the horizon, and many vendors planning to provide it, the PS/2 computer is destined to be the next major standard in business and office computing.

END

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On the left is the superb Apple Macintosh, arguably, one of the world's finest business computers.

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*RECOMMENDED RETAIL PRICES CORRECT AT TIME OF PUBLICATION. APPLE DEVICE & MACINTOSH ARE TRADEMARKS OF APPLE COMPUTER.

Doorley Buchanan ATA3016

Skai Executive 386

Ian Robinson takes this fully-featured, Japanese-made '386 for a run and comes back with good vibes.

In the past, PC suppliers have been able to get away with various injustices that would be unheard of in other areas (including used car salesmanship), because of the relative naivety of the PC-buying market. Invariably, the final purchase cost of a suitable PC system is way above what was initially expected, primarily due to misleading advertising. For example, consider the common practice of advertising system prices without including the cost of the monitor, or hard disk prices minus the cost of a controller card. This trend has spread to the burgeoning 80386 market, with the base price for many systems applying to a screen-less memory-starved cripple of a box, just crying out for further expansion.

For a start, anyone purchasing an 80386-based system needs memory — not just a measly 640k but multiple megabytes. Secondly, a decent-sized fast-access hard disk is essential to complement the processing power of the 80386. Thirdly, a high-resolution screen and plenty of I/O ports should be expected as standard items — not costly optional extras. Quite seriously, most PC users in the position of considering an 80386-based system are looking for their second or third machine, and require all of these facilities from 'day one'. In other words, the typical 80386 buyer is anything but naive, and expects a sensible basic configuration for a competitive price.

In response to this challenge, Porchester Computers, a Melbourne-based PC supplier, has devised the Skai Executive 386. At first glance, the specifications are impressive: 20MHz 80386 with support for a 20MHz 80387 coprocessor (among others); 4Mbytes of RAM (expandable to 16Mbytes); 42Mbyte voice coil hard disk; 1.2Mbyte 5.25in floppy drive; 1.44Mbyte 3.5in floppy drive; Orchid Designer VGA graphics adaptor; 15in flat screen multi-frequency monitor; eight expansion slots; two serial ports; two parallel ports; bundled MS-DOS 3.3 and Windows/386. In fact, the only item missing from the standard configuration is a mouse. All up, the recommended retail price including sales tax is $13,455, which is elevated to around $13,600 when a mouse is included.

A perfect Windows engine

The Skai Executive 386 is best described as a Windows engine, and in that capacity it excels. By implication, this also makes the system a potentially good OS/2 Presentation Manager platform, and Porchester is no doubt hoping to secure many future corporate sales based on that promise.

The Skai Executive 386 keyboard is a standard 101-key AT-style model

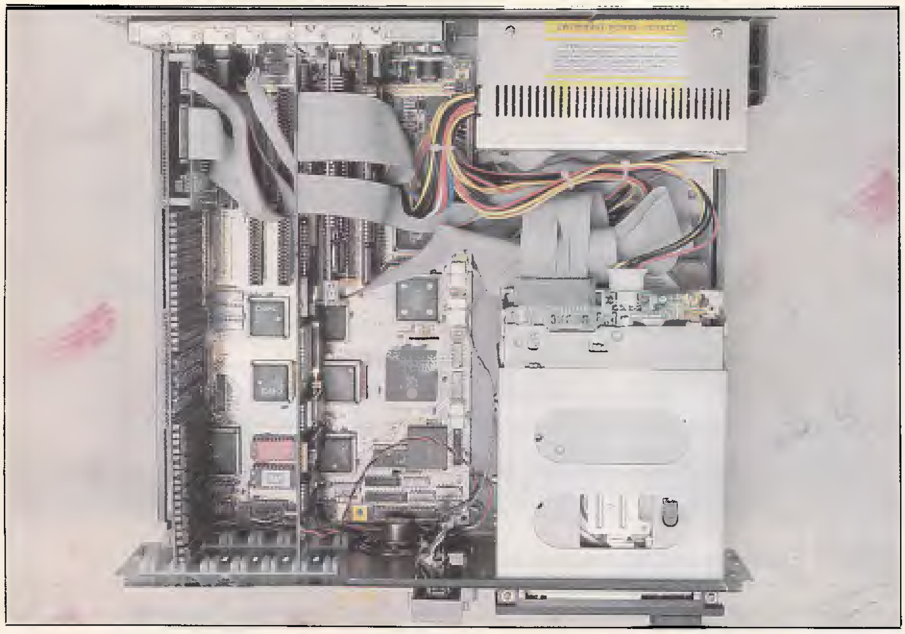
One reason that Microsoft Windows didn't originally set the world on fire was the frequent (and valid) criticism that to experience its full potential, you needed powerful and expensive hardware — at least an 80286 CPU and a minimum of EGA standard graphics. Back in the days when Windows was first unleashed upon the PC-buying public, this type of hardware was definitely not within the capacity of the average wallet. Early product demonstrations of Windows were often staged (rather misleadingly) on turbocharged ATs with EGA screens and masses of extended memory, when all of these were still out of reach for most PC users.

However, prices for 80286-based systems and high-resolution graphics have decreased over the intervening years, to the point where AT-style systems are now regarded as the norm by many PC users — particularly in the corporate sector. Furthermore, applications software packages which exploit the features of Microsoft Windows have only recently begun appearing in quantity, due to the inherent level of programming complexity involved.

As a result, Windows is enjoying something of a renaissance, and the recent arrival of Windows/386 finally presents the graphical operating environment in its best light. For many power users, Windows/386 is comfortably filling the vapourware vacuum created by the inexorable wait for Presentation Manager.

Therefore, bundling Windows/386 with the Skai Executive 386 was a sensible move, as this is one of the few products

Two 32-bit, four 16-bit and two 8-bit slots are included in the Skai Executive 386



Several components of the Chips & Technologies AT/386 chip set are visible on the Skai Executive 386 motherboard

that exploits the more powerful features of the 80386 processor, such as the 'virtual 8086' multi-tasking mode. Similarly, the inclusion of the powerful Designer VGA card from Orchid Technologies helps to show up Windows/386 at its best. It is possible to set up the system with drivers for the enhanced VGA mode (emulating IBM's 8514/A standard) of 1024 by 768 pixels, which has to be seen to be believed.

The impressive screen output of the Skai Executive 386 will be described in more detail further on, but first of all it is worth looking inside the system to see what makes it tick.

Under the hood

Accurately described as a 'small footprint' system, the Skai Executive 386 is based around the latest Chips & Technologies CS8230 AT/386 chip set, which allows the motherboard to be reduced to half the size of a typical AT-style clone motherboard. The seven-chip set replaces the functions of over 30 conventional chips, and provides for higher operating speeds and lower power consumption.

The 80386 processor and surrounding AT/386 chip set are clearly marked for 20MHz operation, and are being driven at that speed, as opposed to some of the more shonky Taiwanese 80386 units around. While the Skai Executive 386 is claimed to operate at either one wait state or zero wait states, the front-mounted turbo switch appears to have no effect on executing applications. The Landmark benchtest claimed that the unit was operating like a standard IBM AT pushed up to around 21MHz, with the turbo switch in either position. The MIPS benchtest from Chips & Technologies claimed that the Skai was running between 20 and 25 per cent faster than a Compaq Deskpro 386 — which was not surprising, since the Compaq uses the slower 16MHz 80386.

Another reason for the relatively small motherboard size is the lack of system memory, as all of it is fitted onto an expansion board occupying one of the specialised 32-bit slots. Each board is organised into two banks of 4Mbytes, one of which is filled in the entry-level model. Since 1Mbit interleaved dynamic RAM chips are utilised instead of the older 256kbit chips, upgrades to 8, 12 or 16Mbytes are relatively inexpensive — with no delays — according to Porchester.

The Skai Executive 386 uses a technique exploited by IBM's PS/2 range known as 'shadow memory', whereby all of the system's BIOS, graphics BIOS, and expansion card BIOS areas are copied to dynamic RAM, allowing them to be accessed much faster than if they remained in ROM. In fact, the Chips & Technologies AT/386 chip set uses every possible technological trick to extract the maximum performance from the aging AT-style (or 'classic') architecture.

The latest revision (January 1988) of the tried-and-true Phoenix AT BIOS is fitted, and the circuitry will support either a 20MHz 80387 numeric coprocessor, or the slightly slower 16MHz 80387, or even a 10MHz 80287, for those upgrading from an XT-style system who wish to salvage the 80287. An unusual hybrid socket is built in, which can accommodate either the square 80387 or the rectangular 80287, resulting in it being a distinctive L-shape.

While eight expansion slots are included on the motherboard, most of these are already occupied by the extensive Skai Executive additions such as hard disk controller and graphics adaptor. Four of these are standard AT-style 16-bit slots, while two are PC-style 8-bit slots, and another two are custom 32-bit slots for expansion memory. However, these additional 32-bit slots are identical to PC slots, with an extra connector at the opposite end of the card, which means that half-length PC expansion cards (such as internal modems) should fit into them with no problems.

Four expansion cards are fitted in the standard model: the I/O and memory board (loaded with 4Mbytes of dynamic RAM); the Western Digital 1006 hard disk controller; a floppy disk drive controller; and the Orchid Designer VGA graphics adaptor (with 512k of video RAM). The I/O board includes a serial and parallel port (with AT-style 9-pin serial and 25-pin parallel ports on its backplane), and is fitted with a piggyback board that provides the additional serial (25-pin) and parallel ports. Empty sockets allow for the addition of another 4Mbytes of RAM, and the extra 32-bit expansion slot caters for the addition of an identical board fitted with a further 4 or 8Mbytes.

Unfortunately, the piggyback I/O card overhangs the adjacent slot, which effectively leaves only three available slots — including one of the custom 32-bit memory slots. According to Porchester, the decision was made to use separate floppy disk and hard disk controller cards (as opposed to most AT clones, which use a single card for both), because of the good performance characteristics of the Western Digital hard disk controller.

Premium disk configuration

The Skai Executive 386 is one of the few systems on the market which has both 5.25in and 3.5in floppy disk drives provided as standard, which would have to be the optimum configuration in this day and age. Just about everyone now concedes that 3.5in drives are the way of the future, but 5.25in drives will remain popular for many years as the ideal standard distribution media. Therefore, it is surprising to see how few

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Technical specifications

Processor:	80386 at 20MHz with zero or one wait state
RAM:	4Mbytes standard
Display:	Idek Multiflat
Ports:	Two serial and two parallel
Expansion:	Two 32-bit, four 16-bit, two 8-bit
DOS:	MS-DOS 3.3
Floppy:	One 1.2Mbyte 5.25in and one 1.44Mbyte 3.5in
Hard Disk:	42Mbyte, 30ms with WD1006 controller
Price:	$13,455

Benchmarks

IntMath:	0.30
RealMath:	0.45
TrigLog:	6.20
TextScrn:	7.55
GrafScrn:	0.95
Store:	1.50

All timings in seconds. For a full explanation of the APC Benchmarks, see the November 1986 issue.

manufacturers include one of each as standard items — I certainly find it indispensable to have access to both formats.

Inspired by the endorsement of IBM's high-end PS/2 models, the 3.5in drive is of the enhanced 1.44Mbyte variety, as opposed to the earlier 720k units. Similarly, the AT-style 5.25in drive has a capacity of 1.2Mbytes, which is still capable of reading 360k disks. In other words, the Skai Executive 386 can read just about anything out there without difficulty, and without having to buy expensive add-on drives.

Likewise, the hard disk supplied with the system is also a joy to behold. With a Coretest reading of just over 30ms for average access time, the Miniscribe 42Mbyte voice coil unit is controlled by a powerful Western Digital 1006 controller card, which shuffles data around at half a megabyte per second, and supports a 1:1 interleave factor. Using complex track buffering and read-ahead logic, the controller is able to read an entire track into its internal cache with each disk access. This means that disk-intensive applications with large amounts of sequential data really scream along. Both PageMaker and Ventura were supplied with the review unit, and their respective redraw times for complex graphic images were testament to the effectiveness of the hard disk and controller (as well as the '386 processor, of course).

Both floppy drives and the hard disk are designed to fit the conventional half-height 5.25in form factor, allowing all three to be stacked on top of each other within the system unit. Porchester has hard disk options up to 240Mbytes available for the Skai Executive 386, and an external Wangtek streaming tape drive is also available for backup purposes.

Other components

The system unit cover is not too different from the multitude of AT clones on the market, and is removed by undoing four screws on the rear panel. A neat central front panel features the usual reset, keylock and turbo switches (does anybody ever run these things with the turbo switched off?) and power and hard disk indicators.

Once the cover is removed (by awkwardly sliding it forward and up), a neat internal layout is revealed, with plenty of open space around the power supply, disk drives and expansion cards — despite the confines of a small footprint chassis. Swapping of disk drives or expansion cards is made fairly simple by the capacious layout, although a full complement of expansion cards may make things a little more difficult.

Apart from changing configuration settings when a new board is installed, the only other switching that may be necessary is to toggle between display modes. Fortunately the Orchid Designer VGA has been designed so that its bank of DIP switches is mounted on the back plane, making them accessible from the rear of the system. This saves the time and hassle of having to remove the system unit cover.

The multi-layer motherboard is well-designed, with no patch wires in sight, and appears almost identical to the prototype layout supplied by Chips & Technologies to its AT/386 chip-set clients. As expected, the board is dominated by the large, square 80386 and chip-set ASICs (application-specific integrated circuits).

The bundled Idek Multiflat monitor has an impressive near-flat screen, which prevents the usual bowing effect around the edges of the screen image, and helps to reduce glare and reflection. Being a multi-scanning monitor, it can adapt itself to whatever mode is being output by the adaptor board, including standard monochrome, colour (CGA), Hercules, EGA, VGA, PGC, or enhanced modes such as the high resolution 1024 by 768 mode used by IBM's 8514/A adaptor.

While the monitor makes an audible click at power-up and each time the mode is switched, the noise is not too annoying. However, like the Zenith flat-screen FTM monitor, the Itek Multiflat is extremely large and quite heavy to lug around. In fact the 15in screen totally dominates the relatively petite system unit.

The Skai Executive 386 keyboard is the fairly standard 101-key AT-style unit that can be found on any Dodgey Brothers Taiwanese clone, and warrants no further comment, other than 'it works'.

The bottom line

With 80386-based systems from some of the more high-profile manufacturers costing well in excess of $20,000, the $13,455 Skai Executive 386 certainly stacks up well against the competition. This is particularly apparent when you consider the number of typically 'non-standard' features (such as 4Mbytes of RAM and a multi-scan monitor) which are provided with the base model. The Idek Multiflat monitor is comparable to the best available, including the top-notch Zenith FTM, and provides a high-quality finish to a system with superior internal architecture.

The Skai Executive 386, in its role as a 'Windows engine', typifies the move of high-end PCs towards the realm of graphic workstations, which has been spearheaded by the emergence of the 80386 processor and graphical operating environments such as Windows/386.

Porchester appears to be targeting the unit as an individual corporate power user's tool, rather than as a departmental file server (an approach which so many other 80386 system suppliers have taken). In this role, the bundling of Windows/386, 4Mbytes of memory, VGA graphics and a fast hard disk are crucial, and will help to give the Skai Executive 386 a further edge over its competition.

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☐ Pop up according to the date and time. Reset the date and/or time anytime. This feature can be turned off whenever you like.

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dBASE IV

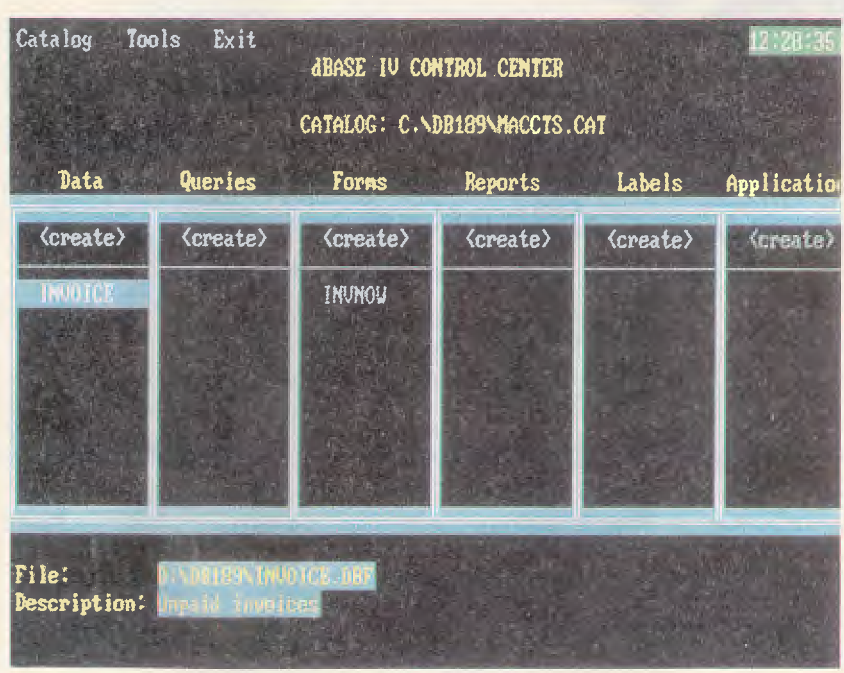
Kathy Lang found that Ashton-Tate has responded to the criticisms levelled at dBASE III Plus, but has not gone as far as it might have done and certainly has not had any radical change of heart.

There are only two numbers in computing: one and more than one. This law applies to database systems as much as it does to many other areas. The purpose of a database is to allow you to store and interrogate structured information of the kind previously stored in a manual card index. Basic data can be handled by software which deals with one file at a time, and does not provide the opportunity for relating unlike sets of data. More sophisticated programs allow you to handle more than one file at a time, and to create relationships between them.

The dBASE family from Ashton-Tate belongs to this 'more than one' category. Within this type of software, there are two ways to handle relationships: tightly bound and ad hoc. Packages such as Quartz make defining the relationships between files an inherent part of file creation. In dBASE II and dBASE III, on the other hand, relationships are set up on an ad hoc basis, and exist purely for the duration of the dBASE 'program' which manipulates them. There are both advantages and disadvantages to this approach, but on the whole it is easier to ensure data integrity if relationships are explicit and tightly bound.

Furthermore, the inability in dBASE II and dBASE III to carry out any sort of manipulation of two or more related files (even on an ad hoc basis) without resorting to dBASE programming is a distinct disadvantage to the ordinary user. This largely explains the sharp contrast in dBASE between the ease of creating basic applications processing a single file, and the complexity of handling several data files at once.

This contrast explains, to a great extent, the increasing inroads into dBASE's popularity by Paradox, which aims to provide a natural progression — particularly for Lotus 1-2-3 users — with a variety of help tools including 'query by example' and a powerful applications generator. Another part of the dBASE market which has been subject to heavy competition is development tools and



All of dBASE IV's features can be accessed via the Control Center shown here

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systems, an area in which the absence of a compiler has been a severe handicap to dBASE developers, who have bought Clipper (a true compiler) and FoxBase (a pseudo-compiler) in significant numbers.

As you might expect, the nature of the competition has contributed significantly to the shape of dBASE IV. As far as the ordinary user is concerned, the basic user image has been completely overhauled, with access to the package through the 'Control Center'. This allows the user to navigate through creation of files, design of screen forms for data amendment and display, design of printed reports, and entry, updating and printing entirely with menus and lists (and without resorting to programming, even where several data files need to be handled at the same time).

The data relationships are still not enshrined with the data definition, but can be stored with each routine which accesses related files. Once set up, such tasks can be grouped together as an application, driven by user-defined menus, again through menu-driven dBASE IV tools.

For more complex applications, additional user-written dBASE programs can be included — you don't have to start from scratch to get one unusual feature. Once an application is complete, it can be passed to the compiler — actually a pseudo-compiler (but still much faster than the present interpreter), — and hence executed. And for developers, there is an enhanced version of dBASE IV which, among other goodies, includes a royalty-free run-time program. So when an application has been developed, you can distribute it together with a copy of the run-time program. The application can then be used without the user having to have a copy of dBASE IV. And for those using large mainframe databases, and thus reared on the query language SQL, there is an SQL facility within the standard version of the new package. This is to be the basis of dedicated database servers which should speed data access dramatically on larger networks.

On the face of it then, Ashton-Tate has provided an answer to most of the criticisms of dBASE III Plus, without making fundamental changes to the way the product handles data relationships. Now for a detailed look at the individual aspects of the package.

Constraints

In addition to the data types already supported, (fixed point numeric, character, logical and date), dBASE IV now has

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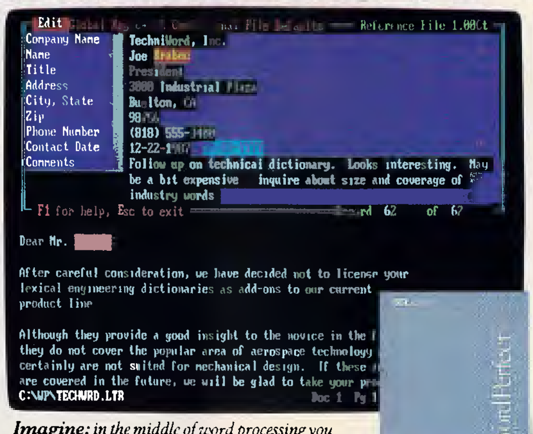
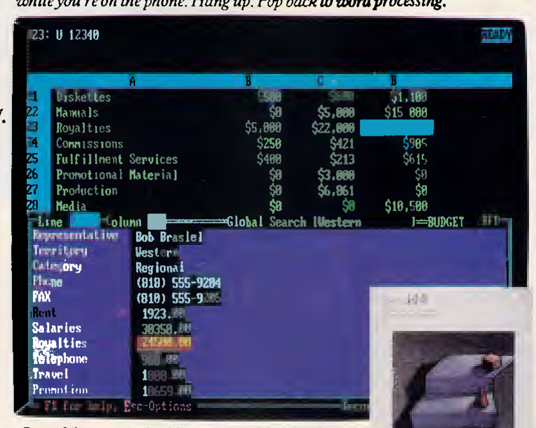


Imagine: in the middle of word processing you need to make a call. You can't remember the number. Pop up Ref-File with just two keystrokes. Search the database, find the number in seconds. Take notes right in the database while you're on the phone. Hang up. Pop back to word processing.



Consider: you're building a spreadsheet and need to check last year's western regional budget. Pop up Ref-File. Search your financial database for "western and regional." Find the record fast. Cut and paste the number into 1-2-3. Deliver forecast ahead of schedule.

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floating point variables. However, there are still no special features for processing time fields. In memory, though not in a data file, you can create arrays of one or two dimensions, containing up to 1023 cells depending on the available memory. A record may now have up to 256 fields. Up to 99 files may be in use at once, including 10 data files, and the number of files needed has been reduced by changes to the indexing — see the screenshots.

There have also been significant improvements to the command file editor, allowing up to 32,000 lines of 1024 characters. This editor also allows much better manipulation facilities on memo fields (which give access to up to 512,000 characters per field, held in a separate file where each record forms a single memo field). dBASE IV does not have the dBASE III Plus ability to use an external word processor on memo fields.

File creation and indexing

File structures are created in much the same way as in dBASE III Plus, using onscreen editing to define each field. At the same time, you can now indicate which fields are to be indexed, and dBASE IV will create a single index, including all key fields or key expressions as tags (a maximum of 47 tags per file). This single file is opened automatically with the data file, thus removing a potent source of error. The SET ORDER TO command is used to specify the particular tag currently used to determine the order in which records are accessed. People who need to continue using dBASE III Plus as well as dBASE IV can choose not to use this mechanism, but to continue to create NDX files which are identical to those used by dBASE III.

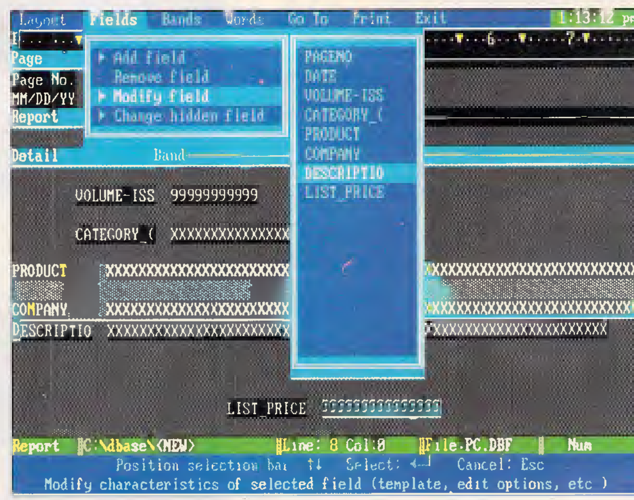
NDX indexes can also be used in addition to the single tagged file, if you should be mad enough to want more than 47 key expressions. (I haven't tried it, but I imagine that such a specification would send you for a cup of coffee in between each file access.)

Files can also be created using SQL statements: these must be bracketed by START SQL and END SQL commands, since there is some overlap in names between SQL and dBASE. However, while the compiler accepts the SQL syntax, SQL statements don't have any effect in my very early version of dBASE IV, so I wasn't able to try it out.

Data entry and updating

Essentially there are two modes of updating files interactively in dBASE IV.

The Browse mode offers more than a mere look at a dBASE IV file: searching, appending and deleting of records is possible through pull-down menus



The paint-a-screen system for creating data entry and onscreen reports has been much improved

Firstly, you can use the EDIT and BROWSE commands (both significantly enhanced), using either default or user-defined screens for data display from the 'Control Center', or from the dot prompt. Secondly, you can program your own data entry routines in the time-honoured dBASE fashion.

Whichever method you use, if you use designed rather than default screens, you have access to considerably more effective validation procedures than were available before. dBASE IV permits default values; copying of the data from the corresponding field in the preceding record; and a validation option on each data read statement which is evaluated field by field, rather than after the whole record has been entered. A look-up facility for handling a set of literal codes is provided. Also included is a function which allows you to check the existence of a code in another file — perhaps the presence of a customer record when entering an invoice. There are also some improvements to the way memo fields are handled. New editing commands make it easier to copy, move and remove memo fields. The editor has improved significantly, removing the need (and ability) to use an external editor or word processor. Retrieval of records for updating may employ all methods used for displayed queries.

In addition to interactive updating, you can update files in a batch, either through the Query option in the 'Control Center', or by writing your own dBASE program.

Screen display

In some ways, the most noticeable improvement in dBASE IV for ordinary applications is the enhanced screen layout facilities. These 'paint-a-screen' tools allow you to design a multi-file data entry or query screen quite easily, using techniques borrowed from word processing such as block marking and copying, against a 'crocodile skin' (their phrase, not mine) background in which it is very easy to see where you've put things. A ruler can be displayed if you wish. Boxes and lines can be used to outline areas of the screen. For screens which show

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CT1188 UPDATE

PREVIEW

fields for more than one file, you must first establish a View — more on this under Multiple Files. Memo fields can appear either as simply a reference, as now, or in a window which dictates the amount of the memo field which can be displayed without Zooming out to fill the screen.

User-defined help can be attached to particular fields, using windows if you wish. (These windows are inherent to dBASE IV, and nothing to do with any Windows environment; dBASE IV is still a text-based program, though a graphics user image is promised when Presentation Manager finally sees the light of day.) The result is a tool which many application developers and ordinary users will find helpful.

Reports

The creation of printed reports follows the same approach as screen design. Three default formats are provided: for customised reports, you can use the screen painter; or start from that and modify later; or write your own dBASE programs. As with dBASE III Plus, the screen painter creates an intermediate file which it uses when the design is modified.

So, although you can modify the PRG file produced by the screen painter, this is a one-way process: thereafter, you cannot use the screen painter to make further changes. Text within a report may be word-wrapped, giving simple letter-writing facilities. The ability to exploit advanced printers has been improved, enabling you to select fonts from within dBASE and to apply emphasis such as emboldening. The HP LaserJet language is supported, although not PostScript printers at present, so for high-quality work I shall still be encoding dBASE output for printing in Ventura.

Selection

You can retrieve records through indexed searches (FIND and SEEK, as in dBASE III Plus, but with the nearest record being found if an exact match is not found), or through un-indexed searching using LOCATE. A new command, SCAN..ENDSCAN, which is essentially a combination of LOCATE..DO WHILE..CONTINUE, makes un-indexed searching much slicker. Queries, which search sequentially, can be set up through the 'Control Center', in which you can specify the search criteria and either the form of screen display or the batch update option. The search specifications can include fil-

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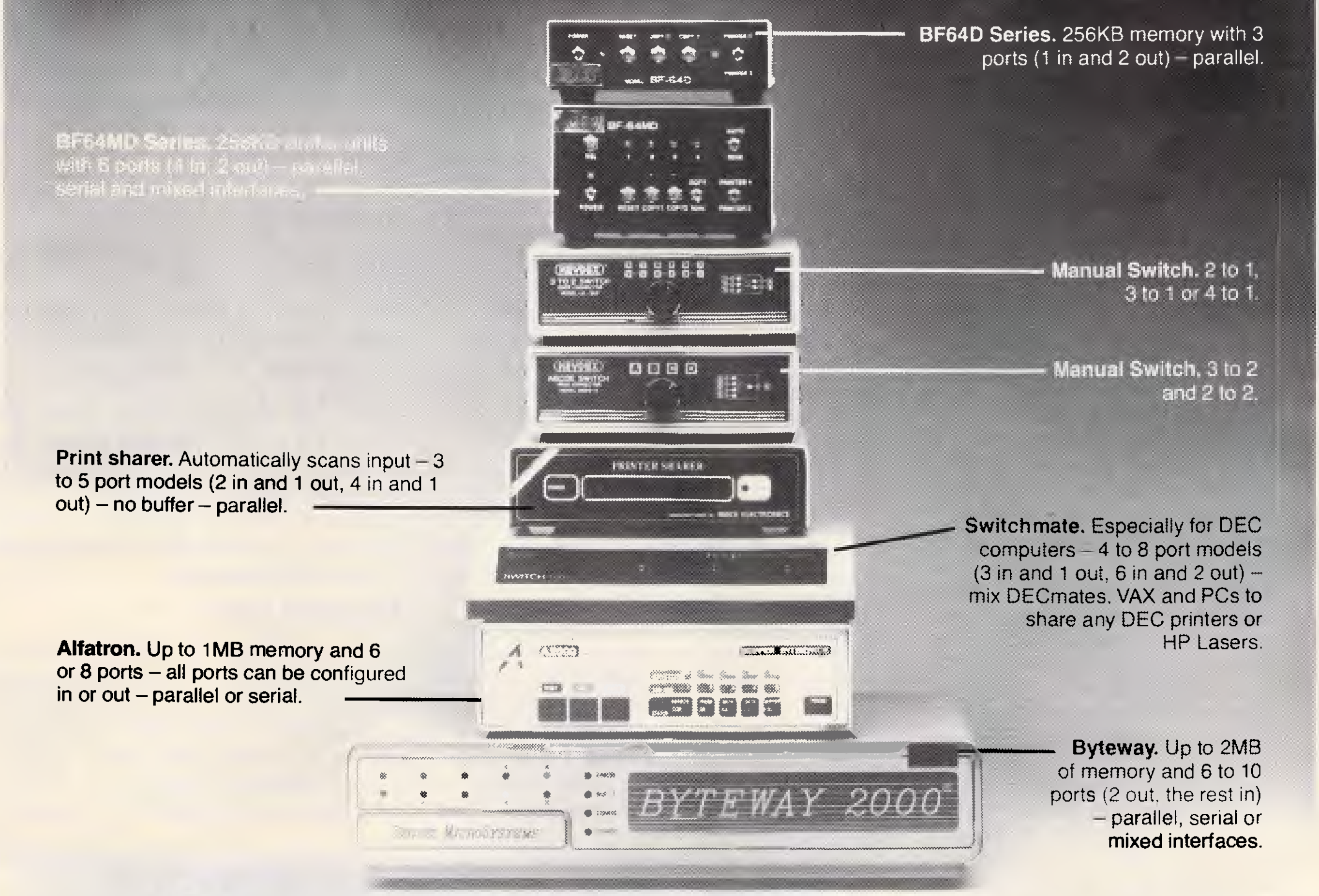

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ters, calculations, and sort order precedence; search criteria established within the 'Control Center' are specified with a form-filling plus expression method similar to that in RapidFile. Within the command language, you can specify additional goodies such as a 'self-join', which would allow you to find all tutors and their graduate assistants when a single file holds records about them all. Such links are specified through Query, using 'Query By Example', to establish a View of the data comprising all linked files.

Better search facilities for memo fields are promised but in the advance copy of the software I had, there were no details beyond the notification in the change summary. This suggests that it will be possible to transform a complete file — ordinary fields as well as memo fields — and use an option on the SET ORDER TO command to retrieve appropriate records.

Sorting

Sorting is not necessary unless one needs complex combinations which cannot be handled by indexing along with SET ORDER TO. You may want to combine selection and sorting with output to another file, or to sort in an unusual order using a dictionary of sort terms; either of these tasks could be accomplished with SORT. It is also useful to be able to set up an ad hoc display or report order which you know you will use only occasionally, to avoid the overhead of updating such tags every time a record is amended.

Calculations

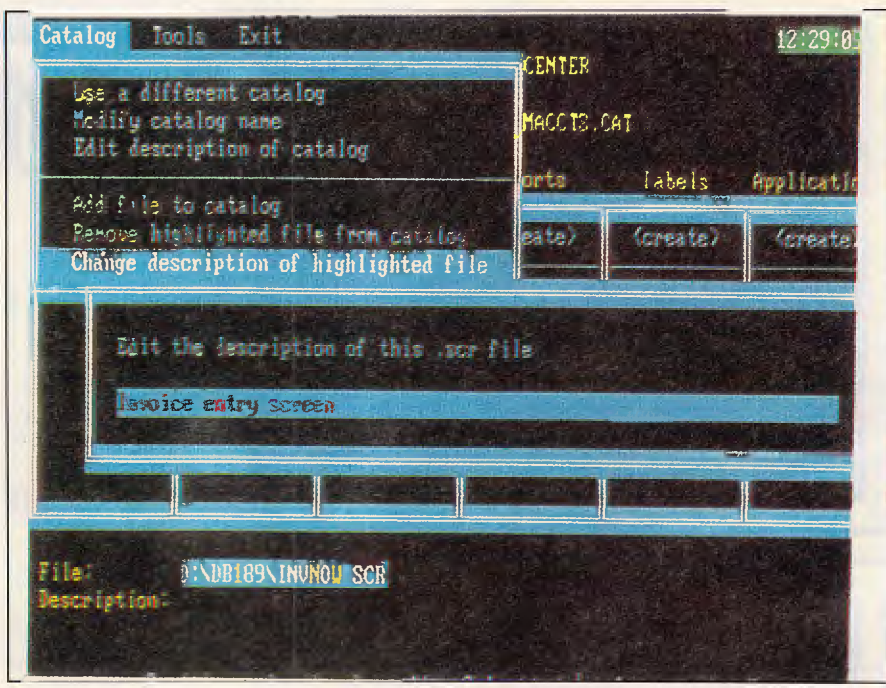
Calculation features have always been among dBASE's strengths. New features in this version include a floating point data type, and the ability to carry out several statistical calculations (SUM, COUNT and so on) on a single pass through a database.

Importing

While dBASE IV does not include any graphical output facilities, it does permit direct links with Ashton-Tate's graphics product. How far it will be possible to run this package from within dBASE IV depends on the way memory is used; dBASE IV supports both EMS and EEMS, but it is not yet clear how far this will enable dBASE code and overlays to be 'paged' out to allow other programs to execute via the dBASE RUN command. The range of permissible import formats has also been extended.

Multiple files

A major weakness of dBASE III Plus is that one can set up file linkages through the VIEW facility only, or through DIY programming. VIEW is still used as the vehicle for linking files without resort to the command language, but its facilities have been much extended. Whereas in



Creating a data file in dBASE IV

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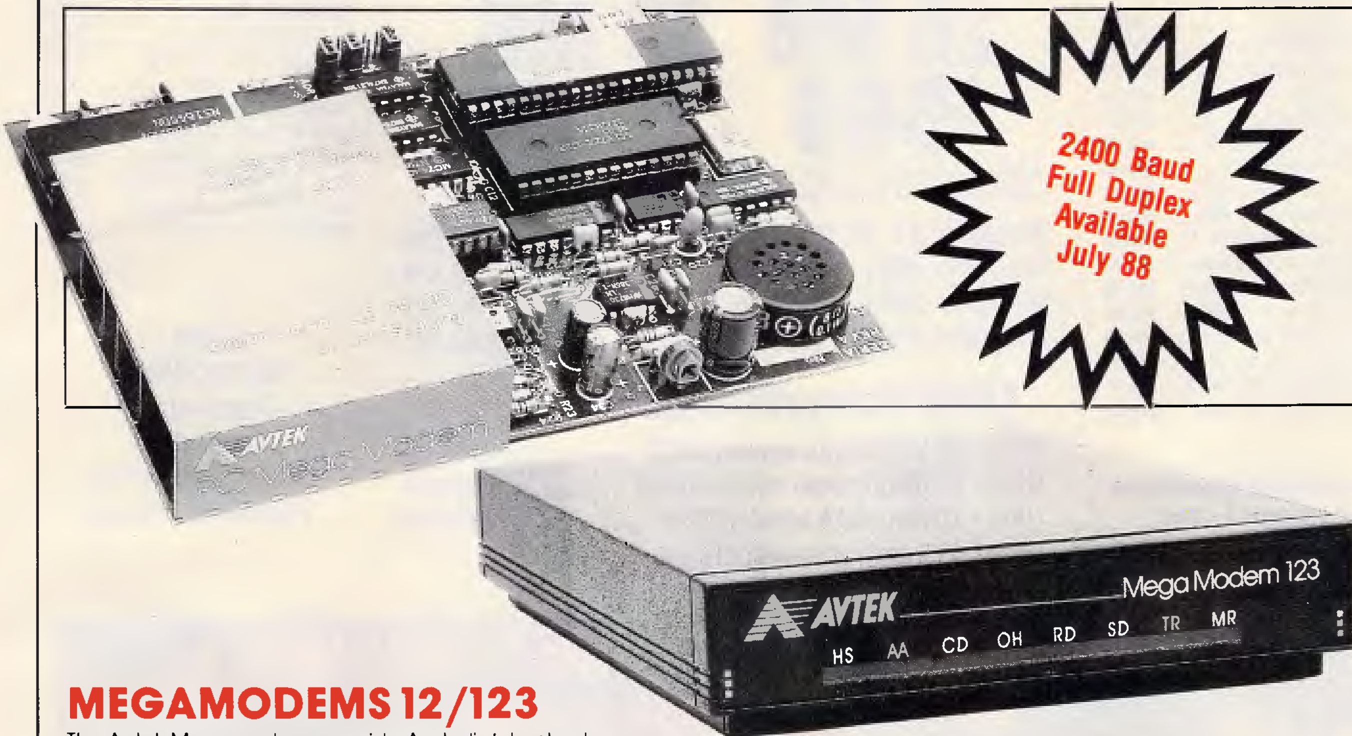

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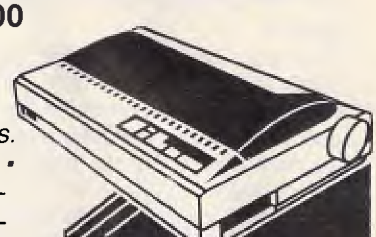

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dBASE III Plus you could link files only in a simple hierarchical chain, you can now link files in any way which can be described using Query By Example. The screen displays skeletons of the structure of each file you want to link, and you enter the same sequence of characters in each field used for linking. Such fields should normally be index tags to allow fast access. There have also been major improvements in alias support, allowing many linked-file tasks to be carried out without explicitly moving record pointers.

However, file linkages in dBASE IV remain virtual — that is, operate for the duration of the VIEW only. It is rumoured that the version of dBASE promised for Presentation Manager will look very much like dBASE Mac and, since that package includes explicit hard file links, perhaps that change will then come in the IBM version. It will, however, bring some attendant difficulties for changeover. The present approach is sufficiently close to dBASE III Plus to make transfer very easy, but the dBASE Mac approach is fundamentally different.

Tailoring

Within the 'Control Center', it is possible to design files, update procedures, queries and reports, set up menu systems to handle them, and build them all into an application without using the command language directly at all. The Application Generator can also incorporate in-line code, so you can use the 'Control Center' for most things, and just write a program or two for the bits it cannot handle. This makes it a serious contender for the attention of developers, unlike the ApGen in dBASE III Plus, which frankly is a joke. If you still need the command language, it is still there in all its (?) glory.

Some good features have been added, notably user-defined functions, which can include most dBASE commands; interactive commands such as EDIT are among the few excluded. The debugger is much improved, and there is at last a cross-reference utility — why so few programming and command languages have this essential feature I'll never understand.

The command file editor can now handle 32,000 lines of 1000 characters. When you save a command file, object code is automatically generated, unless you have carried out the changes using an external editor — in which case the file must be compiled before execution. The compiler produces intermediate tokenised code, rather than being a true compiler. It thus needs either full dBASE present, or at least a run-time system, in order to execute.

However, with the Developer's Release of dBASE IV, you get a run-time system on which there are no royalties, so it can be distributed with each copy of your program object code at no cost to the developer.

Nor do run-time only programs need any further accompaniments to run on a network. Full versions of dBASE IV still need a LAN pack for each copy, and the developer's version of dBASE IV also includes a three-station LAN pack to enable you to test networked applications. In either version, file and record locking is taken care of automatically by the system in dBASE IV, though you can still lock explicitly if you need to (perhaps when performing a series of related updates).

Another addition to the developer's armoury in dBASE IV is the use of templates. When the ApGen generates an application, it takes the various files — screen format, queries and so on — and generates the complete application according to a template. The standard version of the program comes with a default template, which will be appropriate for most applications. But the developer's version includes the template language, allowing you to build customised templates. This can most obviously be used for simple changes such as the inclusion of a logo in a sign-on screen, but it seems to have considerably more potential than that. Unfortunately the current documentation is rather coy about its uses, and I shall await the distributed version before passing judgment.

> *'I am disappointed that users still cannot at least define file relationships when files are created.'*

When you are setting up an update of several files, you may have to program significant error recovery procedures if an update late in the sequence fails. A step towards handling this problem has been taken with a new set of commands which allow you to define a transaction. This consists of a set of commands to operate on one or more files. As each file is altered, a record of the changes is kept in a 'audit trail' file. If an error occurs before you reach the end of the transaction, you can ROLLBACK each update in turn, to undo the effects of the changes. This would not see you through a power cut (I've yet to encounter software which genuinely can, except on 'non-stop' systems which are expensive), but it would help where you cannot check in advance its ability to complete a series of updates.

On networked systems, all records involved in a transaction are, as one would hope, automatically locked until the transaction has been completed.

A continuing problem for developers (although perhaps some regard it rather as an opportunity) is that if you supply users with just the application as a run-time product, they have no means even of simple tweaking to produce reports of their own. It is possible to buy add-ons such as the R&R report generator to fill the gap. However, while such programs produce very good reports, they do not have the ability to create new indexes — which would speed retrieval or allow for different report ordering from that originally envisaged.

The alternative to supplying new report programs constantly is to set the user up with dBASE and train him or her in simple use of the program. But that, in addition to allowing others to steal and amend your source code, immediately gives the user access to all the interactive editing commands such as EDIT and BROWSE. Consequently, this bypasses all the excellent validity checking you have to put in to avoid finger trouble by inexpert users. Password protection (which is integral to this new version of dBASE if you want to use it) is no solution, since it is the very users who must have the passwords who need protection from themselves in this situation. There must be room here for a stripped-down version of dBASE which allows the creation of ad hoc indexes, queries and reports, with access to views and indexes already created, but which does not allow data to be changed.

Using dBASE IV

The most noticeable changes for the ordinary user and the developer of straightforward systems are those to the menu-driven system, the 'Control Center'. This whole area is a dramatic improvement on ASSIST, especially in the screen painting facilities and in the handling of file relationships. The menu- building system and the Applications Generator are very useful features. So, with this new version of dBASE, the command language should become less and less the prerogative of the sophisticated user.

Most developers will be able to do most of their initial work much more quickly using these features. (Whether they will or not depends on whether their watchword is 'real programmers don't use menus'.) The improvements to the interactive commands, notably EDIT and BROWSE, are also very welcome, with

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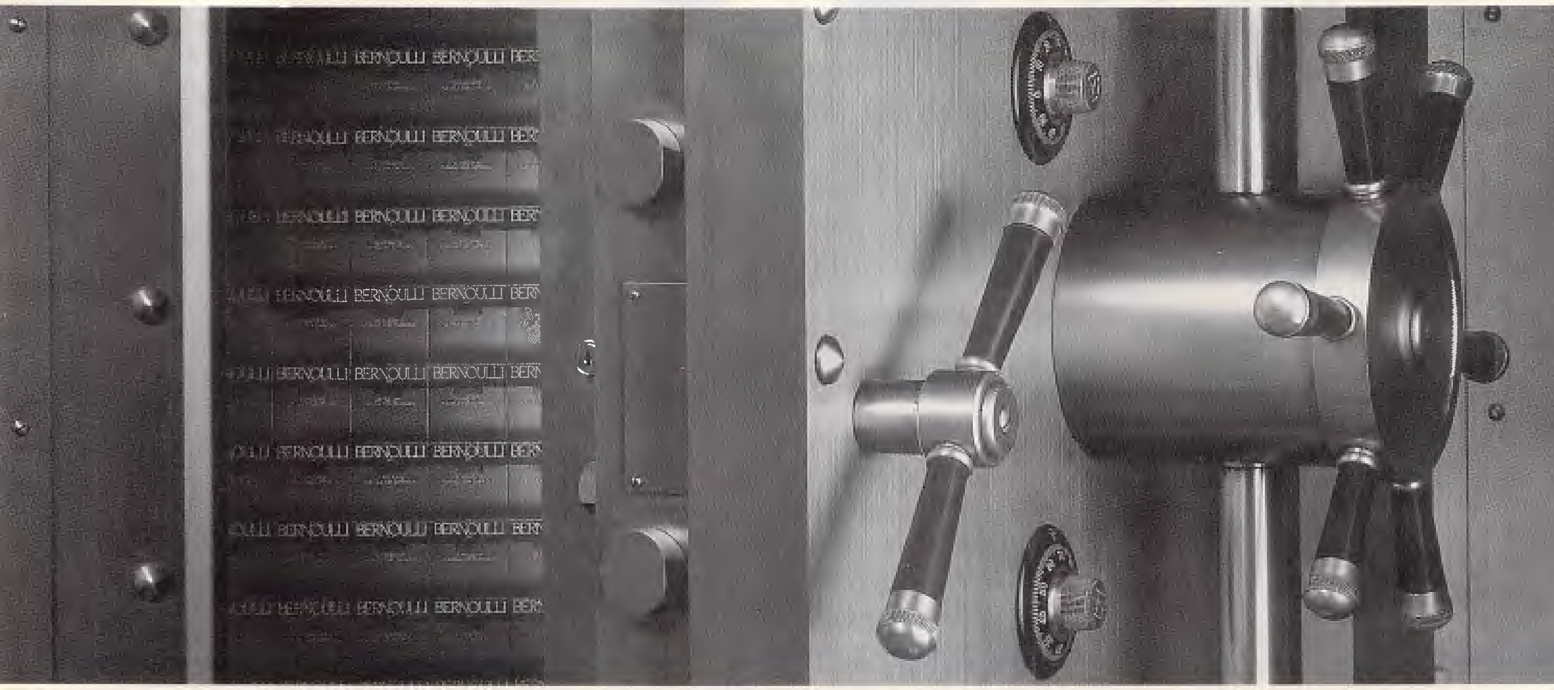

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their ability to handle screens created within the Control Center and VIEW environment. The speed improvements which are likely to derive from the compiler are highly significant.

As for developers, the inclusion of a royalty-free run-time system in the developer's version will make a major difference to many people. The template language may also prove a big bonus if it is well documented; at the moment the manuals still suffer from the common malaise of explaining in minute detail how to do simple things, and rushing at a gallop over more complex aspects. Goodies such as windows, tailored help and user-defined functions will allow dBASE IV to catch up with the competition in this area.

Compatibility with dBASE II/dBASE III Plus

If you are still working with dBASE II, you can convert your data files with Bridge, which is supplied with dBASE IV as it was with dBASE III Plus. Many of your programs will work unchanged, though they may need amendment to take advantage of better ways of doing things.

The data files of dBASE III Plus appear to be fully compatible with dBASE IV. The indexing is different, but only if you want it to be. It is possible to have no tags in the dBASE IV index file, and to continue creating and using NDX files, one per index, which have the same format as in dBASE III Plus.

Virtually all programs should work unchanged — DO HISTORY is the only command completely withdrawn, as the new debugger makes it redundant.

Small changes may need to be made to programs containing FIND and SEEK, if you don't want the 'next nearest' record found. These compatibilities may be particularly useful if some users in your organisation will not be upgrading to dBASE IV; dBASE III Plus will continue to be available (although the price structure has been carefully arranged to encourage people to upgrade), partly because dBASE IV requires more resources. In particular, 640k is recommended (although single-user systems should not need that much) and, while you could use dBASE IV on twin 3.5in floppies (not on 5.25in), a hard disk is very nearly essential.

Conclusion

On first inspection dBASE IV seems to be an excellent product, about which I am allowing myself to be cautiously enthusiastic. The range of facilities supplied meets virtually all the demands made by those hovering between waiting for dBASE IV and changing to hybrid user/developer packages such as Paradox, and goes a long way to meeting the call for a compiler and true developer's environment.

I am disappointed that users still cannot at least define file relationships when files are created, although the new VIEW/CATALOG facilities are a vast improvement. (I dislike Query By Example because it is conceptually such a mess, but everyone else seems to think it's great, so I'll say no more.) Further endorsement must inevitably depend on the final version being as fast as promised, and acceptably reliable.

END

Recent press statements (PC Week, June 2) indicate that the release of dBASE IV could be delayed until the end of the year. As a result, no Australian pricing is yet available.

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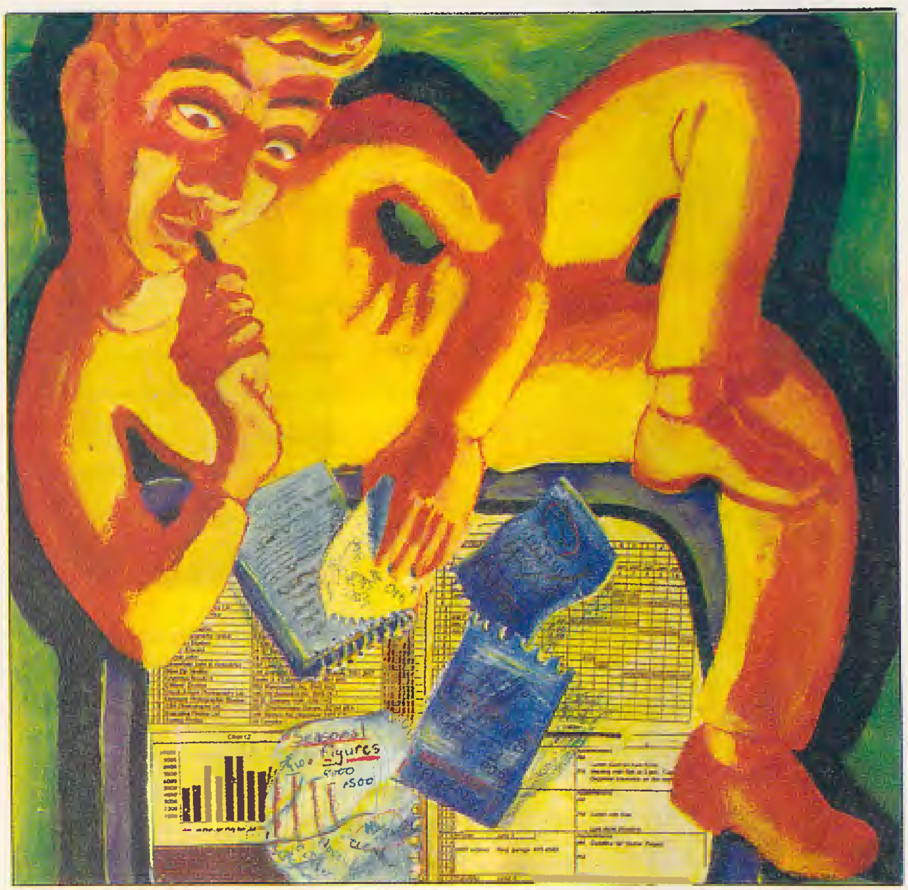
Spreadsheets are both flexible and friendly. In the first part of our series on understanding spreadsheets, accountant Tony Meier explains how they work and examines some potential applications.

If you are the kind of person who, despite your other computer skills, tends to shy away from spreadsheets, then read on. Spreadsheets are more flexible and friendly than you might think, and you can use them for an incredibly wide variety of tasks.

You don't need to be a mathematician or a financial wizard to use a spreadsheet — in fact, you need to know very little in order to put one to work. Within a short space of time you will find that you can start using it for keeping names and addresses, recording your expenses and creating simple models. And, as with many computer applications, you don't have to spend a lot of money to get your hands on a good spreadsheet. You can obtain the same functionality from programs costing less than $300 as you can from programs costing three times as much.

Spreadsheets are one of the most important types of personal computer software. Together with word processors and databases they form the core of today's software applications. And, whereas you can't use a word processor as a spreadsheet, and can't use a database as a spreadsheet, you can use a spreadsheet as both a word processor and a database.



Spreadsheets are powerful and sophisticated tools, but the basic concept behind their use is childishly simple. A spreadsheet can be thought of as an electronic notepad, which gives you the same freedom that you have with a word processor to place information anywhere you wish and use as many pages as you want. However, the spreadsheet gives you much larger pages and the ability to copy and re-use pages and parts of pages easily. Most importantly, it gives you the ability to incorporate automatic calculations for working out sums, relating text and figures to each other and much more. Any tasks involving figures and calculations are ideal candidates for spreadsheet treatment.

How it works

Each spreadsheet is made up of cells, and these cells are the elements into which you can insert your data — text, numbers, dates or formulae. The power of the spreadsheet lies in the fact that you can relate individual cells to each other — you can create relationships, or live links between different cells in the spreadsheet. These relationships are defined by the formulae that you enter into individual cells.

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Every spreadsheet model is a collection of cells that are related in some way to perform a specific task, like working out the costs of a project, storing names and addresses, or calculating your overdraft. The two million or so cells in a spreadsheet are like bricks in Legoland — you can use them to build anything from small and simple tables to large and complex models.

The data and formulae you enter into the spreadsheet remain highly accessible. You can edit or alter the contents of any cell or change the structure of any model at any time. Although you may not be able to see all of your model at once — as the whole spreadsheet will probably be too large to fit on the screen — you can scroll the spreadsheet horizontally and vertically to see different parts of it. Some programs let you split the screen or window into two or four 'panes' so that you can see scattered parts of the spreadsheet next to each other. Some programs, like Microsoft Excel, let you place parts of different spreadsheets on the screen at the same time — in different windows.

Once you have learned how to use one spreadsheet program, learning to use others is easy.

Trapeze, however, is an interesting spreadsheet for the Macintosh that takes a slightly different approach. It doesn't use the normal 'grid of cells' arrangement but instead lets you define individual, separate 'blocks' of cells on a worksheet. Trapeze also lets you incorporate graphics and text blocks, allowing you to create worksheets incorporating numbers, text and pictures. However, the cells in any spreadsheet block use the same concept of formulae to establish relationships between items of data.

> *'The spreadsheet can double as a word processor if you can live with a few limitations; notably, the lack of automatic word-wrap . . . '*

Using formulae

Formulae are a vital part of spreadsheet work — a formula is the set of instructions you type into a cell to tell the program what to calculate and display in that cell. All the calculations on any spreadsheet are performed by the formulae that you have specified. Formulae aren't difficult to use. Anyone who has used a calculator knows enough to create a simple formula like 'B3 + B4', which means the sum of the numbers in cells B3 and B4. The cell that you type this formula into will display the result, just like a calculator. And if you alter the contents of cell B3 or B4 you will see the result of the new formula immediately.

Formulae can be copied and moved around on the spreadsheet in the same way as any other information such as text and figures. But there are more powerful copy commands such as 'fill', which is very useful for automatically copying the contents of a specified cell into every cell in a specified block of cells.

The formulae you create typically will contain cell references like G25, operators like '+', '-', 'x' and '>', and functions like SUM and LOG. Most spreadsheets provide a large number of functions but, in practice, you may find that you only need to use a few of these. To give you an idea of the number of func-

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tions typically available, Lotus 1-2-3 provides 89 and Borland's Quattro provides 100. The relevant spreadsheet manual explains what each of the provided functions does.

Functions fall into a range of different categories. There are mathematical functions like LOG and EXP, trigonometric functions like SIN and TAN and financial functions like IRR (internal rate of return) and NPV (net present value). The financial function PMT (payment) can be used to calculate the monthly mortgage payment required for any loan. If we take the loan to be $60,000, the interest rate 10.3 per cent, and the period of the loan 25 years, we can set up a formula using PMT as follows. First, since we need the mortgage figure on a monthly basis, we must convert the interest rate to the monthly figure — that is, 10.3 percent/12 = 0.8583 percent, and the period of the loan to 25 x 12 = 300 months. Then, using Excel's format, PMT (rate, number of periods, loan amount), — the format varies slightly from one spreadsheet to another — PMT (0.8583 per cent, 300, 60,000) will give us the result we want: $557.94.

There are statistical functions like AVERAGE, MAX and MIN, which can give you information on large blocks of numbers. There are database functions like DAVERAGE, DMAX and DMIN which can give you similar information on records in a database satisfying specified criteria. For instance, if you had a spreadsheet database containing statistics on a range of different cars, you could use the formula DMIN (database, price, engine cap ≥D 1.6) to automatically find the lowest priced car with a 1.6ltr or higher capacity engine.

There are logical (or conditional) functions like IF, AND and OR, which can be used to provide a degree of intelligence to formulae. The formula IF (A5=B5, 'Apple', 'Orange') will display the word 'Apple' if cell A5 equals cell B5 and the word 'Orange' if it doesn't. Logical functions can be used in an unlimited number of situations. The IF function is used in the project planning model described below.

There are date and time functions like DATE and NOW which allow you to perform date and time calculations easily. Thus you can automatically calculate what date it would be 200 days after any other date or what the date was 1000 days previously. Given any two dates, like today and your last birthday, you can automatically calculate the number of days between them. The way the spreadsheet does this is by automatically converting dates and times to numbers, using these numbers in its calculations and then converting the numbers back to dates and times. Each day has a unique serial number and each point in time has a number.

=COPY()	Copy contents of field 'Address line 1' in current cell
=SELECT("RC[4]")	Go to a free cell nearby (E26)
=PASTE()	Paste Address line 1 details into the cell
=SELECT("RC[-3]")	Go back to field 'Address line 2'
=COPY()	Copy its contents
=SELECT("R[1]C[3]")	Go to the cell beneath E26
=PASTE()	Paste the details into the cell
=SELECT("R[-1]C[-2]")	Continue until the address details are held by the block
=COPY()	of cells E26:E28
=SELECT("R[2]C[2]")	
=PASTE()	
=SELECT("R[-2]C:RC")	Select the address block E26:E28
=CUT()	Cut
=SELECT(IH24)	Go to cell H24
=PASTE()	Paste the address block in
=RETURN()	End the macro

You can use a macro to transfer a selected name and address into the word processor section to have your letter addressed automatically

There are also text functions like LEFT and MID that let you manipulate strings of characters. The function MID, for example, can be used to extract a string of characters from another string. It takes the form MID (text, starting position, number of characters to be extracted). Thus, if you typed 'Encyclopaedia' into cell A1, the formula MID (A1, 3, 5) would give the result 'cyclo'. This function could be used for extracting short sub-codes from longer codes in a system handling thousands of different product codes.

Another category of functions are special functions like LOOKUP and ROW, which can be used for a variety of different purposes. LOOKUP can be used to select automatically a value from a table that you have set up within the spreadsheet. ROW is used to give the row number of a specified cell: for example, ROW(A3) would give you the figure '3'. But you don't need to learn all the functions and you don't even need to be aware of all of them in order to build useful models. However, one function that you ought to know about is SUM — unquestionably, the most commonly used. Instead of using the formula A1 + A2 + A3 + A4 + A5 + A6, you could use SUM(A1:A6) to give the same result. The SUM formula is almost universally used at the foot of a column of figures, to give its total.

Using a spreadsheet as a word processor

The spreadsheet can double as a word processor if you can live with a few limitations; notably, the lack of automatic word-wrap and the lack of special formatting effects. It may even be preferable to a word processor for the production of some documents. I personally prefer to use a spreadsheet for producing accounts and financial reports, which incorporate both text and figures, as I find the lack of word-wrap more than compensated for by the benefit of having automatic recalculation facilities. A spreadsheet may also be easier to use for documents containing columnar information such as lists of names and addresses, phone numbers and price lists.

Spreadsheets share many of the flexible features of word processors such as the ability to edit information, copy and move blocks of information, and insert and remove spaces (rows and columns in the spreadsheet).

Most spreadsheets have good printing facilities too. You can usually specify the blocks of cells you want to print, which lets you print any part of the spreadsheet you wish. Most spreadsheets support a wide range of printers including laser printers, which means that you can use them to produce high-quality documents in no way inferior to word-processed output.

Using a spreadsheet as a database

A spreadsheet can also be used as a database, as it is ideally structured to handle a collection of records. The grid arrangement of cells allows rows to be used for records and columns for fields within those records. Most popular spreadsheet packages provide database facilities that use this arrangement. They also throw in a few extra functions as mentioned above to give you additional capabilities for handling the information. You can generally sort and search the database records and you may also be able to extract specified records automatically to a separate part of the spreadsheet.

In fact, you can use different parts of the same spreadsheet for both word processor and database use. You could thus store names and addresses in a database in one section of the spreadsheet and use another for creating letters. You could then use a macro to

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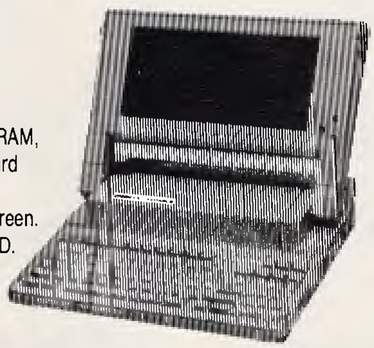

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- EX800 9 pin, 300 cps, 10 inch, tractor, color option.
- EX1000 9 pin, 300 cps, 15 inch, tractor, color option.
- LQ850 24 pin, 264cps, 10 inch, tractor.
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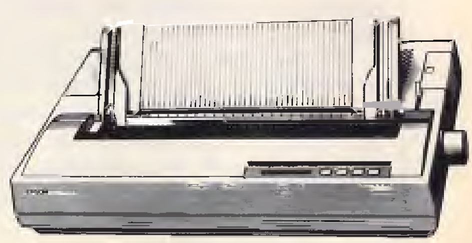

transfer a selected name and address into the word processor section to have your letter addressed automatically.

One of the spreadsheet's disadvantages as a database is its limitation of display. Data is confined to being displayed within the grid, and you can't display more than one line for any record. Because of this, therefore, you may have to scroll the screen across in order to look at all of a record. Entry of data is restricted in the same way. Here again you can use a macro to create a data entry form which transfers entered data to the database section of the spreadsheet. (I shall be describing this in more detail next month.)

A benefit of using a spreadsheet as a database is that you can use all the spreadsheet's in-built functions on the database information, and you can create formulae and models to process the database information directly.

However, spreadsheets are not generally built to store the amounts of data you can store in a typical database. Although the spreadsheet may potentially be quite large — for instance, 256 columns by 8192 rows — its data is usually stored in RAM and you might run out of memory before you reach the spreadsheet's limits. Therefore you should think about the volume of data you need to store before considering a spreadsheet for your database needs. For small databases it may be ideal.

It is interesting to note that Lotus Symphony, a popular and expensive package offering spreadsheet, word processor, database, charting and communications, is based on a spreadsheet.

	A	B	C
1	DOMESTIC BUDGET	JUNE	JULY
2		£	£
3	Joint income	1400	1400
4		-------	-------
5	Mortgage	450	450
6	Food & drink	150	150
7	Petrol	50	50
8	Car ins/tax		
9	Elec	200	
10	Gas		150
11	Rates		
12	Phone	175	
13	Holiday		2300
14	Going out/clothes	130	130
15	Other	100	100
16		-------	-------
17	Total outgoings	=SUM(B5:B15)	=SUM(C5:C15)
18		-------	-------
19	Net in/(outgoings)	=B3-B17	=C3-C17
20	Bank balance at start of month	100	=B22
21		-------	-------
22	Bank balance at end of month	=B19+B20	=C19+C20
23		-------	-------

The humble domestic budget is an easy application for a beginner to get started on and is a good way to plan your income and expenses

	A	B	C	D	E	F	G	H	I	J	K	L
1	ABC DECORATORS - WORK SCHEDULE											
2												
3		Start	Finish	Jun	Jun	Jun	Jun	Jun	Jun	Jun	Jun	Jun
4	Geoff Smith			3	4	5	6	7	8	9	10	11
5	Job A on site	3 Jun	4 Jun	|||||	|||||							
6	Job G99 on site	5 Jun	5 Jun			|||||						
7	Job A report	6 Jun	7 Jun				|||||	|||||				
8	Job B preparation	6 Jun	11 Jun				|||||	|||||	|||||	|||||	|||||	|||||
9												
10	John Burke											
11	Job F stage 2 on site	3 Jun	7 Jun	|||||	|||||	|||||	|||||	|||||				
12	Job F report	8 Jun	10 Jun						|||||	|||||	|||||	
13	Job F stage 3	11 Jun	13 Jun									|||||
14												
15	Barry Jones											
16	Job R5 initial inspection	4 Jun	4 Jun		|||||							
17	Job R5 proposal	5 Jun	5 Jun			|||||						
18	Job R5 on site	7 Jun	21 Jun					|||||	|||||	|||||	|||||	|||||
19												
20												
21												
22												
23												
24												

The model here shows how you can plan and co-ordinate activities, projects and teams of people using the spreadsheet as a project planner or work scheduler

How to build a spreadsheet model

The term 'model' is used to describe the data and formulae you enter on a spreadsheet to perform a specific task or application. Just as you can create as many documents as you like with a word processor, you can create as many models as you like with a spreadsheet. And once you have created any particular model you can re-use it as many times as you want rather like a form letter. The formulae will remain the same but will display different results depending on the data you have entered. For example, the budget model described below can be used by many different people. The expense descriptions and the model structure will remain the same but the data that each person enters will be different — and so will the results. You could similarly build a motor expenses model that works out the running costs of your car. You can input details such as cost, kilometres per litre, and insurance and be provided with a net running cost per month. Each person using this model will be given a different result depending on their own car data.

The following steps take you through the creation of a spreadsheet model.

- **1** The first step is design: it helps enormously to have a clear idea of what you want before you start using the keyboard. It's a good idea to sketch the basic structure of the model first on paper. Plan the layout of the information — the headings you want, the number of columns and rows you estimate you will need, and where you will place the information. Details aren't too important at this stage, as you can amend the model later.
- **2** Determine the formulae you need.
- **3** If you are using macros, determine what tasks or functions you want them to perform.
- **4** Set the model up on the computer, following your sketched design. Remember that inserting rows and columns is easy and gives you flexibility to adjust the model as you go. Alter column widths as necessary to accommodate your data.
- **5** Enter your formulae and some sample data to check whether the formulae work, and whether the model performs the tasks you want. Change the sample data to test the model in a variety of situations.
- **6** Create any macros you need, and test these thoroughly.
- **7** Refine the model. Format the cells to give you the alignment and decimal places, for example, that you want. Tweak column widths to give you the optimum size for both onscreen viewing and printing out in reports. Add helpful comments and protect any cells that need protection. You can also add input and error checks at this stage.
- **8** If you are planning to keep the model for any length of time or to let someone else use it, you should document it. Print the model out showing the formulae you have used, and note down column widths, formatting details and so on, as well as details of how to use the model. It is especially important to document macros, and store macro listings.

Applications

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Suite 802, 251 Oxford St, Bondi Junction, 2022 familiar with budgeting of some kind or other and the budget model described in the screenshot below illustrates the basic principles involved quite well. It will help you plan for your income and expenses and predict your net income or outgoings.

Enter your estimated income in row 3 and estimated expenses in rows 5 to 15. You can insert extra rows for additional types of expense if you wish, or change the expense description by overtyping it. Rows 17 and 19 are calculated automatically and show total outgoings and net income/outgoings.

Cell B17 contains the formula SUM(B5:B15), cell C17 contains the formula SUM(C5:C15) and so on. You will notice that cells containing only dashes are used here for neatly separating one section from another. The cells in row 19 equal the cells in row 3 minus the cells in row 17 — that is, cell B19 contains the formula B3-B17.

If the income or any of the expenses need to be changed, you can alter the figures easily and the totals in rows 17 and 19 will be recalculated automatically.

At the end of the month, let's say the end of June, you can delete the June column and add a new column at the right for December. This way you can keep the budget going continuously six months ahead.

You can enhance this model by adding two further rows at the bottom to reflect your bank balance or overdraft. The first row would be headed 'Bank balance at start of month' and the second 'Bank balance at end of month'. The balance at the end of the month would equal the balance at the start plus the net figure in row 19. And, except for the first month, the balance at the end of the previous month.

'Spreadsheets are invaluable for business use as they are an ideal tool for handling and analysing large quantities of information.'

You can create a simple model in a separate area of the spreadsheet to work out your mortgage using the PMT function described above, and link this into the budget model. Once this is set up it will calculate and insert your mortgage payment automatically into the budget.

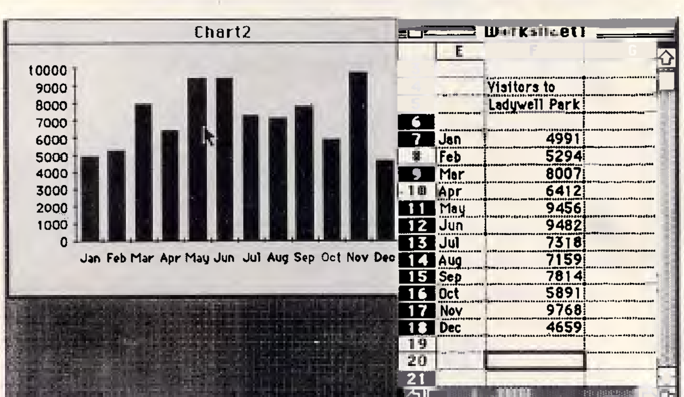
Another use for your spreadsheet is as a diary. You can assign six or eight rows to each day, entering appointments and notes, and work your way down the spreadsheet during the year. If you have 8192 rows and use eight per day you will have room for 1024 days, or over two years' worth of entries. If the spreadsheet has a search or find command this will come in very handy here, as you will be able to perform rapid searches through your appointments for key words or text. For instance, you could search for the text string 'Bob' to find the entry 'appointment with Bob 3 pm'.

The spreadsheet is so flexible that it may be the only program you need. It can be used as a general personal or business organiser and let you store financial information and models as well.

A very interesting, off-beat, use, however, is as a work scheduler or a simple project planner. With skilful use of the spreadsheet's date functions you can create a grid that automatically displays a visual representation of time spans. This can help you to plan and co-ordinate activities, projects, and teams of people.

	A	B	C	D	E
301	Wednesday	June 1		Appointments	
302				AM	
303					Lunch: Card for Aunt Edna
304				PM	Meeting with Bob at 3 pm. Carol at 3.30
305					Organise insurance on the new printer
306					
307	Thursday	June 2		Appointments	
308				AM	
309	Aunt Edna's birthday				
310				PM	Lunch with Ken
311					
312					Late night shopping
313	Friday	June 3		Appointments	
314				AM	Deadline for Hunter Project
315	MOT expires	Ring garage 670-8553			
316				PM	
317					
318					
319	Saturday	June 4		Appointments	
320				AM	

You can use your spreadsheet as a diary if you wish in order to keep a timetable of appointments, or even as a personal organiser holding addresses and financial information



Charts are an excellent way of presenting information. The trend in visitors to Ladywell Park during the year can be seen much more clearly from the chart than from the numbers

Helpful features

Spreadsheets have many features that provide a great deal of help when you are building models. For instance, when you are inserting and deleting rows and columns, you don't need to worry about altering the formulae you have created, as these are adjusted automatically.

You can also turn automatic recalculation on or off. You often find that large spreadsheet models pause to recalculate the whole model whenever you make the smallest change, thus slowing your work speed down. This can be avoided by turning automatic recalculation off and letting the model recalculate only when you have finished making all your changes.

Some spreadsheets provide intelligent recalculation, and only recalculate those cells affected by your change, not the whole spreadsheet. Other spreadsheets provide background recalculation, and only recalculate the cells visible on the screen immediately, returning control of the program to you after this. However, it continues to recalculate the rest of the cells in the background in the pauses between your commands.

Many spreadsheets let you give your own names to cells and groups of cells. Then instead of referring to cell G57, for example, you can refer to 'Jan sales'. This makes recognising cells and creating formulae that refer to other cells easier and less error-prone.

Business and other applications

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handling and analysing large quantities of information. They can also be used to aggregate figures from many different sources, such as sales made by different salesmen in different divisions of a company. They can also be used to generate control figures like totals and percentages, which can be used for planning.

Spreadsheet tasks can also be shared quite easily, as data on a spreadsheet is relatively easy to explain to co-workers and easy to understand and access. Many people within an organisation can work on the same data on separate computers to share the workload.

The spreadsheet's most popular application is probably 'what-if' modelling, where full advantage is taken of automatic recalculation. A spreadsheet model is created to represent real-life relationships between figures. Then, when various figures are altered, such as the selling price, to reflect different possible situations, other figures that are calculated from those figures, such as the profit, change automatically to indicate the consequent outcomes.

One of the most popular 'what-if' models is the cash flow forecast. The cash flow forecast works in a similar way to the domestic budget described above, and is used to predict a business's bank balance or overdraft at the end of each month over a six or twelve month period.

Many spreadsheets let you perform the reverse of 'what-if' analysis — goal-seeking. This lets you specify an end result, or goal, and work backwards to determine the inputs you need to achieve it. For example, if your workshop rent were to increase by 30 percent you could determine by how much to increase your prices in order to achieve the same net profit.

One of the most exciting features of spreadsheet packages is their ability to create charts and graphs automatically. All you need to do is select a group of figures you want to chart and give the relevant command. A chart of those figures will be created immediately. Looking at a chart gives you a much better idea of a situation than looking at a list of numbers.

The spreadsheet will normally provide a range of chart types to choose from, such as pie, bar and line, and each chart can generally be customised to a significant degree to give you the scales, descriptive titles and legends that you want.

Many spreadsheets let you retain an active link between the chart and the figures and display both side by side. Therefore, when you change any of the figures you will see the chart change too, automatically.

Charts are an excellent way of presenting information in an easy to understand manner, and can lighten and enhance business reports and other documents considerably.

Conclusion

Spreadsheets can be used for an unlimited number of applications by individuals, clubs, organisations and businesses.

Given that you have the freedom to arrange text and data in any way you want to, and the freedom to create hundreds of different formulae using any combination of cell references, operators and functions, you can see that the uses you can put them to are only limited by your imagination.

Next month I'll be describing more advanced facilities, macros and their uses, and further applications and ideas for using spreadsheets.

END

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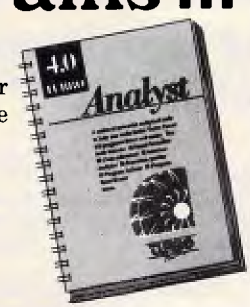

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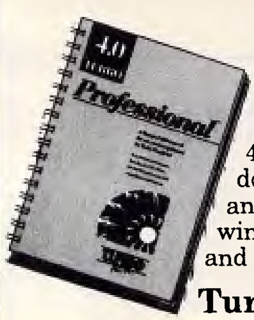

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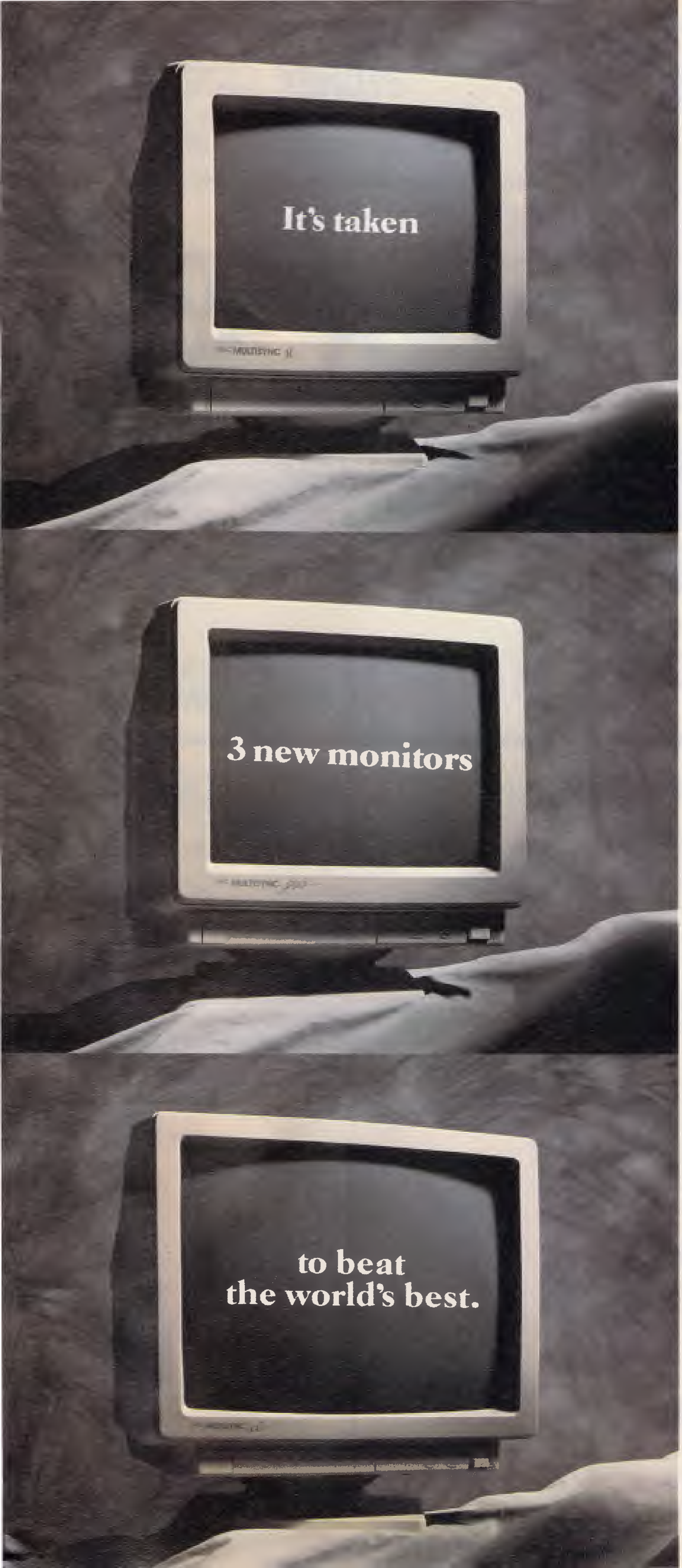

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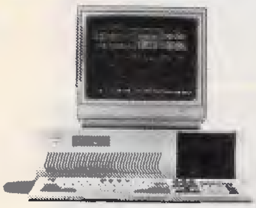

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Family ties

The answer to the dilemma — DOS or OS/2? — may be family mode. Applications developed in family mode can run unchanged under either operating system. Of course, there are sacrifices according to David Schmitt.

IBM and Microsoft, co-developers of OS/2, are building bridges between the old world of DOS and the new world of OS/2. One such bridge is through family mode — programs that can run unchanged under both OS/2 and DOS. The very term *family* mode conveys that OS/2 and DOS are members of a compatible operating-system *family*.

The same family-mode .EXE file can run in OS/2 protected mode, OS/2 real mode, and under DOS. When a family-mode application is running in protected mode, it enjoys the primary benefits of OS/2 — access to more than 640k of memory and the ability to run simultaneously with other protected-mode applications. Family-mode applications cannot freely use advanced OS/2 features, such as internal multi-threading or inter-program communications, because they are not available under DOS.

For software developers, family-mode applications offer the advantages of learning and using OS/2 without abandoning DOS compatibility. Family mode gives developers an alternative when faced with the either-or decision of designing OS/2 protected-mode applications or continuing to write DOS applications while waiting for an 80386-specific operating system.

Family-mode applications are valuable in aiding acceptance of OS/2 and easing transition to the new operating system. OS/2's popularity depends largely on software developers running with the family-mode concept and making available significant protected-mode applications.

This is particularly true given that OS/2 can handle only one DOS program at a time while some DOS extensions and alternative operating systems handle more than one, satisfying user needs to multi-

task existing DOS programs. Unlike OS/3 of the future, which will exploit the power of 80386-based computers and provide multiple DOS partitions, OS/2 allows running only one DOS program at a time and in a smaller partition than under native DOS.

Two OS/2 features that support family mode are the application program interface (API) based on function calls; and

SYSTEM/FILE		
DosAllocHuge	DosFreeSeg	DosQFSInfo
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DosError	DosPortAccess	DosSetVec
DosExecPgm	DosPutMessage	DosSetVerify
DosExit	DosQCurDir	DosSubAlloc
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DosFindClose	DosQFHandState	DosSubSet
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DosFindNext	DosQFileMode	
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Table 1 The subset of OS/2 API functions that is available to a family-mode application consists of those services that have counterparts in DOS or BIOS. The real-mode routines that implement these functions are bound into the family-mode .EXE file, but they are replaced at runtime by dynamically linked OS/2 versions if the program runs in protected mode

dynamic linking. OS/2 family-mode functions are shown in Table 1.

A family-mode application uses only OS/2 API features that have counterparts under DOS. The OS/2 Programmer's Toolkit contains a library named API.LIB that has DOS versions of many OS/2 API services. Functions in API.LIB are called according to conventions of the OS/2 API, but they generate software interrupts corresponding to DOS and BIOS services. By using API services and programming techniques that are common to both operating systems, family-mode applications can shield the user from knowing under which operating system a program is running.

To construct a family-mode application, a developer first compiles and links it for OS/2, using that operating system's standard build tools. Linking in this case means inserting references to the API routines in a dynamic link library (DLL). When the application is loaded for execution under OS/2, the loader resolves the references and then reads in the required API routines from the DLL.

An OS/2 application is converted to a family-mode application by processing the .EXE file with the Bind utility which is provided with the toolkit. The Bind utility adds a stub loader and the necessary API.LIB routines to the .EXE file, but unlike a static linker, it does not resolve API calls, which would defeat dynamic linking and prevent the file from executing in protected mode.

The dual-mode capability of the family-mode program is due to the fact that API calls are not resolved until load time. If loading occurs in protected mode, the OS/2 program loader resolves these calls to OS/2 service routines in a DLL; in real mode, the stub loader performs this function, resolving the same calls to DOS interface routines from API.LIB.

In protected mode, both the loader and the DLL are parts of OS/2; the loader loads only the original portion of the .EXE file, ignoring portions added by Bind. The program loader resolves all calls to OS/2 API functions via the dynamic linking facility.

The presence of the loader and API routines in the .EXE file makes the program self-sufficient for execution in real mode. Whether under DOS or in the compatibility box of OS/2, the program loader reads the stub loader and the API.LIB functions into memory together with the rest of the program. The stub loader gets control, relocates the OS/2 API function calls to point to the API.LIB routines, and then passes control to the application program. From that point on, the application's calls to the OS/2 API are translated into the equivalent DOS services by the API.LIB functions.

Underlying support

Key to the workings of family mode is the structure of the OS/2 .EXE file and the way the Bind utility transforms the executable file produced by the protected mode linker. To support new OS/2 features, such as segment protection and dynamic linking, the format of an .EXE file is expanded from the relatively simple DOS structure.

Fig 1 shows major sections of an OS/2 executable file. The file has three sections recognised by DOS: the header, relocation table, and DOS stub program. OS/2 sections begin with a header and end with a section for each OS/2 code or data segment. Intermediate sections contain information about program-required segments, dynamic links, and other resources.

As far as DOS is concerned, an OS/2 .EXE file consists of only the components before the OS/2 header. Any attempt to execute an OS/2 program in real mode causes DOS to load only the stub program, which displays a message indicating that the program can be run only in protected mode. As another option, the DOS-formatted header can specify a fictitiously large memory requirement, so the loader does not even attempt to load the stub. The protected-mode loader gets the true memory requirement from the OS/2 header farther down the file, ignoring most of the DOS-formatted information.

Fig 2 shows the structure of a family-mode .EXE file that the Bind utility produces from the protected-mode .EXE file. Its major components are similar to those in Fig 1, except that the small DOS stub that displays the warning message is replaced with a much larger section containing the stub loader; the functions extracted from API.LIB; plus any object modules explicitly mentioned in the Bind command. All OS/2 sections remain unchanged and are simply moved upward in the .EXE file to accommodate the expanded DOS section.

When the program executes in real mode, the operating-system loader reads in only DOS-formatted sections and passes control to the DOS stub program. Instead of displaying an error message as the default stub did, the one supplied by Bind re-opens the .EXE file; loads the OS/2 code and data segments; links OS/2 service calls and the functions from API.LIB; sets machine registers to the OS/2 entry conditions (see Table 2); and then jumps to the main entry point of the OS/2 program that is fully set up to run under OS/2.

Details about processing protected-mode .EXE information and DOS memory allocation make the stub loader a little bulky. The .EXE file for a small sample application called FAMDEMO.ASM (Listing 1) grows from 1116 bytes to 9308 bytes, a factor of more than eight, after Bind processes it. The increase is not proportional to the original .EXE size. For example, the .EXE file of a moderately sized real application increased from 127k to 154k after binding, an increase of only 22 per cent.

Performance of family-mode programs is not an issue when loading or executing a program in protected mode because the OS/2 program loader ignores the real-mode portions of the file regardless of size. In real-mode, loading is slightly slower, but DOS and OS/2 family versions of an application generally run at equivalent speeds. The routines in API.LIB are efficient. One disadvantage to family mode is the increase in memory required, because the API routines reside in the application's memory space.

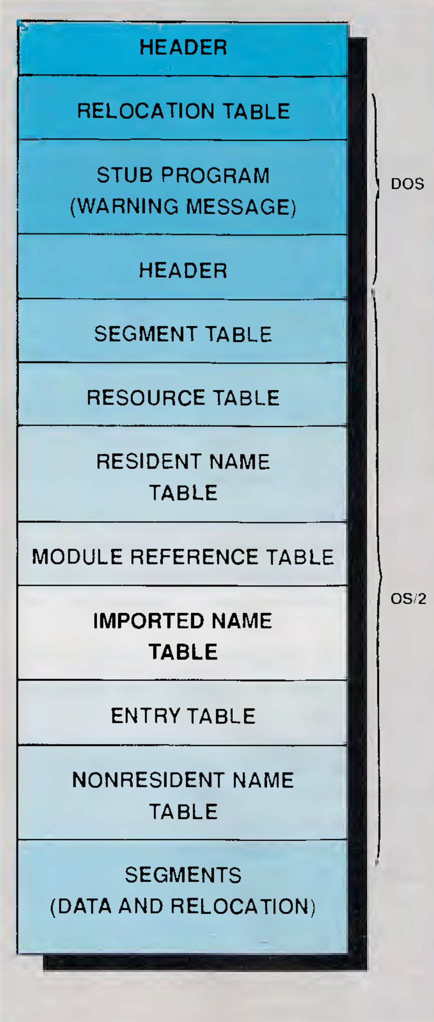

Fig 1 The file consists of two sections — one for DOS and one for OS/2. Each operating system ignores the other's section. The DOS stub program issues an error message and terminates

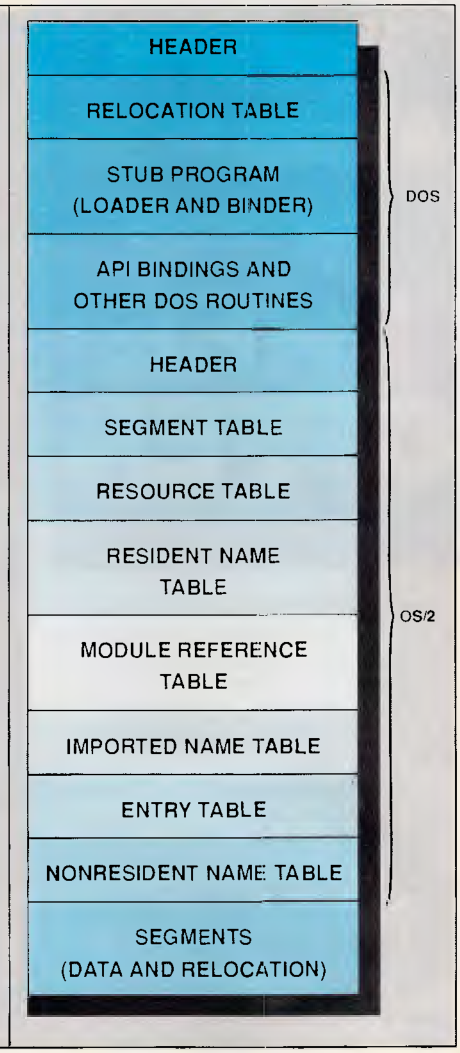

Fig 2 The expanded DOS stub program performs functions of the OS/2 loader: it links API function calls to the bound routines, sets entry conditions, and branches to the OS/2 entry point

From DOS to family mode

In this early phase of OS/2 deployment, most interest in family mode probably comes from those who want to adapt DOS programs to OS/2 without losing DOS compatibility. A single executable file that runs in any mode lowers production and maintenance costs and leaves users less confused.

If a DOS program is well behaved, it can be adapted easily to family mode by recompiling it with the appropriate OS/2 compiler, linking it and binding it to API.LIB. A well-behaved C program designed for DOS has these traits:

- It handles DOS interfaces through the compiler's standard library.
- It does not use low-level DOS interface functions from the library, such as **int86**, **intdos**, **bdos**, or **bios**.
- It does not hook into hardware or software interrupts.
- Keyboard and screen interactions use the simple glass-teletype approach or the ANSI.SYS driver for complex screen operations.
- It treats 32-bit pointers as atomic objects and does not separately manipulate segment and offset portions.

Some programs, for reasons of performance, deviate from these rules. In many cases, however, even they can be converted easily to family mode. For example, many screen-oriented programs write directly to the video display buffer or call the BIOS services instead of using DOS video services. Most of the OS/2 keyboard and video functions (with names beginning with Kbd and Vio) are available in family mode (see Table 1). Some OS/2 ser-

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REGISTER	CONTENTS
DS	Segment selector for the default data segment, or 0 if there is no such segment.
ES	A value of 0.
SS	Segment selector for the default stack segment.
SP	Offset to the top of the default stack.
AX	Segment selector for the environment segment, which contains the environment strings, the application file name, the command verb, and the residual command line.
BX	Offset to the command verb in the environment segment.
CX	Length of default data segment, with a value of 0 indicating 64k.
BP	A value of 0 normally pushed onto the stack to indicate the end of the stack frame chain.

Table 2 The entry conditions for family-mode programs are the same for OS/2, even in real mode. The most significant difference from DOS is that the DS register points to the data segment, not the program segment prefix (PSP)

vices, also available in family mode, write directly to logical and physical video buffers.

The effort required to convert to family mode is lessened if interactive programs have keyboard and screen interfaces isolated into a few modules. Only these modules will need to be rewritten to use the family-mode API functions. For example, one person converting a spreadsheet program (30,000 lines of C code) to family mode using this technique took one week to complete the task.

Determining if assembly language functions are well behaved by visual inspection is more difficult than with C. Without a compiler to generate low level code sequences, an assembly language programmer accidentally can use instructions that are not allowed in family mode. Developers should avoid the following common DOS coding practices that can cause problems in protected mode.

- Software interrupts (INT instructions)
- Direct access to I/O ports with IN and OUT instructions
- Changing the state of the interrupt enable flag with CLI and STI instructions
- Segment-register arithmetic, such as the following sequence which advances to the next 64k segment

```
MOV AX,DS
ADD AX,1000H
MOV DS,AX
```

- Timing loops, such as

```
MOV CX,1000
DELAY: LOOP DELAY
```

INT, IN, OUT, CLI and STI instructions cause protection violations because OS/2 does not allow non-privileged processes to execute them. Segment register arithmetic often causes addressing exceptions because the process attempts to load an invalid selector into a segment register. Timing loops cause the program to behave erratically because the time delay might differ between real and protected mode, even on the same computer. Timing loops are ill-advised, even under DOS, because they might become invalid after upgrading to a faster computer.

Building new applications

Designing new OS/2 applications that will remain compatible with DOS is a bigger challenge than converting existing DOS programs. To develop applications that will run the same in DOS and OS/2, developers should: use a high-level language (such as C); use whatever compiler options are necessary to generate only 8086 instruction sequences; use only library functions that restrict OS/2 API calls to family-mode services; and not rely on multi-tasking or access to more than 640k of memory.

Note that limiting a program's system calls to the family API is not by itself sufficient to insure execution in family mode. For example, an OS/2 application could consist of two or more programs that expect to run simultaneously and exchange data via shared files accessed via standard file I/O calls, not the interprocess communication protocols. Even though each individual program uses nothing but family API calls, such an application cannot be converted to family mode because it relies upon OS/2 multi-tasking for the concurrent execution of several components.

To avoid breaking these rules, the safest way to create a new family-mode application is to develop it entirely under DOS, but using the family-mode OS/2 functions instead of the DOS API. This negates the possibility of hidden dependencies on new OS/2 features, such as larger-than-640k memory. Once the program runs under DOS, getting it to run in protected mode should be easy.

Initially available OS/2 C compilers (from IBM, Lattice, and Microsoft) readily support family-mode programming in that they typically generate 8086 code as default, and most library functions use only family-mode API services. Functions that do not support family-mode represent a small fraction of the library and generally are designed for real-mode-specific tasks, such as generating software interrupts or interfacing with the network manager. Even without this small proportion of functions, family-mode applications can use most of the functionality of a compiler's runtime support library.

Developers who want family applications that behave differently in real mode than in protected mode can embed instruction sequences to execute only under DOS and others to execute only under OS/2.

A spreadsheet program, for example, could use a simple calculation algorithm under DOS, where the size of the spreadsheet is constrained by the 640k limit. In the OS/2 environment, where spreadsheets can get much larger than 640k, it might be appropriate to create a separate thread that calculates in the background while the user continues to enter data via the main thread running the foreground. This reduces keyboard delay during recalculations.

This method is easy to implement because nothing in either DOS or OS/2 prevents loading a .EXE file containing API calls and instruction sequences for the other mode, although the Bind utility detects any non-family API calls and issues warnings. If the program hits a real-mode instruction sequence under OS/2, such as a segment register arithmetic, the operating system aborts the program. It is not as clean under DOS, where a protected-mode instruction sequence can cause a system crash or produce garbled results.

DOS- and OS/2-specific sequences should be entered only after appropriate mode tests. The simple C function that follows can be called to ask, "Is this OS/2 protected mode?"

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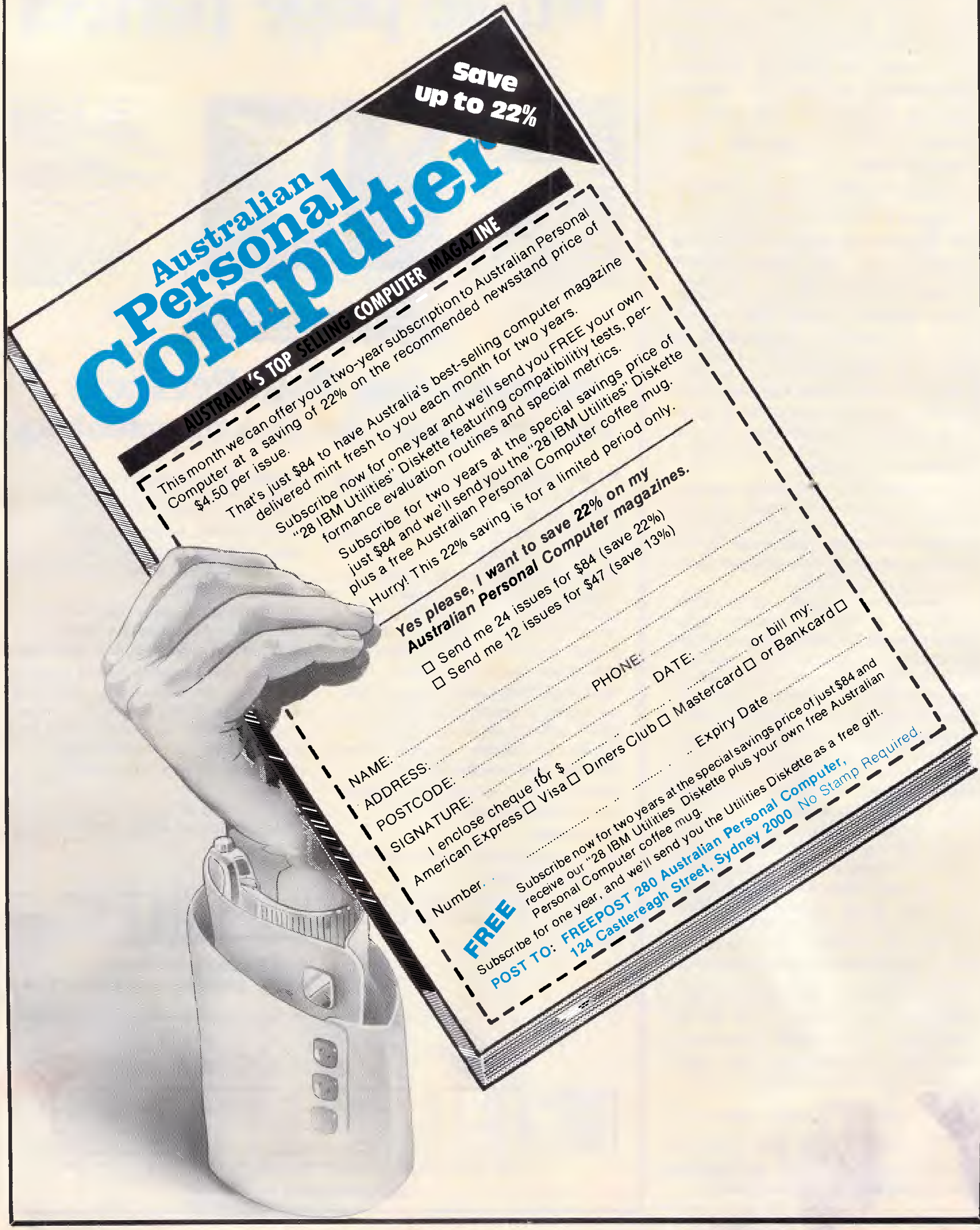

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```
extern far pascal
 DosGetMachineMode(char far *);
int isos2p();
{
  char mode;
  DosGetMachineMode
    ((char far *)(&mode));
  return((int)mode);
}
```

The **isos2p** function calls DosGetMachineMode, which is in the family API. The only argument to this API function is a pointer to a single byte, which is set to 0 for DOS and 1 for OS/2. A program can contain the following logic to tailor its operation to the processor mode

```
if(isos2p())
{
    /* do OS/2 stuff */
}
else
{
    /* do DOS stuff */
}
```

The program needs to call DosGetMachineMode only once because an application cannot change modes after it is started. Most OS/2 C compilers determine the machine mode as part of their start-up procedures and place the mode value in a global variable accessible throughout the program. The mode can be more efficiently determined by testing this variable instead of calling a function each time. With compilers that do not automatically provide such a value, developers can call DosGetMachineMode once near the beginning of a program and place the result into a globally accessible variable.

OPTION	DESCRIPTION
/O newexe	Names a new executable output file to be created instead of replacing the input .EXE file. An extension other than .EXE may be specified.
/M mapfile	Produces a symbol map file with default extension of .BM.
/N func	Binds the named function to the entry BadDynLink when the program runs under DOS. Instead of a function name, the argument can be @*file* to specify a file containing a list of such functions.

Table 3 The presence of calls to API functions not defined in family mode normally causes Bind to generate unresolved reference errors. The /N option allows binding such references to the BadDynLink entry, which may be a custom-written procedure

Sample application

The sample application FAMDEMO.ASM (Listing 1) prints a message that identifies the mode in which it is running; it then exits to the operating system. The

```
;***************************************************
;                                                 *
; Demonstration family-mode program.              *
; Assemble, link and bind with OS/2 build tools. *
;                                                 *
;***************************************************

        EXTRN   DOSEXIT:FAR
        EXTRN   VIOWRTTTY:FAR
        EXTRN   DOSGETMACHINEMODE:FAR

STACK   SEGMENT STACK PARA 'STACK'
        DB      2048 DUP(?)
STACK   ENDS

DGROUP  GROUP   DATA

DATA    SEGMENT WORD PUBLIC 'DATA'
MSG1    DB      "HELLO WORLD! I'M RUNNING IN "
MSG1LEN EQU     $-MSG1
MSG2    DB      'REAL MODE'
MSG2LEN EQU     $-MSG2
MSG3    DB      'PROTECTED MODE'
MSG3LEN EQU     $-MSG3
MODE    DB      ?
DATA    ENDS

CODE    SEGMENT BYTE PUBLIC 'CODE'
        ASSUME  CS:CODE, DS:DGROUP

; In all modes, DS points to data segment at entry.  This is standard
; for OS/2, is performed by Stub Loader under DOS.

START:

;     Call DosGetMachineMode(&MODE)      ; determine mode
        PUSH    DS                       ; push far address
        MOV     AX,OFFSET DGROUP:MODE
        PUSH    AX
        CALL    DOSGETMACHINEMODE

;     Call VioWrtTTY(&MSG1, MSG1LEN, 0)  ; write 1st message
        PUSH    DS
        MOV     AX,OFFSET DGROUP:MSG1
        PUSH    AX
        MOV     AX,MSG1LEN
        PUSH    AX
        XOR     AX,AX
        PUSH    AX
        CALL    VIOWRTTTY

        TEST    MODE,1                   ; which mode?
        JZ      REAL
        MOV     AX,OFFSET DGROUP:MSG3    ; protected mode msg
        MOV     BX,MSG3LEN
        JMP     SHORT WRITE2
REAL:   MOV     AX,OFFSET DGROUP:MSG2    ; real mode msg
        MOV     BX,MSG2LEN

;     Call VioWrtTTY(&MSGx, MSGxLEN, 0)
WRITE2: PUSH    DS
        PUSH    AX
        PUSH    BX
        XOR     AX,AX
        PUSH    AX
        CALL    VIOWRTTTY

;     Call DosExit(0, 0)                 ; terminate
        XOR     AX,AX
        PUSH    AX
        PUSH    AX
        CALL    DOSEXIT

CODE    ENDS
        END     START
```

Listing 1 FAMDEMO.ASM

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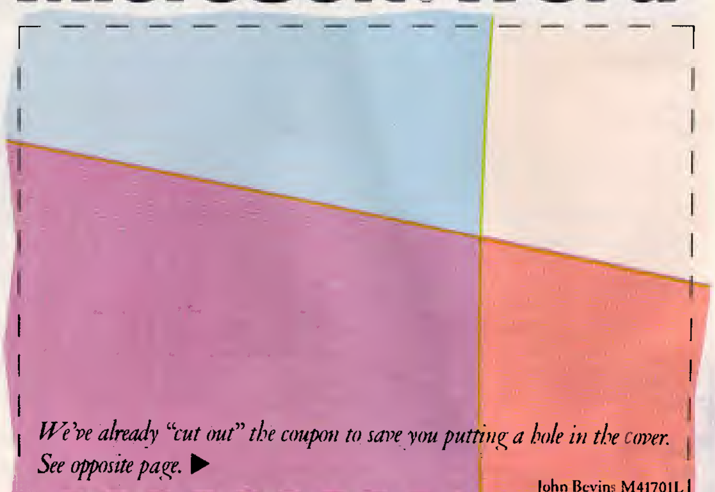

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three OS/2 API calls — VioWrtTTY, DosGetMachineMode, and DosExit — are in the family API repertoire. The entry conditions (see Table 2) are those of OS/2, even in real mode. Therefore, the DS register at entry points to the data segment, not the program segment prefix (PSP), so the application does not need to establish addressability to the data. If the program needs access to the PSP, it can obtain the address with function 62H of interrupt 21H (after determining that real mode is in effect). The most common reason for accessing the PSP is to obtain the address of the environment, but in family mode the loader places this address into the AX register. The following commands assemble, link, and bind the sample program

```
masm famdemo;
link famdemo,,,doscalls;
bind famdemo doscalls.lib
api.lib
```

The assembler can be any version that produces Microsoft-compatible object files, but the linker must be the OS/2 version. The **masm** command produces the object file, called FAMDEMO.OBJ, from which the linker produces the protected-mode executable FAMDEMO.EXE, using DOSCALLS.LIB (given as the fourth argument) to resolve calls to API functions. The functions themselves are not in this library file because the OS/2 API library is dynamically loaded at runtime. The semicolon after the library name indicates that no module definition file exists. This is a new OS/2 linker feature that gives developers a great deal of control over the structure of the .EXE file.

The first argument to the Bind command is the name of the .EXE file, followed by the names of the DLLs being used by the program. In the sample program, only one DLL is specified — DOSCALLS.LIB. The command line also must specify API.LIB, the DOS binding library that provides the actual DOS versions of the API functions. Although the .EXE extension on the input file can be defaulted, the .LIB extension must be explicitly stated for the library files. This is because the Bind utility can accept object files, with .OBJ extensions, that are to be bound into the new executable file.

DOSCALLS must be mentioned in both the Link and Bind commands because Link consults the library in order to convert each API name (such as DosExit) into a numeric index, which is called an ordinal reference. The names usually are not placed into the .EXE file, and the OS/2 loader finds the required functions in the load-time DLL using ordinal references. API.LIB, however, is not a DLL, and its members cannot be found by ordinal reference, but must be located by name. The Bind utility, therefore, must look in DOSCALLS.LIB to convert the ordinal references back to function names.

Use of the Bind command as shown causes the new family-mode .EXE file to overwrite the protected-mode input file. The Bind command has other useful options, as shown in Table 3. The most interesting and helpful option is /N, which allows programs to handle calls to functions that do not have family-mode versions in API.LIB. When binding a program with such calls (for example, within conditional constructs), the Bind utility generates an unresolved reference message for every function that is not in API.LIB.

If the developer identifies those functions in the /N option, Bind resolves API references to a function named BadDynLink. The default version of this function supplied with API.LIB displays an error message and aborts the program. If a program error causes execution in real mode to fall into the protected-mode branch of a conditional, the program can end cleanly without crashing. Developers can supply their own version of BadDynLink in an object module that they name in the Bind command line:

```
bind prog
  doscalls.lib
  badlink.obj
  api.lib
  /n DOSCREATETHREAD
```

This includes the object file BADLINK.OBJ, which must contain the customised definition of function BadDynLink, in the output .EXE file. If the program **prog** makes any calls to DosCreateThread (the function mentioned in the /N option) when running in real mode, the customised BadDynLink is called. Instead of ending the program, this BadDynLink could take some other action.

The Bind utility has one annoying shortcoming. Unlike the linker, Bind does not use an environment variable to locate libraries not in the current directory. It is most convenient to keep source and library files in different directories and build applications in the source directory while specifying the path to the libraries with the LIB variable in the environment. Unfortunately, the Bind utility requires a complete path for all files.

Sliding in smoothly

As developers contemplate how to approach OS/2 in their business endeavours, they should consider family-mode applications as a favourable way to get acquainted with the new operating system and remain commercially viable in the DOS market. Dual-mode applications are an alternative to jumping head first into OS/2-only applications or, on the other hand, burying heads in DOS-only programs.

Family-mode applications involve some limitations, however. They require larger .EXE files and more memory than pure DOS applications; they cannot perform inter communications or multi-tasking within a single program; and they provide slightly slower loading in real mode. On the positive side, execution speed is not affected in protected mode and very slightly in real mode.

Several advantages are apparent with family mode. First, users running family applications in OS/2 can take advantage of greater-than-640k memory and multitasking as it applies to running several programs at a time (not running more than one thread of execution within a single program). In addition, applications that run under both operating systems make maintenance and distribution easier. Finally, family-mode applications provide a way to discover the potential of OS/2, without abandoning DOS.

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LAN operating systems

The fastest drives and interface cards are worth little without the right networking software to run them. Here we take an indepth look at nine major contenders in the IBM and compatibles LAN OS stakes.

Many people worry more about network interface cards and cabling than about operating systems. While they can usually specify that they want a server with fast disk drives and a processor, they don't know how to quantify, measure, or select networking software. But software can make or break a network.

Quite simply, modern networking software is what makes distant resources local. If you are interested in files that reside on a machine down the hall that acts as a server, the software enables you to access those files as if they resided on drives in your own machine. It lets you use printers located thousands of metres — or even kilometers — away as if they were snugly attached to your own LPT1 port. And it allows you to use network modems or even minicomputers as if they were cabled to your own COM1 port.

Network operating systems have a multi-tasking and multi-user architecture; in that respect, they're more like minicomputer and mainframe-computer operating systems than like DOS or Microsoft's new operating system, OS/2. Your PC's DOS takes requests from application programs and translates them, one at a time, into actions performed by the video display, disk drives, and other peripheral devices. OS/2 can satisfy many requests at the same time, as long as the requests are made according to strict rules; therefore OS/2 is a multitasking operating system for PCs. Network operating systems, on the other hand, take requests for services from many application programs at the same time and satisfy them with the network's resources — in effect, arbitrating requests for the same services from different users.

Invisible and modular

Ideally, networking software is invisible to the end users. When you use it, you know you have more resources available, but you usually don't care where the resources are or how you are attached to them.

Structurally, networking software has many modules. Most of them reside in the machine that acts as the server for data, printer, or communications resources. But several important program modules must be in every workstation or, sometimes, in devices poised between the workstation and the network. (See the diagram 'Networking software/hardware interaction'.)

Working together, these program modules perform the basic actions of networking software. In a nutshell, networking software recognises users, associates their preprogrammed privileges with their identities, and then reroutes their DOS requests to the appropriate server for action. The operating system software in the server frequently is not a variety of MS-DOS, but it must emulate DOS and respond properly to DOS requests routed from the workstations. (This admittedly facile description would probably make the developers of these systems protest; they use many different complex techniques to make networking software work, and have made large financial investments in developing technical standards.)

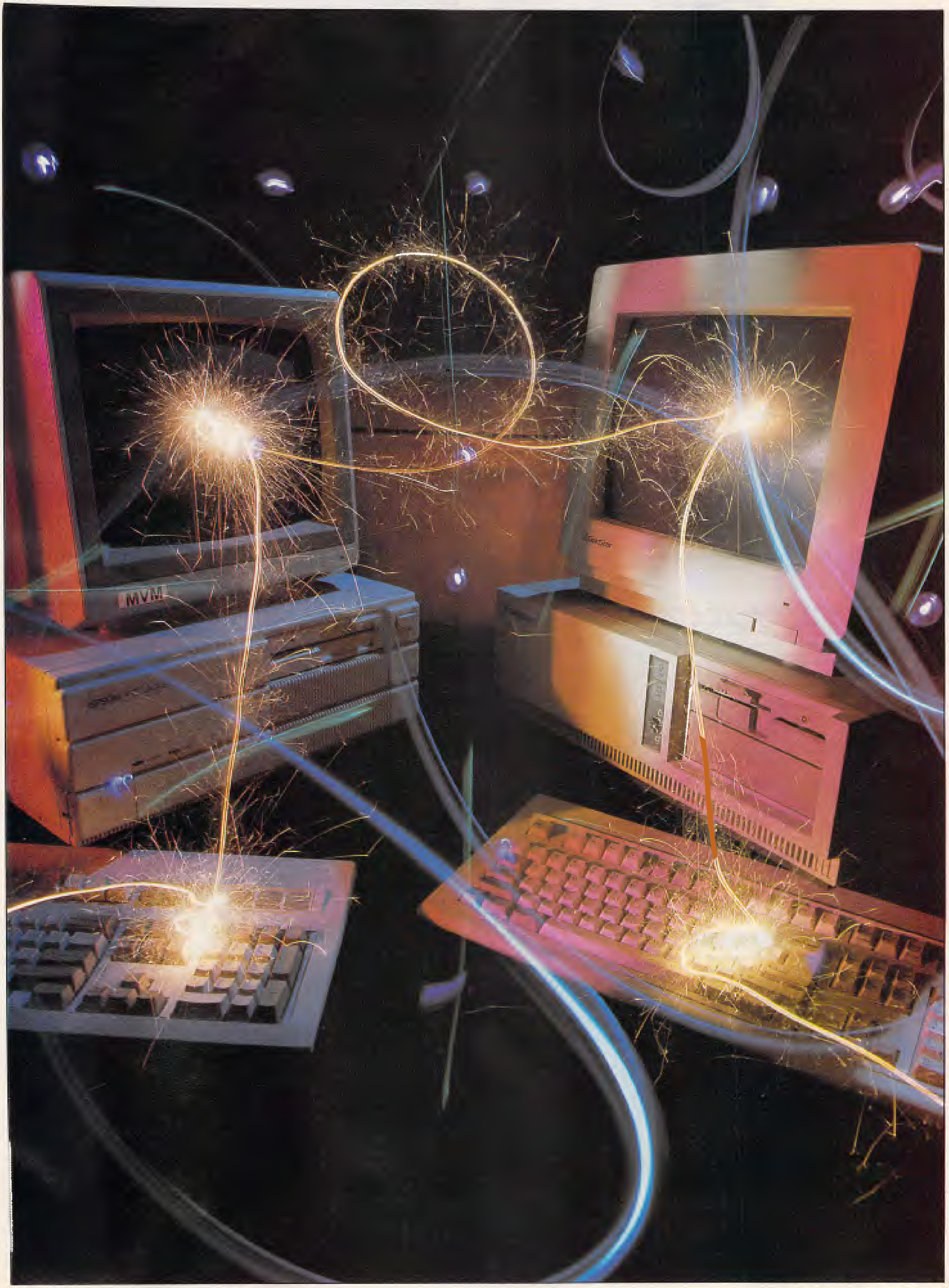
Different species

Darwin's method of categorising strange creatures — according to species and phylum — can also be applied to operating systems, which occur in two different species, each having different ancestors and largely different attributes. One species is derived from MS-DOS; the other has roots in minicomputer operating systems like Unix.

The MS-DOS species

MS-DOS is a weak basis for a network operating system, since it's not designed to be able to run multiple programs and satisfy many users simultaneously. Companies marketing DOS-based network software use patches and shell programs that intercept multiple requests, buffer them, and divide processor time among tasks. Some companies, such as Fox Research (now 10NET Communications) and Centram Systems (now TOPS, owned by Sun Microsystems) developed their own programs to modify DOS and give stations network capabilities. These programs represent separate branches evolving along parallel lines.

The largest number of DOS-derived operating systems, however, are the work of Microsoft. That company developed a set of programs for DOS-based network operating systems called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Networking software/hardware interaction

Network operating software, residing on every workstation and server, is a complex combination of modules that must work together. This diagram shows how the operating software interacts with the hardware and software on the workstation (left) and the server (right). (For both workstation and server, the hardware is the bottom level of the diagram; everything above that is software. Arrows represent the flow of messages — requests for services and data and the responses.)

The workstation is only a 'client', with no capabilities for contributing resources to other network stations. It has the same PC hardware (disk drives, monitor, keyboard, and so forth), BIOS (Basic Input/Output System, the software that links the hardware to DOS), and DOS that all PCs have, whether networked or not.

For LAN operation, several additional elements are necessary, both hardware (the interface cards and cables, tinted blue) and software (the redirector, NetBIOS, and driver software, tinted yellow). First, the application program running on the workstation may have certain added network attributes, such as the ability to issue record and file lock commands automatically through DOS. (This software enhancement is not strictly necessary, since even application programs not designed with a LAN in mind can run on a network.)

Second, the redirector module is added, to intervene between the application program and DOS. It intercepts software interrupt 21h calls generated when an application program asks DOS for services like file access. Each PC's redirector is programmed to switch certain calls — such as requests for data from drives that don't exist in the local PC's hardware — out through the network for service. Thanks to the redirector, a PC application can easily use network resources just by addressing the correct disk drive.

Another added software module, the interface card driver, moves data between the redirector and the workstation's network interface card. This driver software is specifically designed for network interface card hardware. Some card vendors supply it in a format that from the redirector's view looks like the NetBIOS program developed by IBM and Sytek to link their network hardware and software. If the driver is wrapped in a NetBIOS interface, it fits the Microsoft redirector supplied with IBM's PC LAN and many other operating systems.

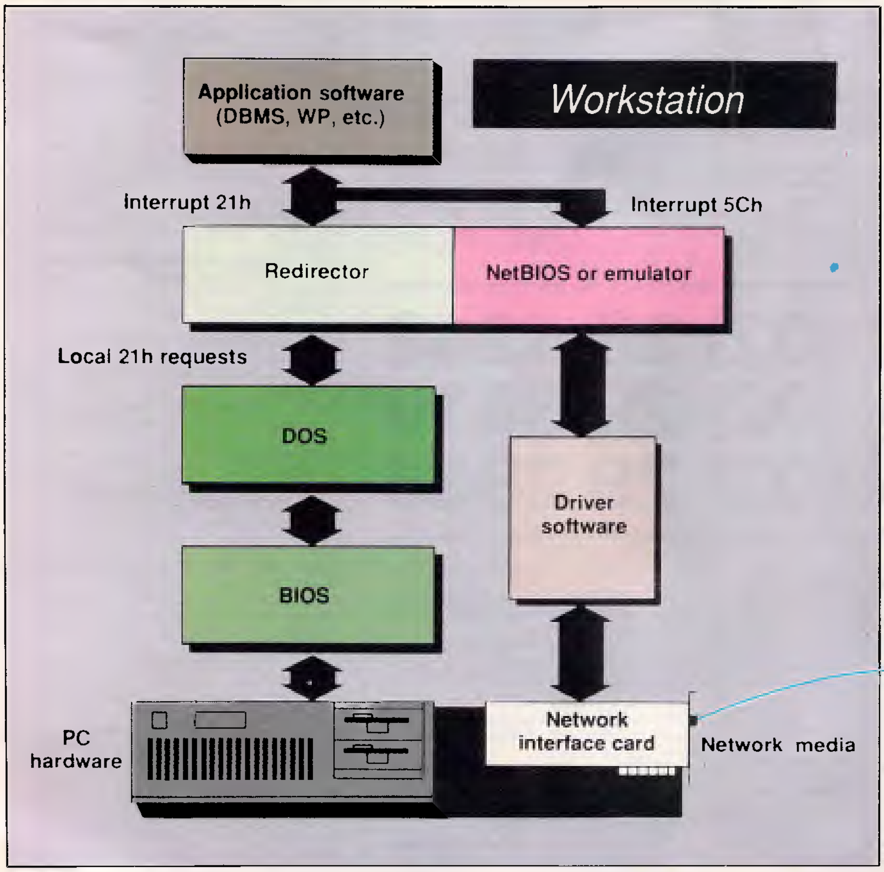
If the interface card driver doesn't perform the communications functions associated with NetBIOS, another software module usually emulates those functions. Application programs use a software interrupt 5Ch to call for session level communications services from the NetBIOS emulator or conforming NetBIOS software.

The network interface card sits in the expansion bus of the workstation. In modem networks, its wiring and its media access protocol are almost always independent of the networking software. The interface card includes programs in read-only memory that manage the creation and transmission of packets over the network.

At the other end of the cable from the workstation interface card is the server, with additional specialised LAN software and its own interface card. After the server interface card does its job, a NetBIOS module or emulator watches for packets containing NetBIOS information. Other messages pass to the security and multi-user software modules.

Like any other computer, the server runs an operating system — sometimes DOS, but often a unique system or one derived from UNIX. If the system is DOS, you can almost always run local application programs and use the computer as a network terminal. But remember, all server software requires a lot of processor RAM and attention.

Finally, network utility programs run on the server, offering print spooling, auditing, and other LAN features.



MS-Net for their use. DEC, AT&T, 3Com, and IBM, for example, incorporate some part of MS-Net in their networking systems, adding their own menus and user interfaces. Some, like 3Com and DEC, add significant pieces of their own code, using only small parts of MS-Net.

These DOS-based network operating systems share a number of characteristics. The most evident one is peer-to-peer resource sharing, the ability to allow any PC on the network to contribute resources such as printers and disk drives. The DOS add-on programs that offer multifunction capabilities work in the background mode, so someone else on the network can use your disk drive or printer, for example, while you are running PC application programs on your machine.

Peer-to-peer resources sharing is both a capability and a limitation. On the positive side, it allows great flexibility and makes these systems economical in installations having as few as two PCs. Since these operating systems can run on any of the Intel processors used in the PC family, even IBM PC-XTs or Model 30s can share their resources with other PCs. On the negative side, peer-to-peer resource sharing typically will slow response times, can stifle the growth of a network, and may make it more difficult to manage. When files and printers are spread among many machines acting as servers, administrative problems multiply.

In the evolution of the 3Com software away from its DOS roots, it lost peer-to-peer resource sharing. 3Com's 3+Share software is the only DOS-based operating system we can identify that requires a dedicated server. But, as we will discuss later, 3Com's software is being grafted back to the DOS tap root, since 3Com is co-operating with Microsoft in developing LAN-Manager, Microsoft's next generation of networking software.

DOS-based systems share another trait: RAM hunger. It isn't unusual to lose 120k or 140k of RAM to the networking software in a workstation. Often buffers and code loaded on boot-up in the CONFIG.SYS file use some of this space, so it's lost to DOS applications whether the network is in use or not.

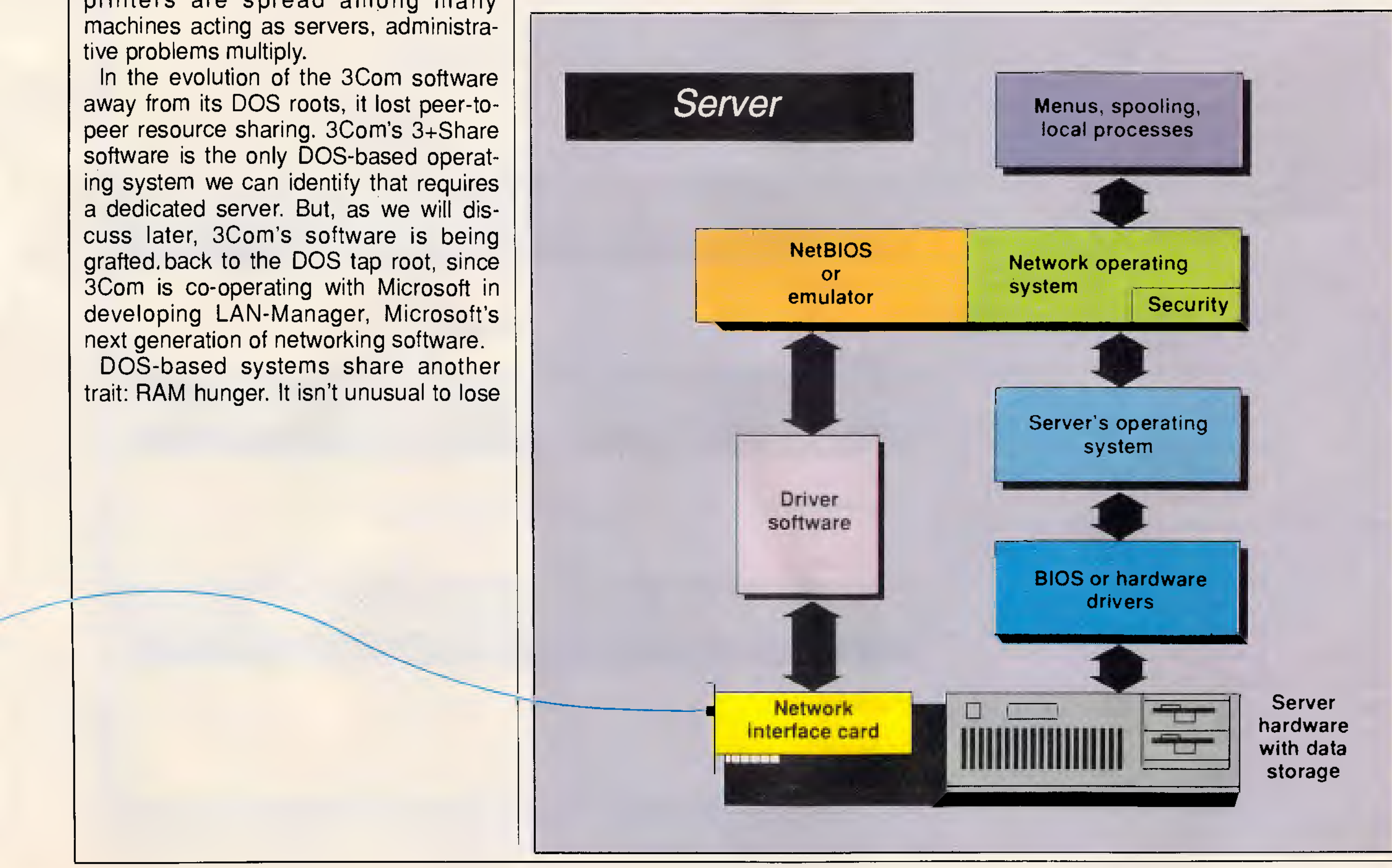
If the workstation is configured to share resources with the network, some programs can occupy nearly 400k of RAM. A few specialised memory add-on products might allow the use of RAM outside of DOS's 640k for at least part of the networking software modules in some programs. 3Com's new EtherLink Plus and TokenLink Plus cards are designed to reduce some of the pressure on RAM by storing more program code on the networking card. But generally you'll lose RAM space for application programs with almost all types of networking software.

The MS-Net-based programs also share a common command syntax. The 3Com programming syntax keeps its individuality by being at least cosmetically different from that of MS-Net. Some members of this species, like TOPS and Tapestry, evolved separately from DOS and use very different command-line statements and syntax (icons in the case of Tapestry). Because MS-Net syntax is used so widely, 10NET Communications adopted it for the 10NET operating system, and Western Digital merged it with ViaNet by simply adding the MS-Net commands to the company's older command languages.

The standard features of the DOS-based operating systems vary widely. They all have menus and some kind of print job spooling and queuing capability, but most do not include electronic mail or network management functions. 10NET, with its standard library of features such as mail, chat, and network statistics, is a notable exception. Torus Systems includes a powerful E-mail capability in Tapestry, and 3Com has add-on features in 3+Share. But many of these programs include only the basics needed for resource sharing. If you want electronic mail, group calendaring, or other productivity tools, you must buy them from third-party vendors.

The Unix species

The other root of today's network operating systems is the minicomputer world. Minicomputer operating systems such as Unix are designed from the beginning with multi-user and multi-tasking capabilities. Non-DOS LAN operating systems for networked PCs don't need patches or added modules to give them these capabilities. But they must still respond appropriately to DOS calls for services. The need to emulate MS-DOS



(and other related elements such as NetBIOS) sometimes leads to incompatibilities, particularly in out-of-step MS-DOS and LAN OS releases.

LAN operating systems derived from minicomputer stock include Banyan's VINES and Novell's NetWare. VINES has the greatest external resemblance to a minicomputer operating system. When you turn on a VINES server, the operating system describes step-by-step the programs it is initialising and running. Together, these programs constitute the network operating system on the server. The Unix file structure is used on the hard disk, and Unix controls the I/O ports on the server. While even the network administrator never directly addresses the Unix operating system, Unix is there performing the multi-user and multi-tasking functions so important to server operation.

In Novell's NetWare family of operating systems, the file structure of the server is unique to Novell, and arbitrary MS-DOS limitations on memory space and I/O port limitations don't apply to the server. Novell's Advanced NetWare/286 runs the 80286 processor in its protected mode, allowing efficient internal processing and external memory addressing.

Both VINES and NetWare use workstation software that is functionally similar to the MS-Net-based products. Software modules (NetWare calls them shells) running in each workstation communicate with the networking software on the server to pass along DOS requests for service. Application programs or DOS command-line entries on the workstations generate the requests. The server software accepts the requests, checks the identity and the authority of the requester, translates the requests into messages the server operating system understands, and passes them to the server operating system. The server software also sends back the requested data and issues appropriate error codes to the workstations.

The major difference between this species of operating system and the MS-DOS-based species is that the server software in the Unix-based species takes care of mediating simultaneous requests for the same data and will also run multiple programs. The result is typically a much faster performance. In addition, workstations in these systems are not able to contribute resources to the network. Only one or a small number of dedicated computers perform the role of 'server' — filing, printing, or running communications. (A special version of Novell's NetWare designed for small installations allows the server to operate also as a workstation — but not vice

A decision guide for networking software

If you are looking for a local area network operating system for a specific workgroup activity, the presence or absence of just one or two features can be the deciding factor. To help you narrow your choices, we've listed typical networking activities, the features crucial to them, and the packages that offer those features.

INTENSIVE DATABASE MANAGEMENT

(Accounting, reservations, inventory, and other functions)

Key features: Fast response time; Addresses more than the 30MB byte limit of DOS

Products:
- SFT NetWare 2.1
- 3+Share
- VINES

MICRO-TO-MAINFRAME AND WIDE-AREA-NETWORK INTEGRATION

(In a corporation or large organisation)

Key features: X.25, TCP/IP protocols; 3270 connectivity options; Multiple file servers

Products:
- 3+Share
- PC LAN
- SFT NetWare 2.1
- Tapestry
- 10NET
- ViaNet
- VINES

MODERATE WORD PROCESSING, SPREADSHEET, AND DBMS CAPABILITIES

(Small office)

Key features: Economy; Easy access to applications; Peer-to-peer resource sharing; Printer sharing

Products:
- TOPS
- ViaNet
- Omninet PC/NOS
- PC LAN
- Tapestry
- 10NET

CONNECTING IBM PCs AND MACINTOSH COMPUTERS

Key features: File transfer; Printer sharing; Hard disk drive sharing

Products:
- 3+Share
- TOPS

COST TRACKING AND ACCOUNTING

(Professional office or government contractor)

Key features: Tracking network activity by user; Bill-back to user's department

Products:
- VINES
- SFT NetWare 2.1

CRITICAL FUNCTIONS

(Such as income production, health, safety, or security)

Key features: Resistance to failure; Fault tolerance; Ease of recovery

Products:
- SFT NetWare 2.1

versa.) This type of network operating system is typically rich in accessories and management tools. You can expect to find network bridging, electronic mail, print spooling, and other software modules supplied by the original manufacturer.

Operating system features

With the two broad species of networking operating systems in mind, you'll want to consider the following features when selecting a particular system.

- **Dedicated servers vs. a shared solution.** Network operating systems such as TOPS, Tapestry, and 10NET allow any workstation to contribute drives, printers, and other resources to the network. Others, such as 3Com's 3+Share, and Novell's NetWare, require a computer dedicated to the server role. The shared solution (also called peer-to-peer resource sharing) is appealing in small installations where the cost of a dedicated machine is a factor, but sharing a workstation's resources always slows down operation of local programs, and dedicated servers give faster performance.
- **Special servers.** Some network operating systems come in versions designed for non-PC-AT-type servers.

VINES comes in an 80286 version, but Banyan's best-selling product runs on special servers using Motorola 68000 series processors. DEC offers versions of its networking software allowing its minicomputers to act as file, printer, and communications servers for networks of PCs. Using such programs can eliminate problems with massive storage needs and communications gateways.

- **Remote station access.** The ability to allow remote users to dial in through an RS-232 port on the server or on other network computers, can effectively extend the reach of your network to stations far beyond the cable network. Though the effectiveness of this feature is often limited by the telephone line's speed, it can be important in certain applications. For instance, salespeople on the road might wish to call in to check mail or use data files on the network. Such systems as NetWare offer this valuable feature.
- **Hardware key.** Some operating systems, specifically NetWare and VINES, require a special hardware key to operate. In NetWare, this can take up a card slot. VINES adds it to the server's serial port.
- **Internal bridging.** Internal bridging allows network managers to mix and match media and topology plans. NetWare, VINES and 3+Share all have the ability to put more than one network interface card in a server. (This capability is standard in Novell and Banyan products and is an option in 3Com products.)
- **Special disk format.** Operating systems that are not DOS-based sometimes require a special disk format, thereby making the drive unavailable to DOS. This requirement, which both VINES and NetWare impose, may be a consideration if you intend to use the machine acting as the server for other purposes.
- **Fault tolerance.** If critical business, security, or safety operations run on a network, the operating system software can help improve survivability. So-called fault-tolerant operating systems mirror the operation of a disk drive or even an entire server on a duplicate resource. If the first drive or server fails, the mirror image takes over. Novell's comprehensive system fault tolerant (SFT) packages provide a wide variety of options and seamless take-over by the mirror image resource.
- **Server-based applications.** In the typical PC-based network, application programs run on the workstations, and the servers run special programs dealing only with security and resource sharing. This arrangement is usually efficient, but

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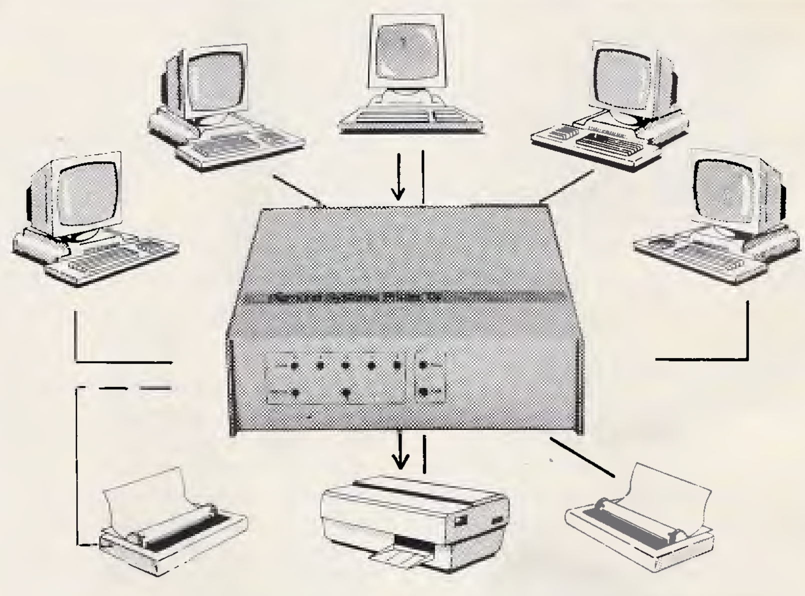

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Benchmark tests: LAN operating systems

These benchmark tests clearly show the speed differences between peer-to-peer shared networking software and software using dedicated servers. Every system that uses a dedicated server is faster than systems in which you can also use the server as a workstation. On the other hand, the systems that offer peer-to-peer resource sharing are more flexible and economical since they don't require the expense of a dedicated machine.

Dedicated server systems

Advanced NetWare/286 took the performance honours by a significant margin, though it is interesting to note that a system not tested here, LifeNet from Univation, performed marginally better than Novell's product. LifeNet was, however, running on its own '386 server while NetWare 2.1 was running on a plain-vanilla 8-MHz IBM PC AT (with extended memory).

It is interesting to note that when there is no load on the network, every dedicated server system will give you performance that is equal to or better than the performance of an 8-MHz standalone IBM PC AT operating from its own internal hard disk. As soon as you rev up the network and start queuing up requests for hard disk activity, however, performance slows.

Peer-to-peer LANS

When we tested peer-to-peer resource sharing networks, we did not run any applications on the workstation acting as the server. When you do use the server station to run local applications simultaneously, you can't predict the effect on network throughput. The reason is that the speed degradation of both the local applications and the network services results from a complex interaction between the number and timing of interrupts and the amount of disk access required by both functions.

To interpret the results of the benchmark test presented here, pay close attention to the reported results when four stations (in addition to the station running the timed test) load the network. This gives you some indication of how well the software handles contention for disk access.

Of the peer-to-peer resource sharing LANs, Western Digital's ViaNet Networking Operating System was far and away the fastest. The interface drivers provided by SoftNet Communication for the system's KAL1000 network interface cards are what helped speed the bits along.

The results of these benchmark tests should clear up some misconceptions about the rated throughput of the interface cards. They show that it is the networking software, not the rated throughput of the interface cards, that determines actual network speed. For instance, our tests give a respectable speed rating to TOPS, which runs on the TOPS FlashCard interface card over Apple's AppleTalk wiring plan, even though these media are rated at a slow 760 kilobits per second.

And even when a network turns out to be incredibly swift, remember that speed is just one factor you should consider when selecting a LAN operating system. For many applications, such factors as dealer support, training, and compatibility with other applications will be more important than throughput.

Our LAN benchmark tests are written in C and are independent of commercial software. We ran the tests on a test-bed of four 8-MHz IBM PC ATs. For our test-bed to better simulate the conditions on a medium size network of 20 or more workstations, we have designed these loading tests so that single station represents five to ten times the load of a user performing an interactive task (for example, updating records) on a network.

The **Network Speed Under Load** and the **Hard Disk Access Load** benchmark tests measure the time needed to perform a standardised task on the network. While the actual work loads used for these two tests (described below) are different, we used the same procedure for both. To obtain the elapsed times shown here, we ran a benchmark program performing a sequential write, a random read, and a random write of large file. The record sizes used in these activities systematically rotate between 16k, 4k and 512 bytes. The numbers shown are the total time necessary for all of these operations. We ran the test on all our ATs to load the network while timing just one of them. We then reduced the number of workstations one at a time to show the effect of loading on the network.

The **Network Speed Under Load** test puts a heavy load on the network interface (cards, media, and so forth) while placing a minimal load on the hard disk by having each station continuously read and write its own 1-byte data file, changing the data each time. For systems with disk caching, the load on the hard disk is even smaller, since cached systems typically perform a disk write but do not require a physical disk read.

The **Hard Disk Access Load** test heavily loads the hard disk and disk-caching system. To do this, each station randomly accesses its own 100k data file using 1k records. Data written to the file is changed each time. The random reads typically access data outside the cache, which forces a disk read, as does any write.

The **Database Load** test exercises the system's record-locking support and the way it handles a number of random simultaneous accesses to a common file. This test times how fast each loading station accesses a common database consisting of an index and a data file. Half the accesses are simple searches of the index file and an accompanying access to a record in the data file. One quarter of the accesses perform the same operation but also lock the data record and update its contents. The remaining accesses update the index file and a data record. The index file is locked during every update and the DOS 3.1 RLOCK statement prevents simultaneous index file updates.

---

sometimes performing certain disk-intensive tasks on the network file server is more efficient; these tasks include indexing a database or compiling program source code. Some modern operating systems, like NetWare Version 2.1, can run appropriate application tasks on the server. The software to use these capabilities is just emerging, but it could bring more efficient (and more complex) operation to installations using disk-intensive applications.

- **Server software memory.** The amount of RAM used by the server software is important if you try to use PCs as both workstations and servers in peer-to-peer networks. It's less critical in networks with dedicated servers, but even then you should know what is required as a minimum (2Mbyte in the case of VINES, Version 2.10).
- **Disk caching.** Disk caching attempts to improve performance by storing frequently requested data in RAM. All the

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COMPUTER KNOWLEDGE

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Network speed under load

Performance times *(Times given in seconds)*

Provides peer-to-peer resource sharing

Software	Server	Interface card	Zero stations	One station	Two stations	Three stations	Four stations
Omninet PC/NOS	8MHz IBM PC AT	Corvus Omninet Transporter	1766	1974	1986	2178	3432
10NET	8MHz IBM PC AT	10NET Adaptor Card	1109	1473	1763	2059	2407
Tapestry	8MHz IBM PC AT	Ethernet Plus Adaptor	725	1016	1418	1802	2224
PC LAN	8MHz IBM PC AT	IBM PC LAN Baseband Adaptors	851	1033	1125	1236	1952
TOPS	8MHz IBM PC AT	TOPS FlashCard	1137	1172	1239	1354	1577
ViaNet	8MHz IBM PC AT	SoftNet KAL 1000/ViaNet	845	932	1086	1239	1361

Requires dedicated server

Software	Server	Interface card	Zero stations	One station	Two stations	Three stations	Four stations
VINES	Banyan DTS DeskTop Server	EtherLink	479	812	1067	1225	1320
3+Share	3+ Server Model 3S/400	EtherLink	360	342	354	388	454
SFT NetWare 2.1	8MHz IBM PC AT	EtherLink	287	296	303	313	333

Hard disk access load

Provides peer-to-peer resource sharing

Software	Server	Interface card	Zero stations	One station	Two stations	Three stations	Four stations
Omninet PC/NOS	8MHz IBM PC AT	Corvus Omninet Transporter	826	1016	1402	1752	2129
10NET	8MHz IBM PC AT	10NET Adaptor Card	523	803	1250	1738	2255
Tapestry	8MHz IBM PC AT	Ethernet Plus Adaptor	335	1105	1371	1857	2105
PC LAN	8MHz IBM PC AT	IBM PC LAN Baseband Adaptors	385	735	909	1394	1683
TOPS	8MHz IBM PC AT	TOPS FlashCard	636	1209	1446	1919	2643
ViaNet	8MHz IBM PC AT	SoftNet KAL 1000/ViaNet	388	1268	2266	3277	3977

Requires dedicated server

Software	Server	Interface card	Zero stations	One station	Two stations	Three stations	Four stations
VINES	Banyan DTS DeskTop Server	EtherLink	218	504	721	960	1331
3+Share	3+ Server Model 3S/400	EtherLink	182	203	258	309	336
SFT NetWare 2.1	8MHz IBM PC AT	EtherLink	139	152	169	181	195

Database load

Provides peer-to-peer resource sharing

Software	Server	Interface card	Zero stations	One station	Two stations	Three stations	Four stations
Omninet PC/NOS	8MHz IBM PC AT	Corvus Omninet Transporter	826	894	1042	1208	1474
10NET	8-MHz IBM PC AT	10NET Adaptor Card	523	1295	1703	2121	2402
Tapestry	8-MHz IBM PC AT	Ethernet Plus Adaptor	335	1376	1678	1798	2001
PC LAN	8MHz IBM PC AT	IBM PC LAN Baseband Adaptors	385	637	839	902	1040
TOPS	8MHz IBM PC AT	TOPS FlashCard	636	648	801	1068	1146
ViaNet	8MHz IBM PC AT	SoftNet KAL 1000/ViaNet	388	1007	1415	1651	1869

Requires dedicated server

Software	Server	Interface card	Zero stations	One station	Two stations	Three stations	Four stations
VINES	Banyan DTS DeskTop Server	EtherLink	218	422	520	612	722
3+Share	3+ Server Model 3S/400	EtherLink	182	202	221	227	234
SFT NetWare 2.1	8MHz IBM PC AT	EtherLink	139	157	152	153	157

operating systems we review here support disk caching.

- **Workstation memory.** Some network operating systems, like PC LAN, use more than 100k RAM on each workstation for the redirection software. Some, like 10NET, require much less RAM. Others, like VINES and 3+Share, can hide their workstation programs in special blocks of memory provided in optional cards. The importance of losing memory in the workstation relates to the kinds of programs you use. Some people might demand access to everything DOS allows, while others might never miss a few hundred kilobytes of RAM. The option of hiding most of the networking code in RAM away from that used by DOS could be important.
- **CONFIG.SYS program loading and/or command-line loading.** Some network operating systems load driver modules through the CONFIG.SYS program when the computer is booted.

Those modules always take up RAM, even when the network is not in use. Other systems load everything from the command line, so no RAM is used when the operating system software is not loaded. And other systems, like ViaNet for example, can load from either the CONFIG.SYS or the DOS command line.

• **Network administration.** Every successful network has someone who officially or unofficially becomes the system administrator. What kinds of tools does the system administrator have to see in order to control who is using the network and what the workload is? Reporting system usage by user is standard in minicomputer systems, but rare in LAN operating systems. Yet on a LAN with many stations, knowing who causes the heaviest workload can be important.

• **Diagnostic utilities.** Some network operating systems give the network supervisor certain utilities to find problems and to configure the server for optimum operation. These utilities include reports of bad packets and network errors, along with tools for the operation of disk cache programs. Corvus Systems' Omninet PC/NOS, for example, reports network errors but does not report bad packets.

• **Security.** Security is usually provided through the use of passwords. The best systems have different levels of access giving users various privileges (including read, write, modify, create, and erase). Another form of security is the ability to provide password protection to facilities such as a disk drive, subdirectories, or even files. With the exception of Omninet PC/NOS, all the systems we review here offer the ability to link passwords with network resources.

• **Electronic mail.** A good electronic mail system alone might justify your investment in a LAN. It should store and forward messages, allow for direct replies and forwarding, and give the status of messages. Quite a few systems we review here lack a store-and-forward mail system, including TOPS and ViaNet; 3Com 3+Share has an optional E-mail system.

'Essentially, the future of networking is greater co-operation among computers. Multiple solutions will be available to handle every task, but no one solution will suit every requirement.'

• **Rude messaging.** Networking software should have the ability to exchange short 'rude' messages that pop up on the bottom of the screen. Such messages are valuable for co-ordinating network operations such as printer sharing and server maintenance. But the rude messages should not become a permanent part of any lines they overwrite on the screen. ViaNet lacks a rude-messaging capability.

• **Print spooling.** When several LAN stations use a printer attached to a central server, the print jobs are saved in a special file called a spool. (Every system we reviewed offers print spooling.) The print jobs queue for printer access. Users should have a way to see the status of their jobs in the queue and to kill jobs sent there by mistake. The network administrator should be able to change the priorities of print jobs in the queue and assign specific priorities to certain users.

The future

Interoperability is the key trend for the future of PC-based networks and their operating system software. Computers running under Apple's Finder, Xenix, Unix, OS/2, DOS, and other operating systems such as DEC's VMS will all interact as peers on the network.

The differences between minicomputers and LAN servers will continue to erode. Machines based on 80386 and 68020 processors will handle both jobs at the same time. DEC has taken the lead in this area, and now it seems that practically every minicomputer manufacturer is offering 'DOS support' that makes the mini a server. At the same time, companies like Novell and Univation are hosting parts of application programs on the network server to improve performance and reduce network overhead.

Another clear trend is improvement in the tools provided to the LAN manager in the new operating systems. Many com-

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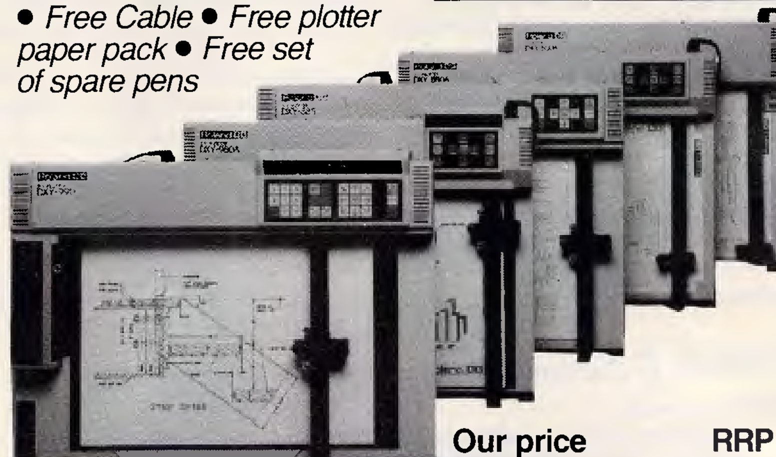

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panies are offering improved reporting and ways to manage security, costs, administration, and operational control of networks. Microsoft is working with 3Com in preparing a new OS/2-based network operating system called LAN Manager. They are providing many performance features, but they are also critically interested in giving managers access to operational cost, performance, and maintenance information. Novell has provided a rich menu of statistical features and management tools in SFT NetWare 2.1.

OS/2 will have little direct impact but significant indirect impact. Remember, OS/2 is a multi-tasking but single user — not multi-user — operating system, and network designers must add multi-user features to OS/2. Companies marketing programs that don't use DOS on their servers will want their servers to host some OS/2 applications, and a number of techniques are available to do so. The long-term impact of OS/2 (in 1989 and 1990) will most likely be the improved quality of application programs hosted under multi-user systems such as Unix. This improvement will, in turn, increase the challenge of multi-user systems to server-based LANs in typical workgroup applications.

Tomorrow's 'enterprise LAN' (a network serving an entire business group, organisation, or enterprise) will have many servers running different operating systems. Smaller networks will make more flexible use of powerful 80386-based machines.

Essentially, the future of networking is greater co-operation among computers. Specialised machines will perform specific I/O-intensive tasks, and powerful machines will split their resources in many ways. Multiple solutions will be available to handle every task but, as is true today, no one solution will be perfect for every requirement.

Omninet PC/NOS

Omninet PC/NOS is a LAN operating system from Corvus, one of the first companies to enter the PC-based local area network business. Corvus markets local area network interface cards and servers as well as Omninet PC/NOS. The $1417 operating system (eight user version), which has an architecture slightly different from that of most other MS-DOS-based network operating systems, offers a peer-to-peer network for sharing files and printers and for transmitting messages.

We tested Version 1.1 of Omninet PC/NOS, which comes on four disks. Mirroring the functions of the network nodes, the labels of the disks are server, shared workstation, workstation, and utility.

A concept unique to Omninet PC/NOS is the shared disk node. This category of network workstation allows you to make your disks sharable while keeping more RAM available for local applications than would normally be available in a server. Selecting this kind of node is advisable only when network applications use a machine's disk drives infrequently, because too may requests for the drive may bind up the system. Since the server module sets a larger amount of RAM aside for disk buffering, you should select this type of node when applications make heavy use of the networked drive.

The workstation software module, essentially only a redirector, makes the most RAM available for running local applications. When you select the workstation module, disk drives are not available for sharing.

Unless you use a device which frees up RAM from the system, you won't have much RAM left to run applications on a fully configured PC/NOS server. On

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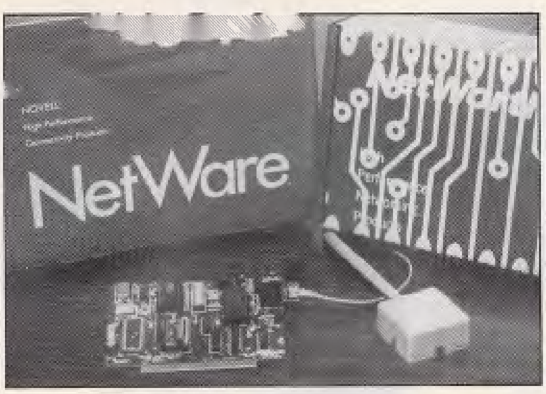

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At a glance

Omninet PC/NOS, Version 1.1
United Computer Group
30 John Street
Lidcombe, 2141
Tel: (02) 649 1222
Price: Eight-user version, $1417
Requires: For workstation: 320k RAM, one disk drive, DOS 3.1 or later. For server: 384k RAM (512k RAM recommended), hard disk.
This LAN operating system for use on Corvus hardware offers fast, solid, peer-to-peer file-sharing and network services. It includes two categories of disk sharing nodes, each with different RAM requirements. System administrators will appreciate the detailed menu system and security options. Not copy protected.

the same machine equipped with 640k of RAM and running DOS 3.3, CHKDSK reported approximately 519k of RAM free on a workstation loaded with PC/NOS, approximately 338k free in the shared disk mode, and 210 bytes free on a server.

Installation

To install the Omninet PC/NOS server software, you simply insert the installation disk in the A: drive and type Install. The menu-driven system asks some simple questions, allows you to select options like print service, and prompts you to enter the required disks. The installation software creates the necessary sub-directory on the server's hard disk and modifies or creates a CONFIG.SYS with the necessary values for files and buffers.

The interface to PC/NOS is a multilevel menu system called NetView, which gives users access to all printers, disk drives, and other resources on the network. NetView consists of a series of vertical pop-up 'strip' menus that show the networked resources as well as the possible DOS device names on the PC, and it allows you to make links among them.

NetView is flexible and complex. When you link resources, layers of menus spread out all over the screen. Special function keys and the arrow keys issue all commands in the menu system. But the question that arises when you try to move through the system isn't "What key do I push?" but rather, "Where do I go from here?" Although help is available for every menu level, getting comfortable with the menu system takes a little time (we had to spend a couple of hours puzzling out all the functions). PC/NOS also has a command-line language that lets you make the same kinds of DOS device name and resource links from DOS batch files. The commands and syntax don't allow the widely used MS-Net model, but they are relatively easy to use. In most installations, administrators will use NetView and set up batch files to link resources for individual users.

Plugs and sockets

Unlike other operating systems, PC/NOS has two categories of connections. The first category is permanent links associated with a particular workstation. The second category includes so-called 'temporary links' made only for a specific user. These commands are associated with a specific user log-on and are broken when a user logs off.

This setup gives users and the network administrator considerable flexibility. If your users frequently enter the network from different workstations, you can make the most of the links associated with user names. But if you want a stable and homogeneous network environment where every workstation is configured the same, you can establish permanent links.

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Omninet PC/NOS's print-spooling and

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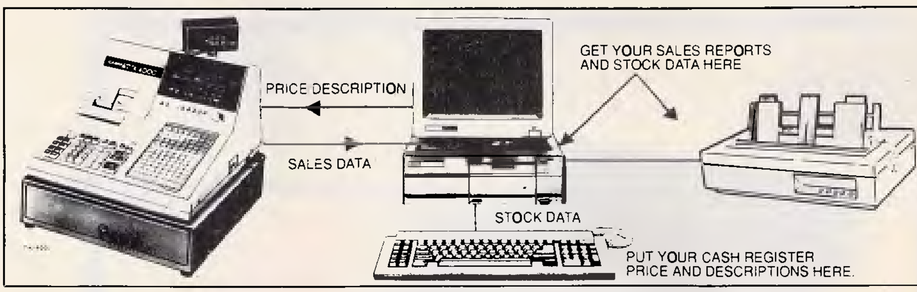

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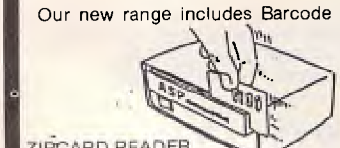

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message-sending capabilities are simple but effective. You can view a print queue and see where your jobs are, and you can link to a print spooler either through menus or using command-line entries. The message capability sends real-time messages to people who are on-line, but it has no store-and-forward capability.

Omninet PC/NOS uses a system of network names and passwords to establish security and user privileges. A user profile lists a well-defined series of privilege levels. If a user's privilege level is equal or higher than the resources security level, he is granted access to the network.

The system's designers recognised, however, that some installations don't need much security, so they created a group name called Maxacs. Anyone made a member of Maxacs has full user privileges — a handy way to adjust individual capabilities quickly.

Conclusion

Since Omninet PC/NOS is designed for the Corvus hardware, the package isn't a viable alternative when you need a system that can operate on a wide variety of hardware systems, as IBM's PC LAN does. But used on the Corvus hardware, Omninet PC/NOS offers good basic services and response times typical of DOS-based network operating software.

PC Local Area Network Program

The IBM PC Local Area Network Program (or PC LAN) is one of the most sought-after network operating systems. Its popularity is due to its low cost, its relative ease of use and installation, and its IBM logo.

The $396-per-station (software only) PC LAN comprises, almost completely, Microsoft's MS-Net series of program modules. Since it lacks the program code needed to drive network interface cards, another layer of software must come between it and the network hardware.

When IBM and Sytek first married PC LAN's immediate predecessor, the PC Network Program, to Sytek's network interface cards, they dubbed the interface program NetBIOS. The original NetBIOS translated requests for service received from the networking software into direct commands to the network interface card hardware. Today, many vendors supply a NetBIOS module for their network interface cards; you can use PC LAN on cards marketed by Sytek, Western Digital, Proteon and many other vendors.

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As other vendors caught on to the use of NetBIOS, IBM changed the name of its latest version of the NetBIOS software to the Local Area Network Support Program (LANSP, but some industry people irreverently pronounce it as if it were LASP). LANSP, which requires DOS 3.3, includes special drivers for the IBM Token-Ring and PC Network II adaptors.

Covers the basics

PC LAN covers the basics: it allows any workstation on the network to make resources available to the network. When you make a drive, subdirectory, or printer available for sharing, you can assign passwords and associate the resource with a network name for security and simpler administration. Workstations with hard disk drives can spool print jobs for attached printers, and a message service lets you send real-time messages to stations active on the network.

At a glance

PC Local Area Network Program, Version 1.20
IBM
Coonara Avenue
West Pennant Hills, 2120
Tel: (02) 634 9111
Price: $396 for single-server version.
Requires: 360k RAM, one disk drive, DOS 3.1 or later.
This simple, low-cost implementation of Microsoft's MS-Net networking software primarily offers disk and printer sharing. With no drivers for network interface cards, it requires NetBIOS or the IBM LAN Support Program, but it also carries the IBM logo and subsequent backing. Not copy protected.

Resource sharing and simple messaging are all you get. If you want to exchange electronic mail, dial in remotely, or see statistics on the use of the network, you will have to turn to third-party add-in software.

Four configurations

Unlike its competitors, PC LAN offers four functional configurations, each of which adds another RAM-resident software module. The basic configuration, which includes only the Redirector, enables you to use resources on the network and to originate messages (one way) to other active stations. Adding the Receiver module lets you see messages addressed to you, on the bottom line of your screen. The Messenger module asks you if you want to see the incoming message before it's displayed. The Server module allows you to make resources available to other network stations. The configuration you use depends on whether your computer has a fixed disk and on the amount of memory it has, as well as on the work you want to do.

RAM is particularly important. In a fully configured PC LAN system with the Server module installed, PC LAN uses 350k RAM. The LAN Support Program can take 20 to 30k more (depending on the hardware used), and DOS and other programs use additional space. The PC LAN manual clearly illustrates a server's RAM needs, but the added processing load is not as clearly described in the section on adjusting network performance. Using a computer as both a server and a workstation sounds like a good idea, but when you divide resources you lose performance.

Installing PC LAN is easy, but if you want to use IBM's TopView or a special non-English keyboard, you have to swap some files around first. The PC LAN Program Installation Aid program creates a subdirectory for PC LAN and leads you through the process of modifying the CONFIG.SYS to add sufficient buffers and file control blocks.

The manual mentions the need for a NetBIOS interface in the third line of one bullet on pages 1-4. Otherwise, you simply have to know that you need to load more software for PC LAN to run. The LAN Support Program's own installation instructions consist mainly of asking you to enter a DEVICE = statement in CONFIG.SYS and specify the right .SYS file for your hardware. You lose 20 to 30k of RAM to the LAN Support Program when the PC is booted, but you don't have to lose RAM to the PC LAN program until you're ready to use the network.

Menus and commands

Versions 1.2 and later of PC LAN include menus that take you through starting the networking software, sending messages, sharing disks and directories, using resources, and controlling printing. Although the menus are simple to use, they don't relieve you of the need to know how to operate the network. You must know path or network names to perform some of the functions. We recommend using DOS .BAT files to set up resources, as discussed in the PC LAN manual.

PC LAN has about a dozen programming commands that you can enter from the command line or a batch file. The most frequently used commands are NET SHARE and NET USE. Many of the other commands, like NET PAUSE (which halts your computer's resource sharing so you can get some work done), are used infrequently. The commands use the Microsoft/IBM syntax established in PC LAN, which is a standard that other manufacturers copy.

Like everything about PC LAN, the printer spooling system is solid and simple. You can see the status of printing jobs in any available queue, and you can create and use separator pages between printing jobs. Many people were frustrated by the way the program always sent a form feed to print jobs, sometimes wasting preprinted forms, but IBM corrected that problem in the latest releases.

No surprises

PC LAN's performance times are typical of MS-DOS-based networks. In a DOS-based network, the operating software filters requests from the network and feeds them to DOS one at a time. DOS sees PC LAN as an application program and makes it share the processor's attention with any other application that is running on the PC. This architecture simply cannot produce the same response time as the architecture of a dedicated server.

PC LAN is inexpensive, simple, and reliable. And it carries the IBM logo. In many situations, that's enough.

SFT NetWare 2.1

Novell's major product is a robust, feature-filled LAN operating system called NetWare. We reviewed the newest version, SFT NetWare, Version 2.1, which retails at $827 per node (based on a ten node system, not including hardware).

Like its major competitors, Banyan and 3Com, Novell is evolving — from being a vendor of network operating systems only to becoming a single source of a wide range of connectivity products. Novell offers links to Macintosh computers, TCP/IP products to interact with the outside world and microcomputers, and X.25 interfaces to connect to not only country-wide networks but also to worldwide ones. It also offers servers, workstations, micro-to-mainframe links, database software, and unique devices such as BatRAM. But primarily, Novell, is a software company and the NetWare line is its best-known offering.

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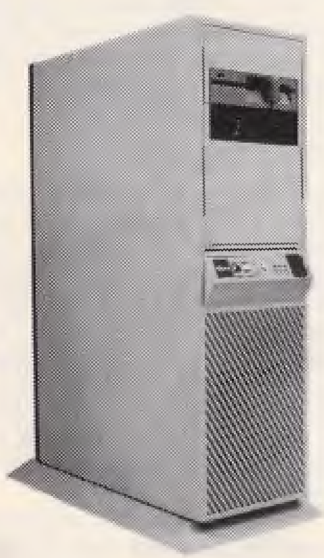

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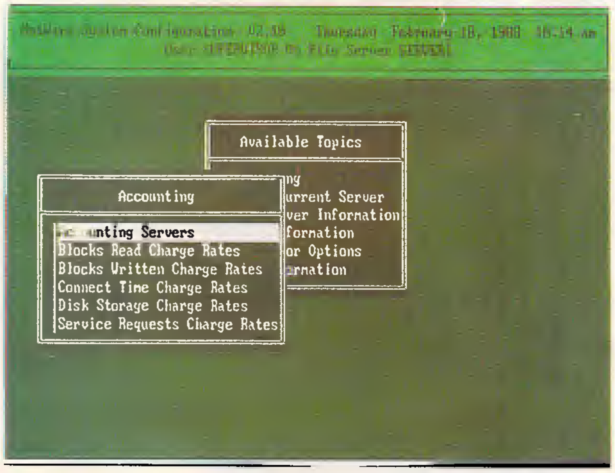
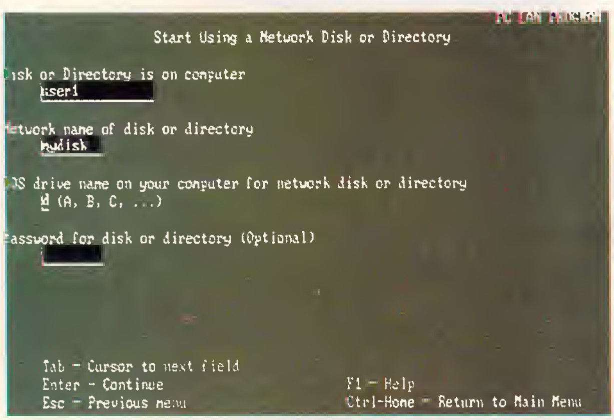
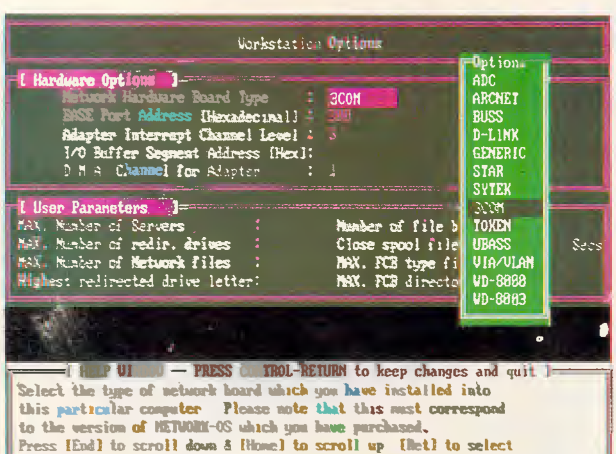


SFT NetWare 2.1 contains many features usually taken for granted in minicomputer operating systems, but rare in LAN operating systems. The screen here shows cost accounting options. This feature lets the network administrator track and price LAN activity according to data blocks read and written, connection time, disk storage, and requests for network services



The latest version of 3Com's 3+Share networking software includes menus that help you move files and access files on network servers. In this example, a user has moved into a subdirectory of the D: drive and is tagging files for transfer



With this special Network-OS display, you can use NetBIOS commands to request the status of the network adaptor card in a workstation across the network. The display shows the configuration of this particular station and how busy it has been. In the hands of a technically inclined network administrator, this can be a powerful network management tool

At a glance

SFT NetWare, Version 2.1
Data Peripherals
16 Suakin Street
Pymble, 2073
Tel: (02) 488 8066
Price: $8276 for ten-node system.
Requires: 80286 or 80386-based server. 512k RAM in the server (more recommended) and 192k RAM in each workstation. DOS 2.0 or later.
Novell's Version 2.1 of the NetWare line of products — a fast, full-featured LAN operating system — includes management tools typical of minicomputer operating systems, but rare in networking software. This powerful yet flexible software system is easy to use at a superficial level yet a challenge to master. Not copy protected.

Variations on NetWare

Novell rehosts and reconfigures NetWare for a variety of applications. Versions are available to support the Motorola 68000 and the Intel 8088 series of processors. Novell's Advanced NetWare/286 uses the Intel 80286 processor in its protected mode and gains significant processing efficiency and memory-addressing capability. Some network companies market OEM releases of NetWare with their own hardware. One version of NetWare, the Entry Level System, is a low-cost way to network a limited number of workstations. It also allows the server to act as a workstation for some applications.

An important variant of NetWare/286 is embodied in SFT NetWare. The SFT (system fault tolerant) concept involves mirror-image operation of one or more failure-prone parts of the server and disk system. SFT NetWare, Version 2.1, offers two levels of fault tolerance tailored to specific needs and budgets.

The simplest version of SFT operation makes redundant copies of file allocation tables and directory entries. The copies provide backups in case the oxide coating of a hard disk is damaged in the area containing critical file directory information.

A more sophisticated SFT function allows two disk drives to mirror each other in different ways as a backup in case of drive or controller failure. The software also performs transaction tracking that prevents file damage if power is lost at critical times and creates an audit trail that permits you to reconstruct data from archive files.

The SFT features are important in any network application in which the data is critical to the organisation's operations and profile-taking ability.

Architecture

All versions of NetWare, except the Entry Level System, have the same basic modes of operation. One dedicated machine acts as a file server for all file-sharing and printer-sharing functions; workstations cannot share resources with other stations on the network. While you can easily establish networks that have many servers, you'll need to install a separate copy of NetWare, protected by a keycard in the server's bus, for each one.

The NetWare installation process reformats the hard disk drive of this server. While the server can contain a DOS partition, you cannot access the NetWare partitions on any server drives through DOS. You can access NetWare files only through the network. As a result, someone gaining physical access to the NetWare server cannot change, copy, or destroy the files on the server.

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Workstations running under NetWare load a program called the network shell, which is Novell's version of Microsoft's redirector. The loading process in SFT NetWare, Version 2.1 brings in the IPX communications driver software separately from the shell. In prior versions the communications driver was part of the shell. This is a clear indication that Novell's developers are planning to accommodate separate communications protocol in the future.

Excellent menus describe the system and its resources for Novell users. But as the menus typically describe available assets in terms of server names, volumes, and other network-unique references, the NetWare menu system is clearly not designed for novice users.

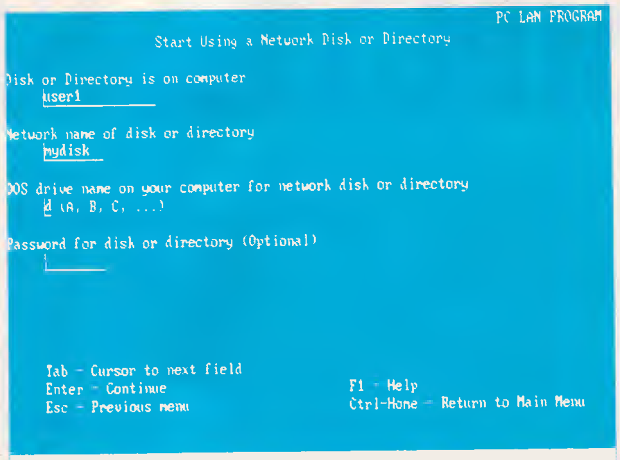
NetWare also includes a menu utility that lets the network administrator create menus that provide access to files, shared printers and other resources, though you could also use DOS batch files to perform the same function. Other utilities included in the system are printer spooling, automatic log-in scripts, and electronic mail. The printer spooling gives excellent control over print jobs. The presence of automatic log-in scripts on the server reduces the administrators need to maintain AUTOEXEC.BAT files on every workstation. The mail system is comprehensive and includes features like the ability to attach binary files to messages.

A high point of the operating system (shared to varying degrees by other network operating systems) is that it allows you to bridge various types of network interface cards inside the server. Consequently, you can hook various networks using different kinds of cabling into the same server or extend those with distance limitations by putting up to four network interface cards in the same server. All of the stations can then talk to each other over the network. Novell provides software drivers for more than 30 different network interface cards, as well as software that emulates NetBIOS communications functions between workstations.

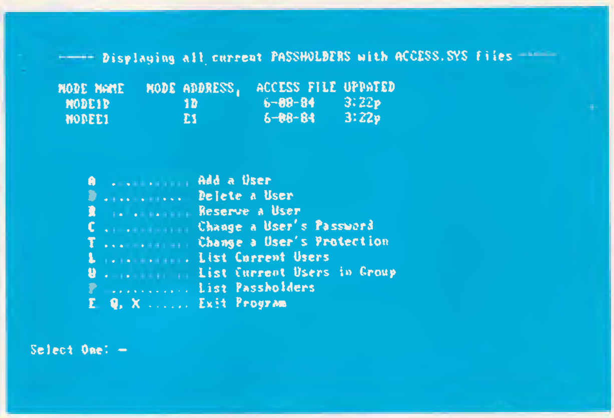
The newest NetWare

Novell's real news for followers of LAN operating systems is SFT NetWare, Version 2.1. Version 2.1 supersedes Version 2.0a, but the difference to LAN administrators is much more than just a tenth of a version. Version 2.1 gives SFT NetWare features usually taken for granted in minicomputer operating systems but rare in LAN operating systems.

SFT NetWare 2.1 has the tools PC network managers need to help reduce costs. It enables the network administrator to determine who uses the network (by user name or by station) and then to assign costs back to specific individuals, departments and profit-and-loss centres. Costs for usage are compiled according to time connected to the network, storage used, and/or file server operations. This cost-accounting feature is both overdue and welcome in PC-based local area networks.



PC Local Area Network Program offers a menu selection that makes it easy to share resources — here disks and directories — and redirect outputs to shared resources such as printers or modems



ViaNet's menu system is simple, yet effective. This system management menu leads to other levels of detail

Other management features added in SFT NetWare 2.1 enhance the security of the system. You can place time locks — of maximum duration for the network user, the time of day, even the date — on the activities of certain stations or processes.

You can also enforce periodic password changes and encrypt with non-reversible encryption algorithms.

Additional new operational features include providing users with access to all printers on the network, regardless of which server they are assigned to, and indexed file allocation tables. Indexed Turbo FAT enable you to search file allocation tables on large files (10Mbyte and larger) quickly.

Novell is also giving third-party vendors more opportunities to make their products a part of the network operating system. Nearly a year before the release of Version 2.1, Novell published the specifications for a new series of application program interfaces.

One irritation in using earlier versions of NetWare is that relatively few makers of add-on hardware products, like disk and tape drives, made it through the process of integrating their products into NetWare. Even an add-on storage device acquired and marketed by Novell, BatRAM from Santa Clara Systems, could not function on a server running under Advanced NetWare/286. Many people were disappointed to find that their favourite tape backup system wouldn't run on their NetWare server.

SFT NetWare 2.1 deals with that compatibility problem through a feature called value-added drivers (VADs). The VAD specification gives developers a standard way to add their drives and other products to NetWare servers. Typically, the software they use to do so is simply another file on the installation disk that comes with the device.

VAPS as well as VADS

Another important application program interface published by Novell for Version 2.1 is for value-added processors (VAPs). VAPs allow programmers to run

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applications on the server in 80286-protected and real-time modes.

The most familiar VAP is probably database service. Novell makes designing the database server module easier by issuing standard VAP specifications. Though no VAPs were available at the time this article was prepared, future VAPs are expected to range from compilers to expert systems and will enable network users to change network applications and the way the network handles them.

Experienced users of NetWare will find that Version 2.1 boasts more of everything: more disks, more menus, more options. Also it takes up more RAM space in each workstation. It's faster, too. Yet all programs and batch files from Version 2.0 will also work under 2.1.

Installing SFT NetWare 2.1 is nothing less than an arduous process. You must shuffle through 33 floppy disks — some of which must be inserted many times. Tiers of menus present you with numerous options, and you'll find plenty of drivers (like the one for BatRAM). The new process makes you long for the familiar Version 2.0 linking process — the very same one that we used to consider so complex.

The NetWare station shell has grown to take up more RAM space on every workstation. With the addition of the IPX protocol drivers, the combination of DOS 3.3, IPX and NetWare takes about 110k RAM on a workstation. Still, that requirement is modest when compared with what some of NetWare's competitors require.

The Menu called FCONSOLE gives the network administrator access to the new statistical reports. Various options adjust these report screens to change their sampling rate and to clear old data.

The Novell future

Novell responded to the introduction of OS/2 and the rising popularity of the Macintosh Finder operating system and of Unix by opening the NetWare architecture to allow interconnection with these systems. The company's response to a world of multiple operating systems is on two levels: gateways and transparent connections.

A LAN gateway uses one machine on the network as a portal to other resources. The most typical gateway is to a larger mini or mainframe computer. Today, most of these gateways let stations on the network operate as terminals connected to the host. However, newer concepts such as Novell's TCP/IP server allow peer-to-peer operation between PCs on a LAN and a host system. Similarly, the Novell X.25 gateway can give network stations connections to other computers through value-added networks such as Austpac.

Novell is increasing the ways that it provides so-called transparent connections service between dissimilar systems. Transparent services allow an inexperienced user to access any resources in a multivendor network without knowing where they reside.

NetWare has always been able to link different kinds of network interface cards in what is termed an internal bridge. This capability increases in importance every time IBM cements in the Token-Ring Network as a method of connecting to its mainframes. Even if your network uses ARCnet or StarLAN, the server is capable of internally bridging a Token-Ring card to an IBM 9370 or any similar system that is equipped with a Token-Ring.

The NetWare Message Handling System allows anyone to send messages to a wide variety of remote networks without knowing where the recipient is located or how to route messages. A joint development between Novell and Soft-Switch gives the PC Mail system the ability to access host-based mail systems like IBM's PROFS and DISOSS, DEC All-In-One and VMSmail and Wang Mailway and Office. The Soft-Switch Mailbridge Server interfaces with The Co-ordinator on the network side and with the host-based mail service through a gateway or direct connection.

Novell promises future development of a Universal Network Architecture (UNA). UNA conceptually allows for vendor-specific interfaces like IBM's APPC and DECnet functioning as value-added processes.

Making room for OS/2

Since OS/2 is still evolving, Novell's methods of accommodating it are also still evolving. In the first quarter of 1988, Novell introduced the NetWare Requester. This OS/2 module extends the services of OS/2 across the network to the NetWare server. The NetWare Requester runs in network workstations along with the Standard Edition of OS/2. Developed by Novell with assistance from IBM, it allows workstations equipped with OS/2 Standard Edition to coexist on a NetWare LAN with DOS workstations; provides access to all NetWare services; and allows users to run both DOS and OS/2 applications.

The Novell NetWare Coprocessor, scheduled for delivery following the release of IBM's Extended Edition of OS/2 in the fourth quarter of 1988, will provide NetWare support for OS/2 server-based applications on the file server. The NetWare server processor will remain dedicated to network operations while the coprocessor runs NetWare value-added processes. The coprocessor will be available for both the standard IBM PC AT bus and the IBM PS/2 Micro Channel architecture.

Conclusion

Overall, NetWare sets the standard for a robust and complete LAN operating system. Any job that you can do reasonably well on a PC-based network, you can do using Novell's NetWare: it's mature, flexible, powerful, and fast. Like any powerful tool, NetWare can be a handful to master, but it's also rich in tools and alternatives.

Tapestry

Tapestry, a local area network operating system marketed by Torus Systems and sold in the six-user version for $1895, is one of the most complete DOS-based LAN operating systems. It operates with Torus's LAN hardware or any other LAN hardware that comes with a NetBIOS interface, including hardware from IBM and many other vendors.

Tapestry features an icon-based interface, a feature-rich electronic mail service, and extensive printer-sharing utilities. It also sets the typical networking philosophy — that the best network is invisible and that an administrator should use DOS techniques to hide the network from the users — on its head. Instead, Tapestry uses the network to hide DOS.

In the Tapestry system, icons represent applications and tools. Because of Tapestry's strict security and file-sharing system, a multi-user application like a database (where multiple users read and write files) must operate through the selection of an icon. The user has little opportunity to interact with DOS, although the administrator can build icons that activate batch files.

Tapestry is one of the few DOS-based LAN operating systems that you can use either over network interface cards running NetBIOS or through the special software drivers that Torus supplies for some cards. The NetBIOS compatibility of Tapestry is related to IBM's marketing of the product in Europe as a graphic alternative to IBM's PC LAN.

Tedious to install

Tapestry is one of the most complete DOS-based operating systems in terms

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Networking's necessary hardware

LANS do not live by software alone. You also need servers, workstations, cards and cables to fashion a complete system.

Servers, workstations, cards, and cables are the dry-bones hardware into which networking and application software breathe life. Though this issue emphasises software, you need to understand how to put the software together with the hardware to come up with a complete system.

Servers and clients

In a PC-based network, computers act in the functional roles of servers and workstations (sometimes called 'clients' to differentiate them from high-powered graphics 'workstations').

The servers make their attached disk drives, printers, modems, and other resources available to the workstations. Software running in the workstations gives network users access to the data and devices available on the server(s). The networking software running on the server determines whether the server will be dedicated to its service role, or whether it can also run local application programs (in what are termed 'peer-to-peer networks').

You can use an 80286 or 80386-based machine as a server. Many networking companies also sell heavy-duty AT-class machines with the power supply and cabinet capacity to support several disk and tape drives as dedicated servers. Companies such as Novell and 3Com increasingly feature dedicated servers with 80386 processors. Banyan sells servers that use processors in the Motorola 68000 family.

Interface cards

Inside each workstation and server, a network interface card communicates with the networking software through either NetBIOS or special driver software. The size and on-board processing power of the network interface cards vary greatly. Vendors such as 3Com and Proteon sell cards, typically used in servers, that carry their own 80186 processors and RAM to keep network-communication tasks from burdening their host systems.

Companies such as National Semiconductor, Texas Instruments, and Standard Microsystems market chip sets for Ethernet, Token-Ring, and ARCnet network interface cards. While 18 months ago a typical network interface cost $1500, the increased availability of these chip sets has resulted in 'no frills' Ethernet and ARCnet cards ranging in the low $500s.

Some networking software, such as 10NET, runs only on proprietary network interface cards. But many other products will support cards from a variety of vendors.

Connecting cables

It's the network interface card that determines the type of cabling you'll

of added features, but it is also one of the most tedious programs to install. The operating system needs to know the specific address of every interface card used in the network. Since this address is burned into a ROM on the cards and not noted externally, you must first run a special program on every PC to get the address of every card. Then, you must enter each 17-character address into a relatively complex menu. You must establish and keep an exact correlation between a menu of users and a menu of node names and identifiers.

Each copy of the software becomes linked to the interface board on which it is installed. Therefore moving equipment and swapping interface cards requires more than the normal amount of attention to details — like which copy of the software goes with which interface board.

Once you've installed the software, you have to set it up. Because of Tapestry's unique architecture, the setup process is not intuitive. We spent long hours staring at icons and the manual, trying to understand the process. While we're not making a direct indictment of Tapestry's operation or structure, we found its installation and setup slightly confusing, somewhat tedious, and definitely more complex than those of its competitors.

At a glance

Tapestry
Sourceware
586 Pacific Hwy
Chatswood, 2067
Tel: (02) 411 5711
Price: Tapestry Network Manager Pack, required for your first PC, $1395 (limit 100 stations); Tapestry Workstation Pack, required for each subsequent station on the network, $895.
Requires: For workstation: any network adaptor that supports NetBIOS, plus 320k RAM, and one disk drive, DOS 3.1 or later. For server: 384k RAM, hard disk.

One of the most complete DOS-based LAN operating systems, Tapestry offers an icon-rich interface, E-mail service, and extensive printer-sharing utilities. Although these features help novice users, the system burdens the network installer along the way and later forms an obstacle to basic DOS functions. Copy protected.

Easier in operation

The good news is that once the administrator's initial work is done, the users have things easy, within a limited world of alternatives. All the resources of the network are available though point-and-shoot icons. You typically pass from a Tapestry menu to the opening screen of the application with no intermediate stops. Terminating a program brings you right back to Tapestry.

Tapestry's icons use the office analogy. Disk drives are divided into filing cabinets and drawers. You 'open' cabinets and drawers by tagging them from a menu in the bottom half of the screen. Not only can you click a mouse on the icons, but the program even gives you the up-and-down 'elevator' boxes next to windows of file listings.

You use Tapestry's tools for every DOS function, from formatting disks to making file transfers and viewing text files. A full-screen editor lets you build batch files or write notes without fancy formatting into ASCII files.

All of this insulation from DOS brings its own set of adjustments and complexities. Some actions, like changing the active disk drive, are more complex in tapestry than in DOS.

need to connect the servers and workstations. Choices include twisted-pair telephone wire, shielded twisted-pair data-grade wire, coaxial cable, and fibre-optic cable. However, if one of these types of wire is already installed in your building. you'll want to select an interface card that can work with the existing wiring.

Twisted-pair telephone wire is typically installed in buildings to carry voice Private Branch Exchange (PBX) telephone traffic. Many companies see this wire as an excellent way to carry data too. You're likely to find sufficient twisted-pair wiring for your LAN if your building was wired for a PBX within the last six to seven years. But you can now get Ethernet and ARCnet interface cards for unshielded twisted-pair wiring. IBM's PC LAN Baseband Adapters use two pairs of twisted wire to carry data signals.

When you find them installed, twisted-pair telephone wires have the significant advantage of economy. However, because the wires can absorb noise from radio and electrical devices, the network interface cards will have difficulty communicating in environments that have a great deal of electrical noise.

Data-grade twisted-pair wire on the other hand, carries an external aluminum-foil or woven-copper shield that is specifically designed to reduce electrical noise absorption. Different companies have their own specifications for these cables, although IEEE standards apply to systems like IBM's Token-Ring.

Shielded twisted-pair cables are expensive and difficult to work with and require custom installation. Still, IBM has been successful in marketing a wiring plan that uses these cables for Token-Ring installations. The IBM plan adds reliability (and substantial cost) by using a separate run of cable between every server or workstation and a central wiring hub. This wiring plan significantly increases the amount of cable used, but it also ensures against total failure of the network in the event that one cable is broken or shorted.

Coaxial cable, particularly the thin RG-59 or RG-62 type, is easier to install than shielded twisted-pair data-grade cable and has many of the same noise-resistance advantages. This cable is used in Standard Microsystems' ARCnet and 3Com's EtherLink.

ARCnet typically uses a hub wiring plan in which every station links directly into a central wiring hub, a scheme that reduces the vulnerability of the overall network. EtherLink, on the other hand, uses a station-to-station wiring scheme that is economical because it uses less cable than a hub-type scheme but that runs the risk of total network failure if any one link is severed or shorted.

Though it does not improve transmission speed, fibre-optic cable allows for greater distance between stations and provides total immunity to electrical noise.

A fibre-optic link can run for several kilometres without the need for repeaters to regenerate the signal. Radio transmitters, arc welders, and noise fluorescent lights have no effect on the light pulses travelling inside such cable. Many vendors, including Proteon and 10NET, offer versions of their network interface cards adapted to fibre-optic transmission.

Constructing the whole

Because of currently available de facto standards and protocols, you can mix and match these pieces — servers, network interface cards, cables, and software — in myriads of ways to form an optimally productive and cost-effective network.

The default is to set Passwords for the use of practically every service. But there are no handy tools like network names or group associations to make security activities easier for the administrator. Security in Tapestry means that users and the administrator must keep track of lists of passwords.

Tapestry has five levels of read/write protection for files. These levels of privileges offer separate capabilities for the owner of the file and for other network users. If you want to create a file and then share it with others through the network, you have to execute a complex series of actions to select the file and unlock it so that others can modify it.

Plusses and minuses

To its credit, Tapestry's performance was better than that of many of the other DOS-based products compared in our benchmark tests. We ran the program on Western Digital Ethernet cards supplied by Torus Systems.

When power was lost to the network stations, the server could not recover and reboot if other stations were attempting to contact it after a reboot. So after a power blip, you must turn off the nonserver stations until the server is powered on.

Tapestry's excellent electronic mail system notifies you of incoming mail and has the ability to attach binary files to outgoing messages. The printer spooling system is also excellent. It notifies you of completed jobs and makes selecting available networked printers easy for any user.

Overall, Tapestry burdens the network installer and administrator and doesn't give them anything back in the way of diagnostics or troubleshooting tools. The total environment Tapestry offers makes it easy for novice users to start applications, but users who know DOS will have little use for that knowledge.

10NET

"Very good gets much better" describes 10NET Communications' 10NET ($1330 per node, $1790 for fibre-optic version). This integrated package offers functions that are extra-priced options or unavailable even on heavy-hitting networks from Novell, 3Com, and Banyan. It supplies all hardware except wire or cable, and you must use the 10NET software with the 10NET cards (and vice versa). The software includes electronic mail, public calendar, bulletin board, communications programs, print spooling, disk caching, and management reporting programs.

Since 10NET is based in DOS and allows peer-to-peer resource sharing, it's slower than networks requiring dedicated servers but more flexible. Release 3.3 includes disk caching that significantly improves performance and adds NetBIOS services for gateway and mail products using NetBIOS session services.

The 10NET architecture offers a great deal of flexibility in network configuration. 10NET allows any workstation to contribute resources such as disk drives or attached printers to the network. Any user can move to any network node and have full network privileges.

The three 10NET disks contain the main network program for every workstation and several utility programs for communications and administration. On workstations that don't share resources, 10NET and DOS 3.3 take about 130k of memory. Stations that act as servers and share their resources lose over 300k RAM to 10NET and DOS. More RAM can go to disk cache if extended memory is unavailable, but it's easy to terminate the 10NET program in

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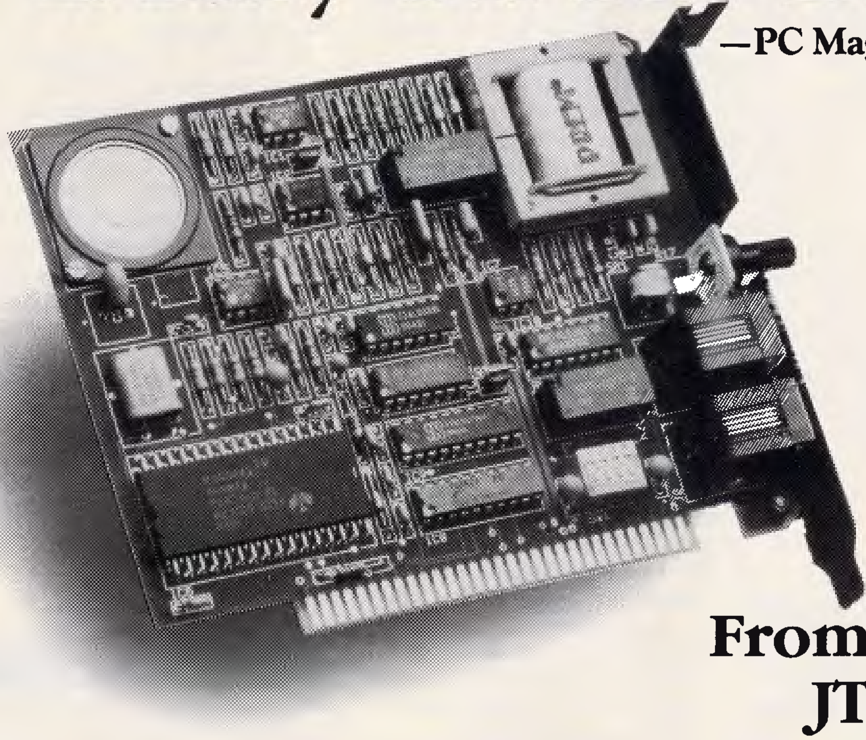

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Choose commands or menus

10NET users have a choice of entering commands (either directly or through batch files) or using a series of easily accessed menus. Many network menus are RAM resident, so you can access facilities like CHAT and printer spooling from within an application.

Fox Research (the original name of 10NET Communications) released the 10NET programs with a series of commands borrowed from mainframe systems, such as MOUNT (gain access to a shared resource). In response to the popularity of the MS-Net redirector, Fox augmented the old command words with words used in other LAN programs. MOUNT is still there, but the more common NET USE, borrowed from MS-NET-based programs, will work too.

Strong security

10NET's access security features are strong and flexible. Each person at a station contributing resources to the network, such as a disk drive or a printer, can set security restrictions on the use of the resources. You can assign security 'levels' to each network user. To gain access, the user must have an equal or higher security level than the one assigned to the device. You can also protect individual files the same way. 10NET even lets you assign different security levels for writing and reading an individual file.

More features and utilities

The list of features and utilities included in the 10NET networking software is longer than that of any other LAN, regardless of price or architecture. 10NET includes printer sharing, calendaring, diagnostics, electronic mail, and station-to-station communications. Some features, such as station-to-station communications and diagnostics, are available from RAM-resident menus. Other utilities, such as electronic mail and group calendaring, run as application programs.

A network with distributed resources requires solid station-to-station communications. You have to be able to send a quick message to the person next to the letter-quality printer to ask if letterhead paper is loaded or to the person with a hard disk to ask if a file is current. We refer to this as 'rude messaging', because the messages interrupt you in the middle of your work. 10NET has an excellent rude-messaging capability; it's easy to use and also easy to lock out.

CB is 10NET's unique station-to-station capability. It allows network users to engage in multipoint public discussions over the network. A utility called CHAT allows private point-to-point on-screen real-time discussions.

TALLYS, NETSTAT, and NETLOG are three 10NET administrative features. TALLYS gives an immediate report on technical network parameters — such as the number of packets sent, received, and acknowledged; full buffers; collisions; bad packets; and statistical errors. NETSTAT describes the resources available to any user on the network. It displays the name of the node, users of the node, and the utilities available. NETLOG is a management tool that reports on the users signed into a network superstation. It gives a good picture and audit trail of the major actions taken by specific users on that station.

The new 10CACHE utility lets you set aside RAM on a station acting as a server for disk caching. A minimum of 70k RAM is required. The caching is effective, and an excellent cache performance screen gives statistical information you can use to 'tune' the size of the cache. The 10CACHE program can run in extended or expanded memory.

The 10SPOOL utility intercepts and holds printing jobs until the specified printer is ready. Several screens give the status of the jobs in the spool. You do have to remember to close the spool to send a job to the printer. We particularly liked that the spool program sends a message back when your job has finished printing.

At a glance

10NET, Version 3.3
Megabus Minicomputers
526 Hampton St
Hampton, 3188
Tel: (03) 598 5022
Price: Software, $1330.
Requires: For workstation: 192k RAM one disk drive, DOS 2.0 or later. For server: 296k RAM.
This flexible integrated network, with peer-to-peer resource sharing and DOS-based servers, has many features not standard on other packages; you must use 10NET hardware with 10NET software, and vice versa. Excellent printer-sharing utilities and unique group-calendaring features are included. Not copy protected.

10MAIL is a store-and-forward electronic mail system that runs on each individual PC but stores the message files it creates on a single shared hard disk. Text can come from a built-in text editor (with overwrite, insert, and full-screen cursor movement) or from a text file. But you cannot attach binary files to a 10MAIL message.

10NEWS is a simple electronic bulletin board that would normally be used by the network administrator to announce completed or proposed changes to the system. Anyone on the network can use it to make any type of announcement.

The 10NET calendar (a utility people ask for frequently and almost no other LAN vendors offer in their basic packages) allows each user to indicate free or busy periods on a public calendar. It's a handy way to schedule meetings, certainly beating the "When are you free?" telephone exercise that workgroups must frequently perform.

If your network needs are best satisfied by a network with peer-to-peer resource sharing and DOS-based servers, we recommend 10NET highly. It's perfectly suited for office or classroom applications.

3+Share

3Com's network operating system, 3+Share ($2034 for one to five users), doesn't fit neatly in the categories of network operating systems. The 3+ server software has MS-DOS at its core, and the workstations use the MS-Net redirector. 3+Share requires an investment in dedicated server hardware, for which it returns excellent performance. The latest versions of the software, 3+Share, Version 1.3, and 3Plus for the Macintosh, link MS-DOS-based and Apple products and make installation a snap.

3Com is working on its fourth generation of networking software. Bob Metcalfe, one of 3Com's founders, invented Ethernet, so the first generation was the development of the Ethernet/XNS protocol standard at Xerox. The second generation, 3Com's first product as a company, was EtherSeries.

The third, and present, generation is 3+Share, while the newly announced fourth generation is 3+Open/LAN Manager. Each generation has sought to include the emerging hardware and software standards of its time.

The development of the Ethernet/XNS protocol identified both the physical media and the protocol to accommodate the amount of data that Xerox envisioned in the paperless office of the future. With the second-generation Ether-

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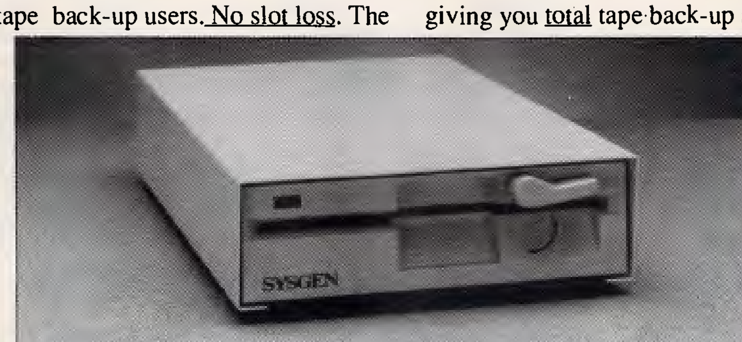

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Series, 3Com developed a network operating system that integrated DOS-based PCs into one network for sharing high-priced peripherals.

The original limitations of MS-DOS severely restricted the ability of Ether-Series and other DOS-based network operating systems from sharing data within an application running on a network. MS-DOS 3.1 and later versions try to address this problem by providing commands for both record and file locking.

Together with the enhancements to DOS, Microsoft and IBM developed PC-Net. PC-Net included three protocols and interfaces that became models, if not 'standards', for PC-based networks: the Microsoft Redirector, NetBIOS, and Server Message Blocks (SMB). 3Com incorporated these developments into its present networking software 3+Share, which retained the dedicated server concept and offered significantly better performance.

At a glance

3+Share, Version 1.3
Imagineering
77 dunning Ave
Roseberry, 2018
Tel: (02) 697 8666
Price: PC server is $2034 for one to five users, $3747 for more than five users.
Requires: For server: 640k RAM PC AT or compatible, one disk drive, extended memory card, DOS 2.0 or later.
This high-performance network operating system is recommended for dedicated service on 3Com server hardware. With features that include support for Apple Macintosh products and internetworking, product is easy to install and performs on a par with Novell's NetWare and Banyan's VINES in all but its management tools and statistical reporting. Not copy protected.

Core of the system

The core of 3Com's network operating system is 3+Share with its adjunct 3+Menus. The 3+Menus system lets the administrator build menus guiding the use of the resources of the network and local computer. The LAN administrator can use the menu system to design various degrees of insulation between novice users and both MS-DOS and 3+Share.

Besides 3+Share and 3+Menus, 3Com has a series of optional products. 3+Mail, an electronic mail package that is both powerful and simple to use, provides all the fundamental 3-mail message services as well as the ability to attach a number of DOS files to any message. 3+Remote is an add-on product giving people dialling into the server the capability to act as a local network workstation.

Easy to install

Version 1.3 of 3+Share, designed to support 3Com's new 80386-based server, uses the 80386 architecture by making 32-bit memory moves internally. Some of the best news is that the program is easy to install. 3Com's new line of servers (3S/200 and 3S/400) comes with all the basic software preinstalled, and you also get a copy of the software on disks.

Since DOS comes with 3+Share, you get ready-to-run workstation boot disks that bring you into the network. Install the cables and cards, boot the disks right out of the box, and you are 'on the air'.

The system comes up with menus and some users installed, and with applications ready to customise and install. System installation that used to take a couple of hours now takes just a few minutes (not counting cable installation).

Variety of modules

3+Share offers a basic suite of network services. It includes modules called the Process Manager, Concurrent Input Output System, 3+File, 3+Print, 3+Name, and Locator. They fully support the industry-standard MS-DOS file structure, the expanded network capabilities of DOS 3.1, the Microsoft Redirector, and NetBIOS. Adherence to these de facto standards ensures compatibility with all IBM PC-compatible software, all PC-Net-compatible software, and all applications written for NetBIOS.

3Com designed each level of 3+Share with software modules that conform to the OSI (Open System Interconnection) model. In a network workstation, 3Com implements these modules as standard DOS drivers loaded by CONFIG.SYS at boot-up. The networking software requires over 150k of RAM. If you buy 3Com's top-of-the-line network adaptor card (with 256k of on-board RAM), most of the drivers will run in the adaptor's memory.

The modularity of 3Com's protocols lets them support NetBIOS in two stages. Initially they emulated only the essential interrupt calls. Starting with

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Version 1.2.1 of 3+Share, 3Com's software supports the full specification, running NetBIOS on the workstation and the Locator module on the server. Most of the LAN-to-mainframe gateways now on the market need these resources.

The Process Manager (PM) module allows a network server running 3+Share to perform multi-tasking. It realises that not all tasks are equal — some are slower than others. By switching back and forth between tasks, the PM seeks to use hardware resources as efficiently as possible.

Both MS-DOS and the PC's BIOS were designed around single-tasking and one-at-a-time disk access. If multiple workstations needed to access a network disk simultaneously, the contention between them would cause the ROM BIOS to lock the system. To get around this problem, 3Com developed a Concurrent Input Output System (CIOSYS).

CIOSYS provides two main services. First, it queues and processes multiple disk access requests (according to disk location), using an elevator-type priority system. Second, it provides caching of both disk FATs and of most-recently used data. If the server has expanded memory, all caching occurs there.

3Com used the concept of a network name (the company calls it a 'sharename') as a way of sharing network resources. Any user can establish a sharename and assign it access rights and a password. Other users can then link a DOS drive (logical) to the sharename.

Network security depends on the system of access rights and passwords. The security system has another important aspect. Under 3+Share the root directory of each partition belongs to the server user. Thus no other user — not even the network administrator — has access to another user's home directory without permission. When a project member transfers to another project, the LAN administrator simply must change the sharename passwords (and distribute new passwords) to deny access.

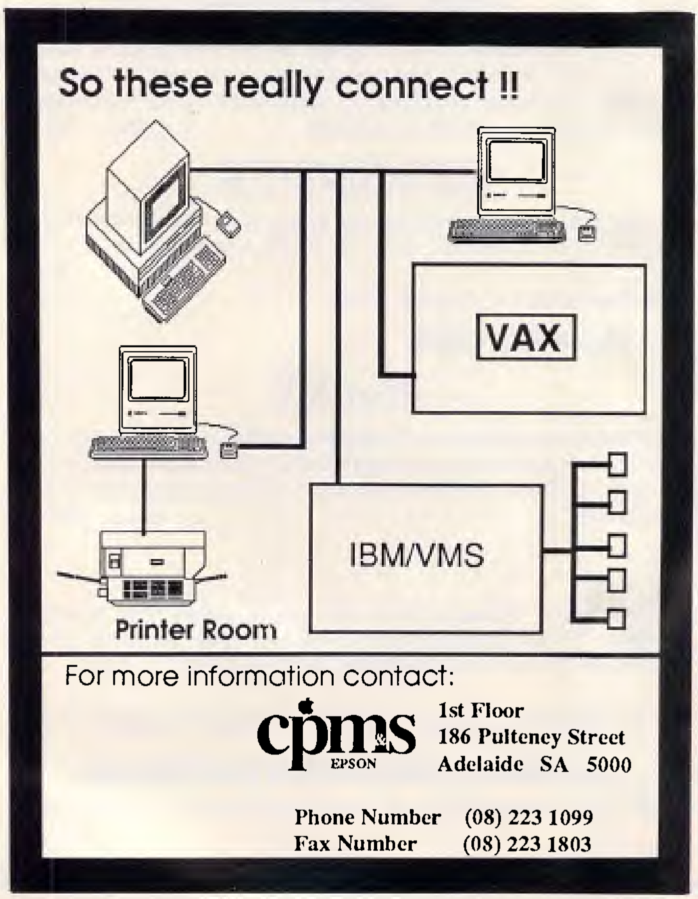
Dedicated server approach

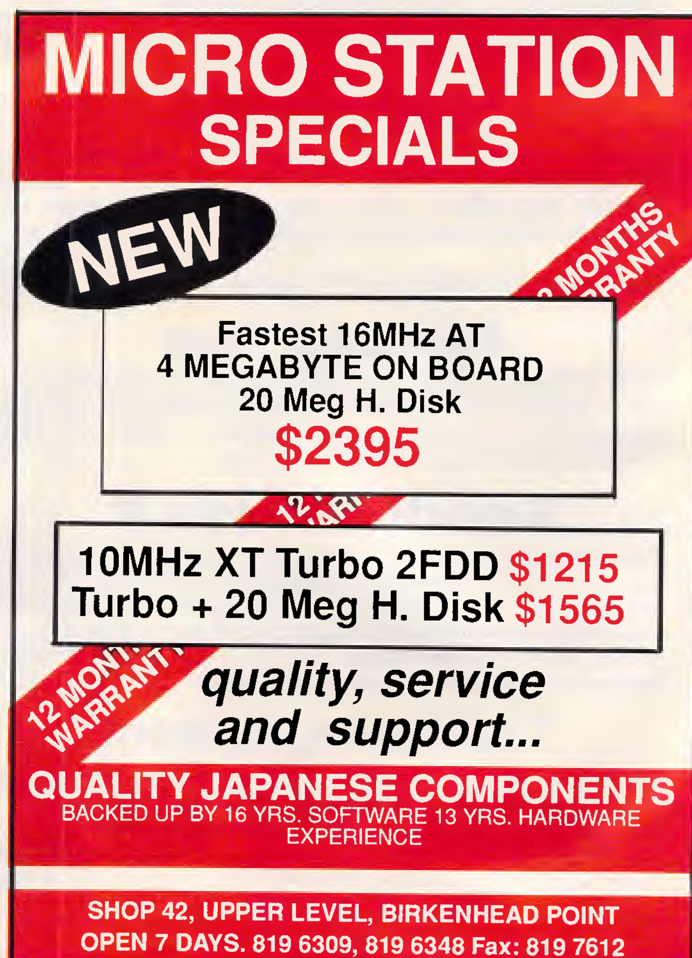
3Com designed its 3Server line of network servers as dedicated servers. Although the software allows you to use a PC as what the company calls a concurrent server — as both server and workstation — 3Com does not recommend doing so because the software is largely memory resident.

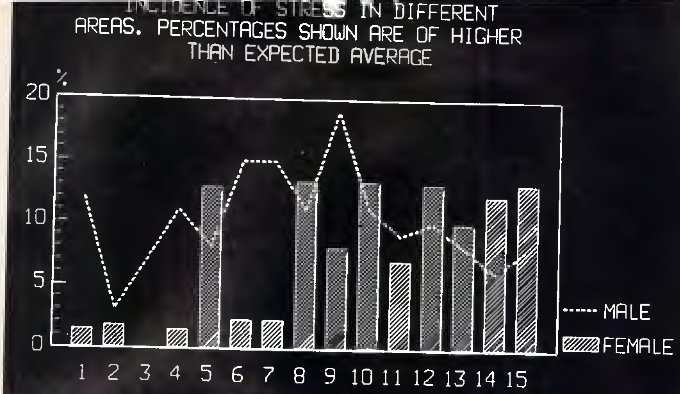
The dedicated server approach 3Com does recommend lets the parts of the DOS memory map reserved for slots, video memory, and other functions become available for use as RAM. The extra RAM allows the server to run more software and to have more buffers without resorting to expanded memory.

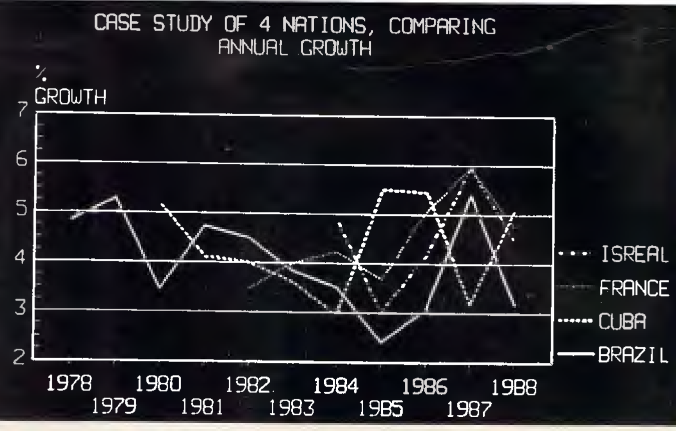
The 3Servers set expanded memory aside for caching. They cache both the FAT and the most recently used sectors of each partition. So a 3Server (with an 80186 processor) provides better performance than a PC Server (with an 80286 processor). It is also capable of running more 3Com program modules simultaneously and giving better performance.

One of 3Com's most-significant new products is the 3S/400 server, built around a 16-MHz 80386 processor. It represents a major design philosophy departure for 3Com servers. On the one hand, 3Com has added four AT-type slots to the server, adding greater ease of 'in-server media bridging' similar to that of Novell, using 3+Netconnect. On the other hand, it has upped the level of architectural sophistication. To improve









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performance and speed, 3Com has added mini/mainframe type features to the servers.

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3+ for the Macintosh

3Com, which puts an AppleTalk port on every 3Server, has introduced software to integrate Macs and PCs on the same network: '3+ for Macintosh'. Now Mac users can have all 3+Share services, including file sharing, printer sharing, and E-mail. They can tie AppleTalk hardware to the 3Server, and those with slotted Macs can insert a 3Com Ethernet card for the Mac.

3+ for Macintosh offers full internetworking features and security. The Mac user interface is compatible with Apple Share. Network Folders representing network resources appear on the desktop. You use the Chooser on the Apple menu to select the directory you want to operate in. If Apple and PC applications have the same file format, their data files are immediately available to applications on either or both machines. 3+ for Macintosh, though, does not do application-specific data file translations.

OS/2 extension promised

3Com and Microsoft are jointly developing the OS/2 LAN Manager, one of the promised extensions to OS/2, slated to provide network support. 3Com calls this system 3+Open. The approach to the extension assumes that the basic operating system on both the workstation and the server will be OS/2. According to 3Com, this assumption is in tune with IBM's LAN philosophy.

OS/2 has a programming interface called Pipes; 3+Open will extend these with Named Pipes. Essentially, Named Pipes associates names with software running on a workstation (or the server). This allows program-to-program communication and distributed processing. Overall, where 3Com tries to adhere to industry practices and standards, Novell attempts to create its own standards with specifications such as value-added processes. Where 3Com's designers worry about future flexibility and backwards compatibility, Novell looks for high capacity and power. Where 3Com designed products to provide interoperability with AppleTalk and Token-Ring, Novell sought media independence.

The only area in which Novell's NetWare and Banyan's VINES surpass 3Com's 3+Share today is that of management tools and statistical reporting. NetWare and VINES make it easier than 3+Share does for a manager to monitor the performance of a server, to control user entry, and to determine exactly who should pay for what. No doubt 3Com will remedy this imbalance with 3+Open.

TOPS

Using the TOPS interface card and software, from TOPS (formerly Centram Systems, now owned by Sun Microsystems), you can link PCs with Apple Macintoshes and UNIX computers.

Since the Mac has become a legitimate corporate tool, the $1315-per-node TOPS can be a valuable way for companies to share data and printers among PCs and Macs. Other developments are making such connections easier and Macs more valuable. In fact, new Macintosh computers have a built-in network interface port for the AppleTalk telephone wire connection.

The TOPS network interface cards for the PC work only with the TOPS software, and you cannot use NetBIOS as a standard interface card and other network operating systems. But the TOPS software works with several PC network interface cards designed for compatibility, including a new Hercules card called Network Card Plus (combining Hercules monochrome graphics and networking) and Apple's own AppleTalk card for the PC.

The software provides the translation facilities enabling the different vendors' machines to share files and peripheral devices. TOPS, with an architecture designed for flexibility and simplicity rather than speed, can link up to 32 computers on the network. You can bridge the network, with multiple networks mixing any of the supported computers. TOPS provides specialised software for each of the different vendors' machines, allowing them to run on the network.

TOPS acts as a standardised environment, providing universal file-access protocols. It handles the problem of incompatibility between systems by translating local requests of a certain machine's operating system into a re-

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FOXY

quest it recognises in any machine on the network.

The TOPS network is a peer-to-peer network, meaning that any workstation can share or use any other workstation's files and devices. The latest version, 2.0, lets any station on the network make an attached printer available to the network.

If you use a PC or compatible, your applications can use TOPS to access data stored on another PC or on a Macintosh. You can refer to a Mac's drive just as you would a floppy or hard disk on your own PC. If you are using a Mac, PC volumes appear on the Mac screen as disk icons just as if they were on the attached drives of the Mac.

TOPS for the PC, or TOPS/PC, is a functional, basic, easy-to-install network for PC-to-PC networking alternatives, but it isn't as expensive or difficult to maintain as some of these alternatives are. TOPS/PC lacks, however, the electronic mail, calendaring, security and administrative features found in competing PC-only products like 10NET.

Software modules

The TOPS networking software modules intercept certain DOS calls, redirect them out through the network, and answer requests for services coming in through the network. Some modules give users an optional menu of service;

At a glance

TOPS, Version 2.0
Imagineering
77 Dunning Ave
Roseberry, 2018
Tel: (02) 697 8666
Price: For network software required to put one PC on TOPS Network, $360; hardware interface product, $595; $360 for TOPS teleconnector, which is required for use of network.
Requires 200k RAM, one disk drive, and DOS 2.0 or later.
Designed for flexibility and simplicity rather than speed, TOPS offers a valuable way for companies to share data and printers among networks comprising up to 32 PCs, Macintoshes, and Unix computers. This software/hardware matchup is best recommended for PC/Mac file exchange, PC integration into Mac networks, and access for PCs to Apple LaserWriter products. Not copy protected.

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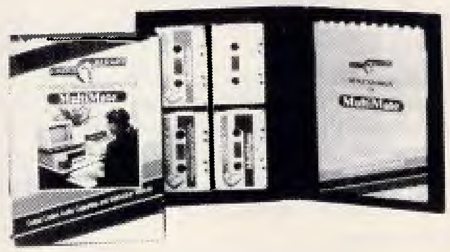

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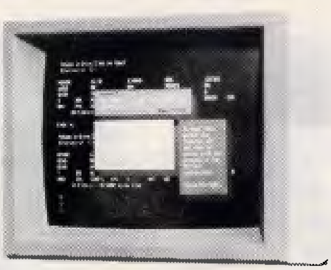

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others accept inputs from the DOS command line or batch files. A background print-queuing module holds printing jobs until the networked printer is ready to accept them.

Several TOPS program modules reside in memory in each networked station, taking about 192k RAM away from applications in a PC workstation. However, keeping these programs in memory lets them operate nearly invisibly in the background mode. TOPS offers a way around the loss of this memory through the use of a HIcard. In a typical installation, the HIcard makes 629k RAM available for DOS and applications.

Interface

TOPSMENU, an interface for end users, consists of a series of menu and submenu options to manipulate the TOPS system. The main menu is divided into Client and Server options. A Client is a station using a volume (directory or subdirectory) published (made available for sharing) by another station. A Server is a station that has made files on its disk drive public or available to the network.

Using the Client submenu, you can list the available servers on the network, list the volumes published on a server, attach to a volume so it becomes a virtual disk drive, choose an access mode (read-only or read/write capabilities), and detach from a volume.

On the Server submenu, you can list directories on a drive, publish a directory to the network, list clients attached to your networked drive, make parts of a drive unavailable, change a password, and perform other functions. TOPSMENU allows you to address designated files with an 'alias' (normally a meaningful title like RECEIPTS) instead of requiring you to know path and file names.

To accommodate more-advanced users and to automate TOPS instructions through batch files, TOPS has a commandline interface that offers all of the functions accessed through TOPSMENU. The word TOPS serves as a prefix to all the TOPS commands, and you activate the command interpreter, TOPS.EXE, when you type TOPS followed by a command and its parameters on the command line.

The inelegant security scheme is more effective against operator errors than determined attempts at access. You can optionally attach a password to the files you make available to the network. Additionally, you can specify if users have only read or both read and write privileges.

At a Glance

***ViaNet Networking** Operating System, Version 3.06*
Vianetix
222 LaTrobe Street
Melbourne, 3000
Tel: (03) 667 0218
Price: $240 per node.
Requires: 128k RAM, one disk drive, DOS 2.1 or later.
This DOS-based network allows any node to contribute resources; it's easy to install and use if you know DOS, but performance is only average. Unique strengths include the ability to tie Unix, Xenix and DOS machines in a resource-sharing network and its use of a visual DOS-tree structure for using those resources. Not copy protected.

Some uses, not others

If you want to do a lot of database management over the network, we recommend using a system other than TOPS. If you want to use a 3270 LAN gateway, we think you can find better connectivity alternatives.

But if you want to exchange files between a PC and a Mac, integrate a PC into a predominantly Mac network, or give PCs easy access to Apple LaserWriter products, TOPS is an excellent choice.

ViaNet Networking Operating System

Like 10NET and TOPS, ViaNet Networking Operating System, from Western Digital for $240 per node (plus network interface card), uses MS-DOS as its base but is not derived from MS-Net. ViaNet is a mature operating system that is easy to set up and, partly because of its DOS kinship, easy to use.

Also like 10NET and TOPS, ViaNet is the product of a small company that was later acquired by a larger firm. Western Digital now owns the company, but other vendors still sell and support ViaNet with their own hardware.

Versions of ViaNet are also marketed for UNIX and Xenix systems. According to the documentation, files and directories on nodes running under UNIX or Xenix appear on the directory of DOS-equipped machines on the same network. This doesn't guarantee file compatibility for application programs, but it does allow file

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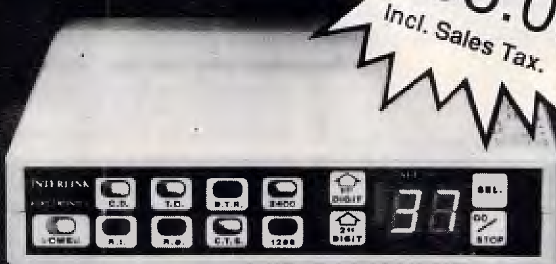

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access, file transfer, and printer sharing. ViaNet also includes a virtual terminal facility, so PCs can use the network attachment to act as terminals and run programs on a UNIX or Xenix host.

Multiple marketing channels means that several versions of ViaNet are available. Western Digital now markets a version of ViaNet to integrators that is able to drive any networking card having a NetBIOS interface.

Resource sharing

ViaNet allows any workstation on the network to share resources with the network (although typically only machines with hard disk drives act as print spoolers). The authors of the ViaNet documentation clearly appreciate the complexity of managing a network in which stations also act as servers; they give you a series of forms to document and describe the available resources of every station. The program disks include the forms in ASCII files.

Western Digital made a smart move when it added the programming commands and syntax Microsoft used in MS-Net (and therefore those that IBM used in the PC Local Area Network Program) to ViaNet's command structure. The same training, experience, and batch files gained with MS-Net-based products carry over to ViaNet.

ViaNet has a unique method of displaying available resources. When your workstation enters the network, the network becomes drive Z:. At sign-on, you are shown a directory of all subdirectories on drive Z:. These subdirectories are actually the node names of computers on the network making resources available to the network. ViaNet lists them by the node names the network administrator assigns.

To access these resources, you use standard DOS commands like Change Directory (CD). After you change directory into the node name, you see as subdirectories the resources available on that node, for example, A, B, C, LPT1. Executing another change of directory links you into the resource. To access files on the C: drive of a computer with the node name of IBMPCAT, for example, you sign on to the network and look at the directory of the Z: drive. If IBMPCAT is in the directory, you know the machine is operational and available. Typing CD\IBMPCAT\C links your virtual drive Z: to the C: drive of the AT.

Any application running on your machine can access the AT's C: drive by sending DOS requests to your Z: drive.

One interesting aspect of this approach is that you can set a DOS PATH to several resources simultaneously. In this way, you can draw program files from one server and access data files on another server without using complex server-naming schemes.

ViaNet holds the names of the resources available on every workstation in a .SYS file on each individual machine's local drives. The network administrator makes devices available or unavailable to the network by editing this file. The administrator can substitute network names for network directory path strings. Changing directory into the network name ACCOUNTS on the Z: drive can take you through a much more complex nesting of subdirectories linked by the administrator with the ACCOUNTS network name.

Entries in the .SYS file also determine file and directory protection. ViaNet assigns individual read and/or write access rights to individuals and groups. The ability to link individuals with a group having certain rights makes moving and deleting users easier.

ViaNet's print-spooling utility is efficient. You send a file to the networked printer from within an application program by hitting Ctrl-Alt-PrtSc. A programming command, VIAPRINT, then sends an existing text file to the print spool. This command may include arguments that put the text into a predefined form for printing or that modify the text according to a specific format.

You pay a price for ViaNet's flexibility. On our IBM PC AT running DOS 3.3, the networking software and DOS used about 178k of RAM.

We like ViaNet. It's easy to install, and

At a glance

VINES, Version 2.11
Datacraft Australia
Maroondah Hwy
North Croydon, 3136
Tel: (03) 727 9111
Price: Priced according to server, but approximately $3500 for ten users.
Requires: For workstation: 256k RAM, DOS 2.0 or later. For server: 2Mbyte RAM, hard disk, and one floppy disk drive.
This powerful LAN operating system is best run on a Banyan server with a 68000 series processor. Version 3.0 will add new management tools, the ability to have networked printers on workstations, and improved performance. VINES' communications capabilities are particularly strong. Not copy protected.

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users comfortable with DOS find it easy to use. Its unique strengths include the ability to tie UNIX, Xenix, and DOS machines in a resource-sharing network and the use of a visual DOS-tree structure for using those resources.

Overall, ViaNet's performance is no better or worse than the average DOS-based operating system with nondedicated servers. Yet since ViaNet did not handle small data block activities (like those of a multi-user on-line database) as efficiently as other programs, its overall performance on our benchmark tests looks worse than our practical experience indicated.

VINES

VINES, from Banyan Systems, is the most minicomputer-like LAN operating system we reviewed. While a version of the $3500 (for ten users) program is available for the 80286 processor, the operating system comes alive when a Banyan 32-bit server with the Motorola 68000 series processor is its host.

A VINES server is a dedicated machine requiring a separate RS-232C connected terminal for controlling and monitoring the UNIX-based operating system. Each separate feature of VINES, like electronic mail or 3270 communications, runs as a separate task in the server.

This review examines VINES, Version 2.11, and looks at the features Version 3.0 will offer. (We also examined a beta version of VINES 3.0, which should be on the market by the time you read this review.)

VINES is powerful: one machine functions as print server, file server, and communications server. (Print server functions will be distributed in VINES 3.0.) VINES has no peer-to-peer sharing of disk drive resources between workstations. The UNIX operating system takes care of multi-user, multi-tasking operations.

Each time the VINES server is turned on, the software examines the hardware configuration in the server and reads in the right drivers and interfaces for the hardware. The server can internally bridge up to four network interface cards. VINES doesn't offer the wide variety of drivers for different interface cards available in Novell's NetWare (Novell has more than 30) but the program can automatically address the 17 most-popular interface cards. The server start-up routine takes several minutes, but it is almost completely automatic and, in our experience, trouble free.

Editor's choice

- **SFT NetWare 2.1**
- **10NET**

Because networking software clearly falls into two categories, dedicated server and peer-to-peer, we've selected one Editor's Choice for each. Both of these front-runners had better keep up the pace, however, because two dark-horse candidates are sneaking up on the inside.

If you need the power of a dedicated server, then the speed, efficiency (on an 80286 processor), and features of Novell's SFT NetWare 2.1 make it an easy choice. NetWare, in its many versions, is compatible with a wide variety of hardware, and includes utilities ranging from menus to mail, and now has features previously available only in minicomputer operating systems. These capabilities include producing network statistical reports, allowing access according to time and date, and assigning costs for services according to usage, storage, and connection time. The SFT NetWare 2.1 we tested lists for over $8000 and takes patience and perhaps training to install, but it is an industrial-strength product that is equally effective moving a byte or a gigabyte of data.

While SFT NetWare 2.1 is impressive, the most promising challenger (not reviewed here, but tested with a view to a full benchtest in a forthcoming issue) in the dedicated server category must go to Univation's LifeNet.

LifeNet has delivered an operating system able to use the 80386 processor in protected mode and is shipping what appears to be a practical database server system using the DataFlex DBMS., but what it does have is impressive.

In the peer-to-peer category, the standard features and steady performance of 10NET give it the nod. The 10NET software includes one of the best calendaring packages in the industry and many other features like chat, electronic mail, a good disk cache, performance reporting and some diagnostics. At $1330 per node (hardware and software) it is fairly priced, but not a bargain.

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Full plate of features

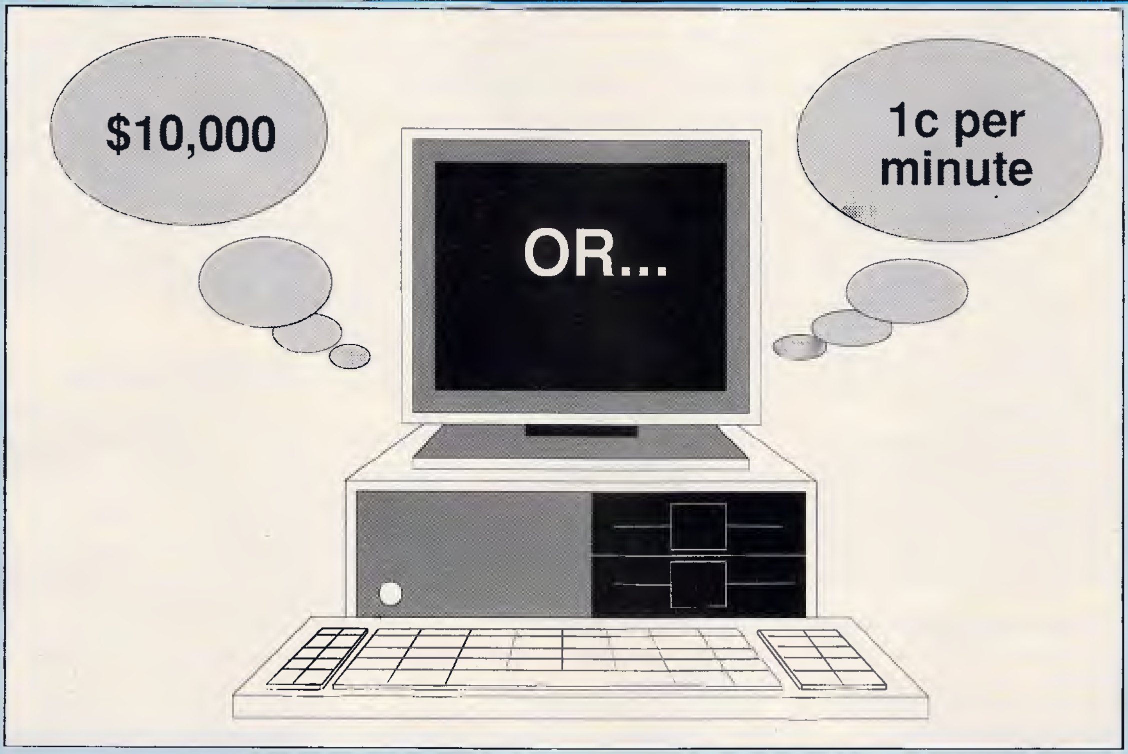
The VINES product line includes a full plate of features and enhancements. The 'Base VINES' system includes Net manager, a powerful administrative and troubleshooting utility, a good menu system for users and supervisors, NetBIOS emulation services, and excellent performance.

Many options are available, including an excellent electronic mail package and various communications capabilities that, for instance, allow for a lot of communications between the network and other devices or between multiple network servers. Whether you want to hang shared modems off the server, bridge networks, or make 3270 connections, VINES gives you a good way to do it.

VINES also features one of the best remote dial-in facilities in any network. You can call into the network using a laptop in a phone box and have virtual drives and full use of the network. Use caution choosing what tasks you do, because every action tries to push a lot of packets through a slow telephone line; if you have the time, though, you have the access.

Despite the system's internal complexity and power (or maybe because of it), VINES is easy for both end users and system administrators to manipulate. A relatively complex naming scheme for servers (StreetTalk names in Banyan's terminology) allows you to find and use files, printers, and services like electronic mail and NetBIOS. Virtual links between DOS names on the workstation and resources on the servers are easy to make, either through the menu system or through direct commands. The operating system, in addition, keeps detailed profile information on every user.

VINES' commands for programming the operating system are similar in concept and syntax to those of MS-Net. Issuing a SETDRIVE or SETPRINT command, for example, connects the workstation's drive or printer port with a networked drive or printer. VINES gives networked resources ranging from printers to subdirectories, and NetBIOS services what Banyan calls serve names. You can access the service names through SETDRIVE and similar commands.



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A user profile stores the links established through direct programming, or through the menus, which do the same things in more-structured steps. The user profiles and service names make it easy for a network manager to make changes to the network.

A peek at 3.0

Release 3.0 of VINES, which we saw as a beta version, is a substantial change to the program. Banyan's press announcements detail over 100 'improvements, enhancements, and features'. The most interesting are in the areas of security, management, and (even more) communications interfaces.

The VANGuard security module gives the network administrator options typical of those available in mainframe operating systems. The administrator can limit the access time, force password changes, and perform other security practices.

VANGuard wisely encrypts passwords during transmission. The encryption scheme changes, so replaying the passwords won't work. Encrypting passwords is another improvement.

Our benchmark tests of the current version of VINES show good performance, but the system slows down disproportionately in our small-block-size (512-byte) transfer exercise. New code in VINES 3.0 promises to significantly increase the speed of small data block transfers.

Banyan's software designers made a smart move when they added an option allowing you to share network printers attached to nondedicated PCs on the network. Physically, this means you don't have to cluster all the printers next to the server. Operationally, it means that you don't have to burden the single server with printer communications management.

The remote shared printers operate much like those physically attached to the server. The print job queue remains on the server, but it doesn't have to handshake with all those printers. On the PC, a 7k background program accepts text from the server. The program senses activity on the PC and slows down printing to give priority to the foreground PC application.

Because of its strength in communications, Banyan is a leader in providing Transmission Control Program/Internet Program (TCP/IP) services through a LAN. Banyan's new TCP/IP routing option allows a single Banyan server or a network of Banyan servers to connect multiple TCP/IP networks. This capability means that the network server can eliminate the need for a wide area network routing computer. A new Banyan TCP/IP server-to-server option lets people with access to TCP/IP networks link servers over the network. Thus, local area networks become worldwide networks.

Making inroads

Although Novell's NetWare clearly leads the LAN software industry in sales, companies like Banyan are making sure Novell doesn't become complacent. With Version 3.0, VINES will have new features, speed, and maturity. We don't recommend running VINES on anything but a Banyan server and we sometimes dislike the syntax of the commands, but otherwise VINES gives us no reason to complain and many reasons to applaud.

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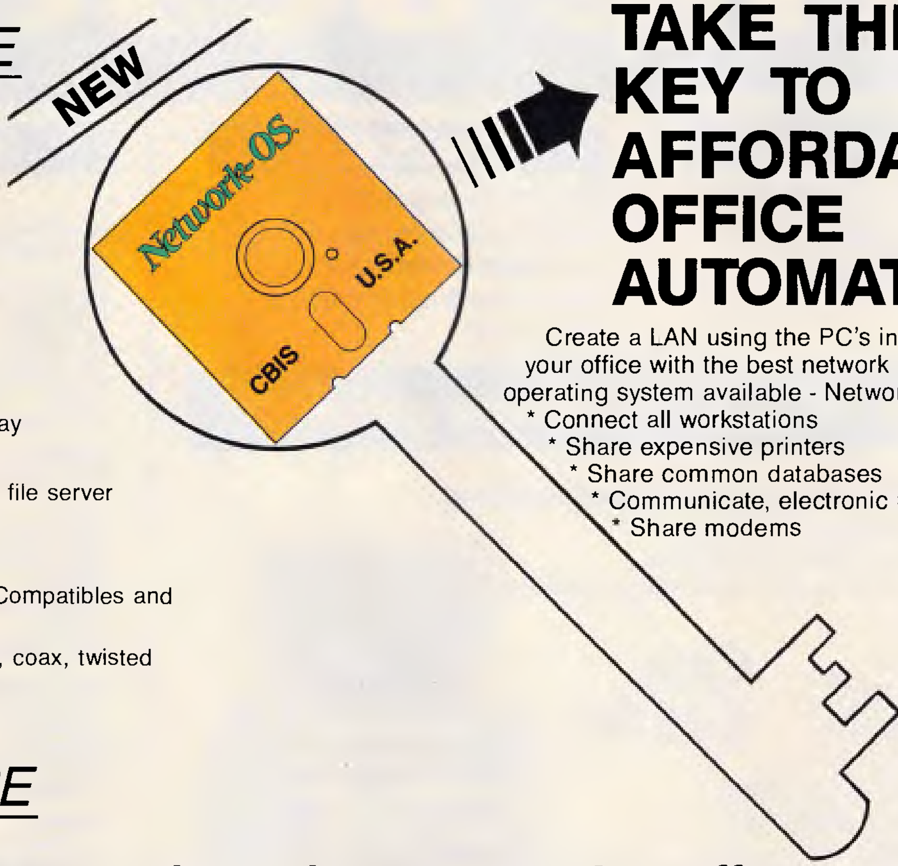

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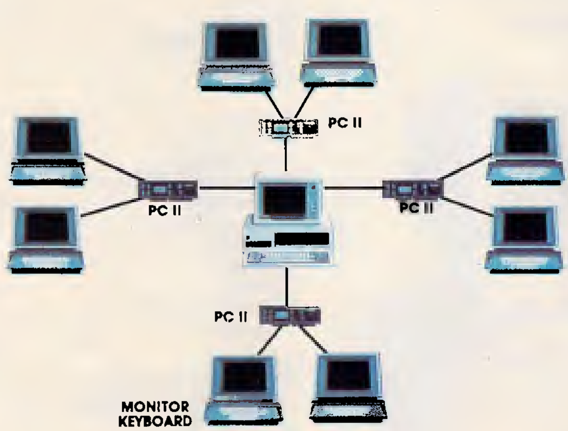

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The future of networking

Unlike their hardware counterparts, software houses have dragged their heels in providing good-quality network solutions. Robert Piper feels that OS/2 could release their inhibitions.

Networking PCs is often painted as the total solution to office integration, but as you might have suspected, the path to the solution is full of pitfalls. The biggest problem is hardware selection, but if you think that once you have cracked this nut you are on the home straight, be warned. The network-compatible applications packages you are going to need are not quite as plentiful as the software houses would have us believe.

This might sound rather surprising in these days when the IBM PC has effectively released us from compatibility problems, but software that can be used by groups of people, referred to in network parlance as 'workgroups', is rather different to that designed for just one user. The snag is that despite the tremendous advances in networking hardware, the software houses have not kept up with the pace in producing applications packages capable of running reliably on a network.

There are several software-related problems but the most significant is that several users may demand simultaneous access to one file located on the network's central hard disk or file-server. There is a danger of the file's contents being corrupted if two users, unbeknown to each other, simultaneously try to make changes and save them back to disk.

In the case of a program file, a very different problem arises. If two or more users try to run the same copy of Lotus 1-2-3, the software licence is being violated. Effectively, one copy of the program is being used by more than the one operator the licence allows. If the software houses allowed users *carte blanche* on network installations, their revenues would practically disappear overnight, so a complex arrangement of site licences has been set up by many but not all suppliers.

Data security

Imagine the situation where two users in separate offices have called the same record from the company's client-address database. User 1 wants to check the address for a letter, User 2 wants to update it. As User 1 takes down the old address, User 2 starts to make the modifications to create the new one. What happens in this situation depends on the sophistication of the applications software being used.

If you are running single-user software the results are somewhat unpredictable. One thing is for sure: there is no way that User 1 will get to know about the change until User 2 has saved the record back to disk. There is also the risk of the record being corrupted, especially if both users were to try to make changes.

> *'The OS/2-based network will certainly be easier to use thanks to a consistent windows-style user interface.'*

Simple networking software offers what are called file and record-locking procedures which block access to data already being used by someone else on the network. This system works at two levels. In more obstructive, but safer, file-locking systems the second user trying to gain access to a file is blocked by a message like: 'This file already in use'. This approach is sometimes made less impenetrable by admitting subsequent users to the file but on a read-only basis. In record-locking systems the file is open to all, but individual records are limited to one current user.

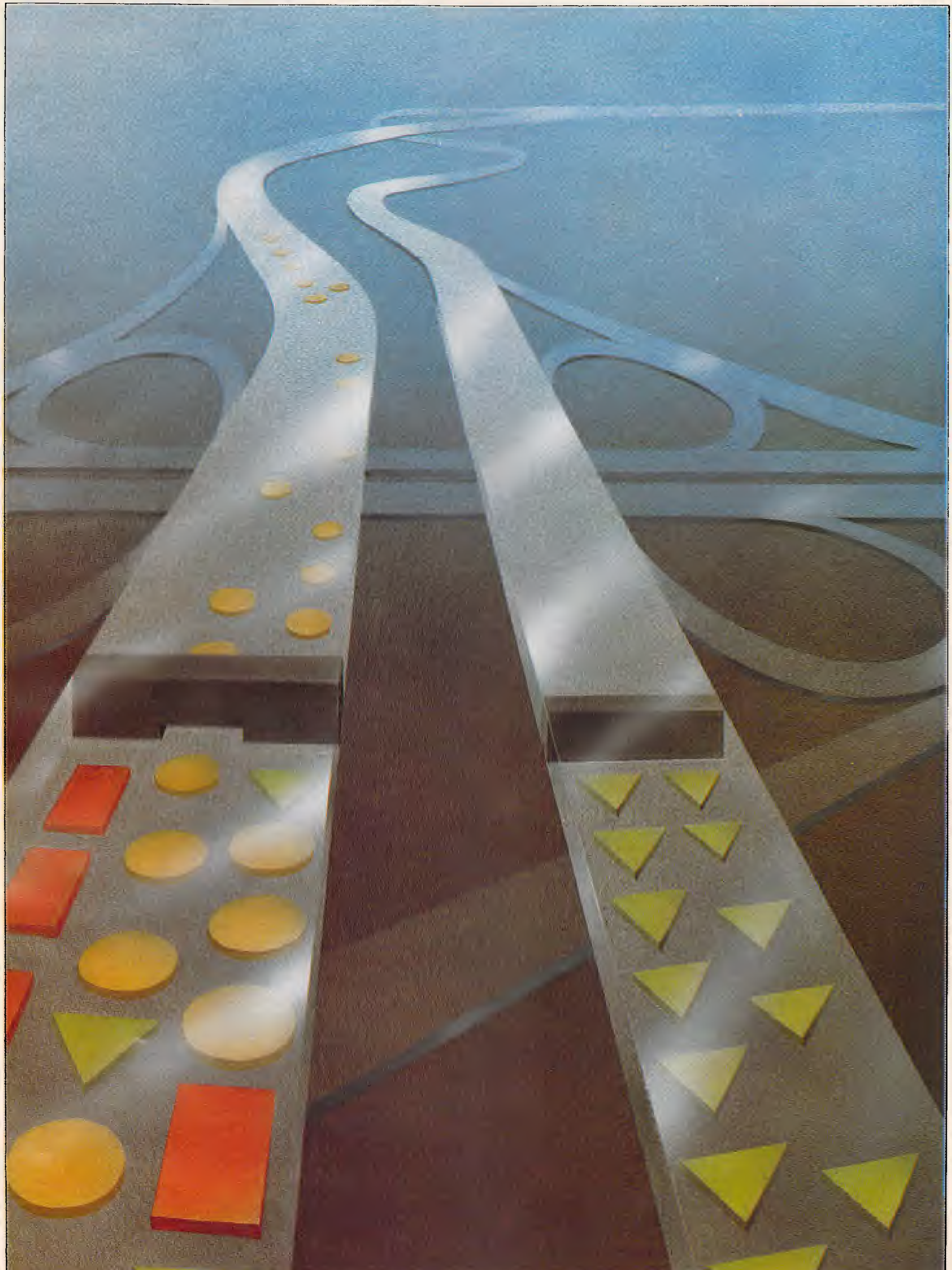
As we go further up the sophistication ladder so the security systems begin to shed their inhibitions. If User 2 makes changes before User 1 has finished reading the record, the system will notify User 1 of a problem. This either takes the form of a message at the bottom of the screen, like 'Please reload record — changes have been made by another user', or a demand that the user calls for an update before leaving the current display. Either system ensures that User 1 is notified about the change of address.

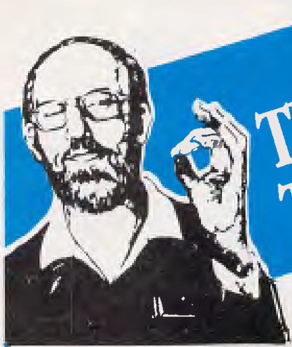
The ultimate system, which is found on a remarkably small number of PC applications, alerts the first user and then automatically updates the record without having to rewrite the screen totally.

The mechanics that make file and record-locking possible are quite complex and get more so when there is a possibility that both users might try to change the record at the same time. Most databases process individual requirements independently, recording the value to be changed, taking it away, processing it and then replacing the original value with the new one. But if one user tries to modify a data item a split second after another, the two update cycles could overlap so that an erroneous value is replaced in the record.

Automatic write-locking prevents this by locking the record once one update cycle has started. If another user tries to modify a field during this period, a message is displayed instructing him to wait. When the original update cycle is complete, the second user is granted access to make his own changes. The time length of these 'locks' can be increased or shortened as required and the delay is called a 'waiting period'.

There are circumstances when automatic locking can actually hang up two users altogether when two files are open. This occurrence is referred to





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rather sinisterly as the 'Deadly Embrace'. Take, for instance, a situation where User 1 performs a database operation which updates File 1 followed automatically by an update to File 2. User 2, on the other hand, wishes to update File 2 first and then File 1. In this case User 1 will be waiting for User 2 to finish with File 2 and User 2 will be waiting for User 1 to finish with File 1; total stalemate. This problem can be avoided through the inclusion of a 'time out' feature which aborts the update operation and removes the associated data locks after a period defined by the user.

Other security considerations which should be incorporated into network compatible applications software include passwords to prevent unauthorised users gaining access to sensitive files. It is also useful if the software supports the messaging system used by network operating systems like Novell.

To make the most of a network's facilities the software should support advanced print-spooling techniques. This means that documents created by users on the network can be placed in a queue for production on expensive peripherals like laser printers. This process keeps the output devices busy and also enables supervisors to allocate priorities by making sure that important documents can jump the queue.

Licencing

Problems with software licencing have been approached in rather different ways. The most common method is to offer LAN packs. These include all the necessary single-user software plus the additional network support utilities for the specified number of users.

One point to watch here is that some software houses include only one set of documentation, and with users spread all over the building this may prove to be rather impractical.

Other software houses, the most notable example being Microsoft, take a more open approach and state that their package can be installed on a single PC or a network file-server. These applications can be used by all the PCs attached to a server, a policy which can cut your costs quite dramatically. This approach also means it makes more sense to buy a few high-performance file-servers rather than a greater number of low-capacity units.

Compatibility

Another point to consider when purchasing 'network ready' software is hardware/software compatibility. Al-

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NETWORKING

though problems in this area are on the decline, thanks to more widely accepted standards such as MS-NET and NetBIOS, it is just not worth taking any risks. Make sure the networking hardware you are using is supported by the application you intend to purchase. It is best to take assurances from dealers with a pinch of salt — if things go wrong, trying to find anyone willing to sort out the problems on unsupported hardware could be very difficult.

Bear in mind also that problems which arise in a network may remain invisible for some time. A faulty network installation can introduce errors into your valuable data for a long time before the mistakes are actually detected.

Most software houses support networking hardware standards such as the IBM PC Network, IBM Token-Ring, Novell, 3Com 3 Plus and Ungermann Bass. On top of this the applications package should work with the networking software, and the big names here include the IBM PC LAN, Novell Advanced NetWare, 3Com Plus and MS-Net.

The future

While many of the major performance limitations of the current generation of network software packages can be attributed to half-hearted efforts by their authors, there are more deep-seated problems that are beyond the control of the writers. Probably the most significant of these lie in the MS-DOS operating system. When used in conjunction with NetBIOS this has proved an adequate rather than outstanding platform for networking applications.

The situation looks like improving dramatically when its replacement, OS/2, is fully up and running. It is no secret that many software houses have been shifting resources away from the MS-DOS environment in favour of the new contender. This could explain the number of single-user MS-DOS packages which have simply been tweaked to run on a network; the software houses have been saving the best up.

OS/2 has its own networking software called LAN Manager and, together, this formidable duo possess many useful features for aiding security and performance. In fact, it is claimed that networking will provide the first real challenge for this powerful operating system. Whereas Microsoft's MS-DOS networking product, MS-NET, works well enough in terms of workstation requirements, OS/2 should bring about a significant improvement in the performance of file-servers.

OS/2 can undertake several tasks concurrently and it is this facility that LAN

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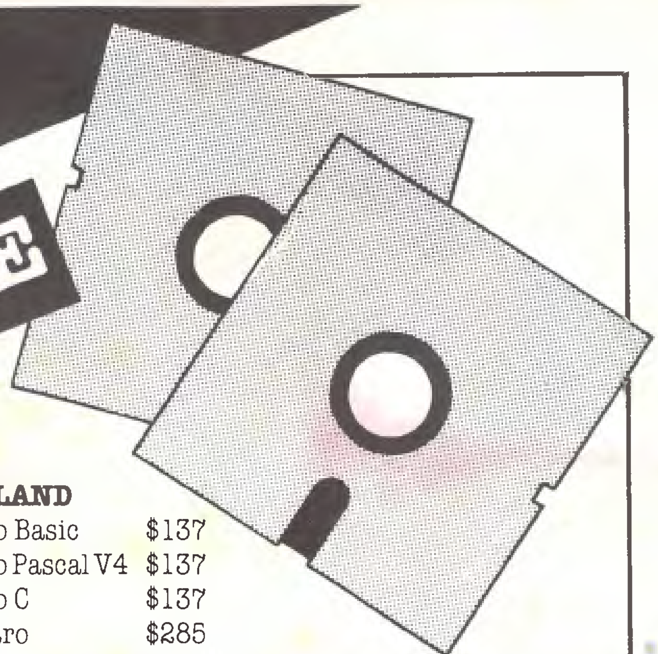

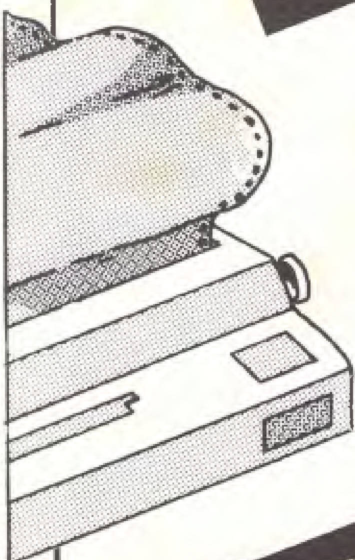

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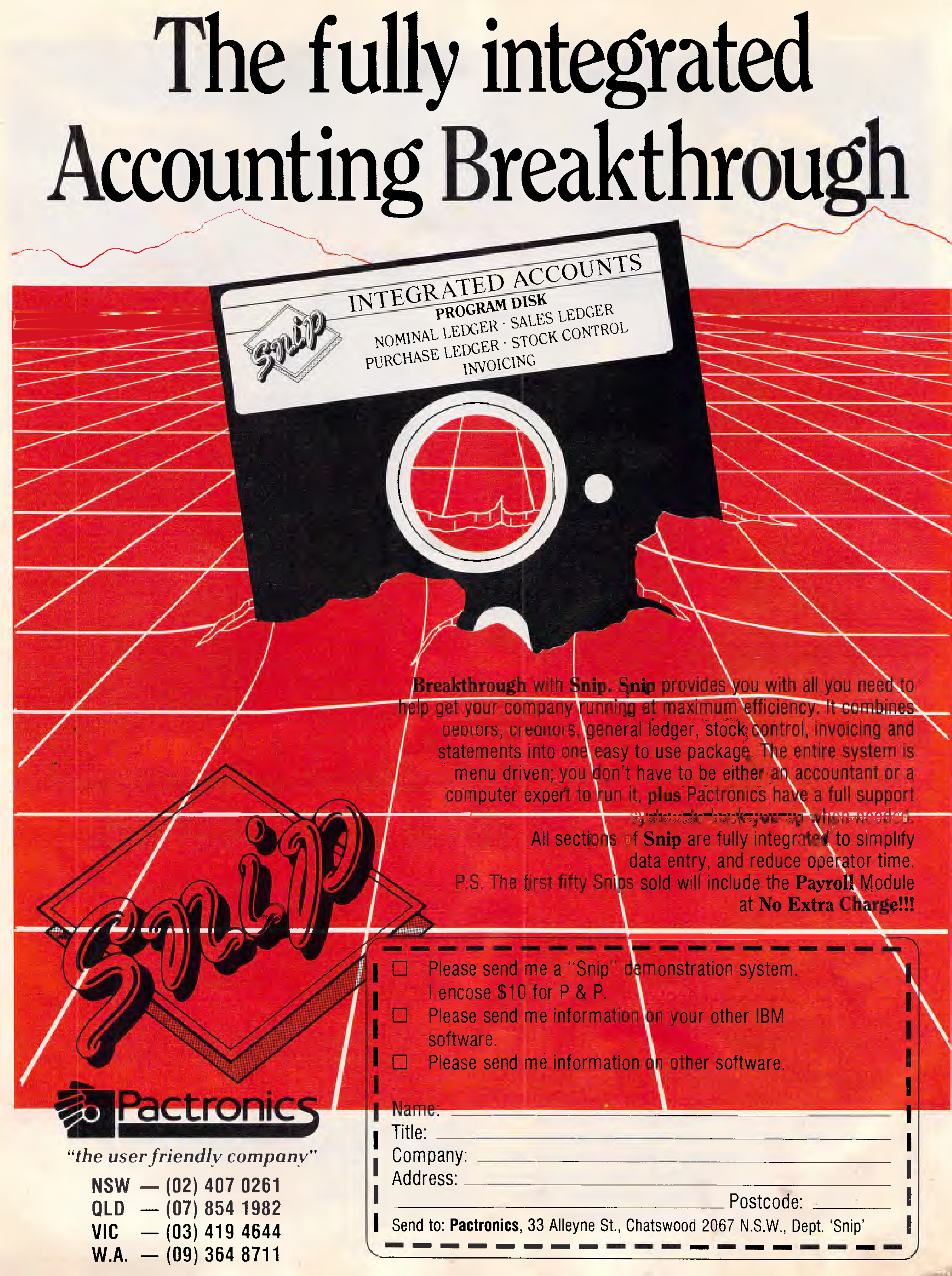

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Manager will exploit to good effect. OS/2 includes two special features for networking: 'threads' and 'pipes'. Threads are separate operations within a program which, instead of running one after the other, can be set to work concurrently.

With this approach the results arrive faster and can be placed in a 'pipe' which works as a buffer between different modules of a program. Data either can be written to or read from a pipe, much like a disk file but a lot faster. Another advantage of the pipe is that it can be used to transfer information from one module to another.

The OS/2-based network will certainly be easier to use thanks to a consistent windows-style user interface. System security will be improved by more formal logging on routines, group and sub-level access permissions, and network audit trails.

Applications packages will also undergo change. Already there is a shift towards database software that supports the Structured Query Language (SQL). This enables a database to be interrogated in exactly the same way irrespective of the hardware it is running on, be it PC or mainframe. dBASE IV includes SQL support and it seems likely that this will be a pre-requisite for future mainstream database packages.

Ashton-Tate and Microsoft have joined forces to develop an SQL Server package which takes full advantage of OS/2 and takes much of the normal data processing work away from the user workstation and into the file-server. This gets around one of the traditional snags of the database: the high level of network traffic caused by frequent requests for data and the failure of the server to deliver the right data first time round. SQL Server shifts intelligence from the PC workstation to the file-server, reducing traffic.

Conclusion

Although these developments look like changing the face of PC networks, the old standards are not about to be dumped unceremoniously. MS-DOS networks will be around for some time and are supported under LAN Manager.

So far, the quality of networking hardware has outstripped that of the applications software. What packages there are can be seen as competent, but security considerations make it difficult for them to unleash the full potential of the network concept. OS/2 and LAN Manager should dramatically improve this situation, but it is not going to happen overnight.

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7 or 8 bits */ int
/* buffer for chars being read */ int
char **argv; { int

Dynamic memory management in C

David Fox shows how to use C's built-in memory functions to produce better programs, plus some debugging code to make using them easier.

Memory management is the process by which programs keep track of where the data they need is stored in the computer's memory. When the correspondence between data and physical memory locations changes during the execution of a program, its memory management is said to be dynamic.

Some pitfalls are waiting for you when you use C's memory management tools, but there are techniques for avoiding them.

C memory management and memory functions

Much of the memory management done by C is transparent to the programmer. For example, the declaration *int i;* reserves one word of memory to store the value of the variable *i*. If this declaration occurs outside a function, then other functions can access *i;* in this case, *i* is an external, or global variable. If the declaration occurs inside a function, the word used to store *i* is allocated on the stack. Here, the allocated memory is available inside the function, but discarded when the function returns, making it available for use by another function.

This sophisticated memory management scheme requires no effort on your part: you simply declare a variable, and it is available wherever the declaration is in effect. In addition to the built-in memory management through global and local declarations, the standard C library contains several functions that give the programmer access to the heap. These functions are listed in Table 1.

The *malloc()* function returns a pointer to a region of at least size contiguous bytes of memory that can be used in any way you see fit. *Free()* returns a block of memory to the heap that was obtained by *malloc()*. *Malloc()* and *free()* are the same as *new()* and *dispose()* in Pascal. *Realloc()* changes the size of a block of memory reserved by *malloc()*. The memory block requested can be larger or smaller in size. It is important to note that *realloc()* may modify the pointer to the memory block. If this happens, the contents of the original block (up to the smaller of either the old or the new block size) are copied to the new location. Finally, *calloc()* provides an alternative to *malloc()* when requesting a block. It differs from *malloc()* in two ways: it uses two arguments to specify the block size; and it zeros the contents of the allocated memory block.

> 'Using C's dynamic memory management functions results in programs that are portable and adapt to the amount of memory available on the host computer.'

Advantages of the memory function

Why would anyone use these functions when C has built-in memory management for variables? One answer is that a C compiler can allocate only fixed amounts of memory for a program when it is compiled. For example, suppose you have written a program for sorting a list of numbers. Before the numbers are sorted, they are read into an array in memory that's declared as *double numbers[1000];*.

This array works fine until you need to sort a list of 1001 numbers. To fix the problem, you can change the declaration to *double numbers [5000];* and recompile the program. This solves the immediate problem of sorting the larger list, but it introduces a new problem: the rest of the memory reserved for the array goes to waste. Worse, the program won't load unless it has enough memory to allocate the entire array, whether or not all of the array is used. If the array is large enough, the program won't run at all on many microcomputers. Only those with lots of memory will work. You can avoid both problems by using *malloc()* or *calloc()* to dynamically allocate memory for the array, making it as large as possible on a given machine at run time. This would fail only when the data set is too large for the machine — a limitation that everyone must live with.

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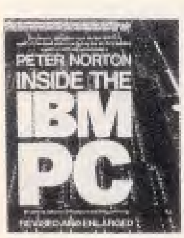

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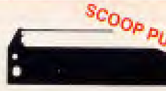

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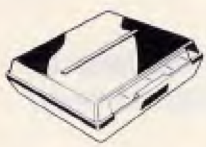

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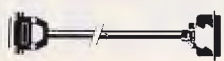

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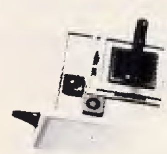

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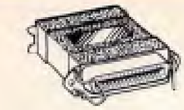

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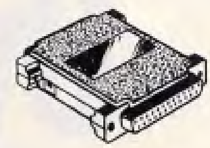

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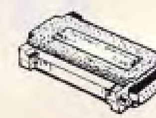

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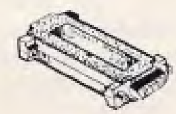

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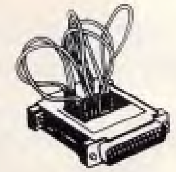

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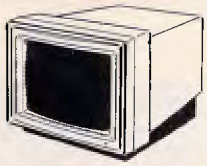

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VIDEO
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Display Format: 25 lines, 80 characters per line, 9 x 4 dots per character block.
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Resolution: 900 lines at centre 80 characters x 25 lines
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Cat.No	Description	Price
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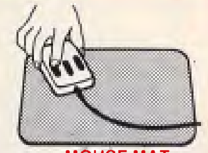
X14502	(AMBER)	**$149**



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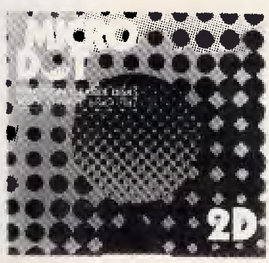

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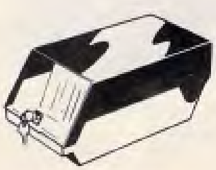

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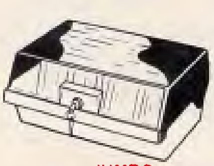

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Unnecessary limits caused by fixed array sizes are all too common. For example, in MS-DOS, try setting the Path environment variable to a string of more than 127 characters. As in the previous example, using fixed-size arrays to store the command lines is wasteful, since you must make the array size large enough to hold the longest possible line. Listing 1 shows a routine called *getline()* that reads a line of any length. This routine avoids the wastefulness of fixed-size blocks by adjusting the size of every block to the line it contains. It reads characters and stores them in an array created by *malloc()* until a new line character is read. If the array fills up, it is expanded by calling *realloc()*.

When blocks of memory are needed at different times, *malloc()* and *free()* allow the program to re-use memory. For example, the code fragment below can use the same memory (at different times) for an array of integers and an array of pointers. This can often reduce the total amount of memory required to run a program, or it can allow larger amounts of data to be processed in a given amount of memory.

```
char **s;
int *p;
/* Allocate space for an
array of 1000 integers. */
P = (int *)malloc(1000*size
of(int));
...
/* Finished with integers. */
free(p);
...
/* Allocate space for an
array of 1000 pointers. */
s = (char **)malloc(1000*
  size of(char *));
...
/* Finished with pointers. */
```

The examples given so far have all dealt with simple arrays. The benefits of using *malloc()* and *free()* to perform dynamic memory management are multiplied when they're used with more complex data structures, such as linked lists and trees. While it is possible to store a tree in an array of node structures, you must keep track of which array elements contain active nodes and which are unused and available as new nodes. *Malloc()* does all the bookkeeping for you. To create an empty node structure, you simply execute

```
nodeptr = (struct node *)mal-
  loc(sizeof(struct node));
```

When the node is no longer needed, you use free*(nodeptr);* to get rid of it.

Disadvantages

Like most things of value, the benefits of dynamic memory management are not without cost. The first drawback that comes to mind is increased overhead. This overhead turns out to be quite small. The memory allocated by *malloc()* is as efficient as any pointer in C. The extra work is required only when a block is created or released. The additional memory used by *malloc()* for bookkeeping is significant only if many very small blocks are being used.

Dynamic memory management's second cost is that debugging is more difficult. Exceeding the size of an allocated memory block is one of the toughest programming errors to find and correct. Adjacent areas of memory are written into as a result of this error, and you won't detect the damage until you attempt to use the contents of the overwritten memory. These modified values generate all sorts of strange bugs that don't point to the real problem. In the case of an array allocated at compile time, the variables assigned to memory adjacent to the offending array are determined by the declarations in the source code. Since related variables are often declared together, there is a good chance that the problem will be localised.

The location of objects in memory is not under your direct control when you use *malloc()*, and there is a good chance that completely unrelated data will be stored adjacent to one another in memory. Even worse, most implementations of *malloc()* store the data needed to maintain the free list adjacent to the allocated block. Over-running the end of a block won't destroy data visible to you,

```
#include <stdlib.h>
```

Purpose: ANSI standard header containing declarations of memory management functions.

```
size_t
```

Purpose: The integral type (defined in `<stddef.h>`) of the result of the `sizeof` operator.

```
void        *malloc(size)
size_t      size;
```

Purpose: Dynamically allocates memory. The size of the memory requested, in bytes, is passed to `malloc()`. A pointer to the block is returned if the operation is successful; otherwise, `NULL` is returned.

```
void    free(pointer)
char    *pointer;
```

Purpose: Releases memory blocks allocated by `calloc()`, `realloc()`, or `malloc()`. The pointer to the block is passed to `free()`.

```
void        *realloc(oldptr, newsize)
void        *oldptr;
size_t      newsize;
```

Purpose: Modifies the size of an allocated memory block while preserving its contents. A pointer to the old block is passed to `realloc()`. A pointer to the new block is returned if the operation is successful; otherwise, `NULL` is returned. The pointer returned can be different from the one passed to `realloc()`:

```
void        *calloc(nitem, itemsize)
size_t      nitem;
size_t      itemsize;
```

Purpose: Similar in function to `malloc()`, except that the contents of the block are zeroed. The size of the allocated block (in bytes) is `nitem*itemsize`. A pointer to a block whose size can hold the items requested is returned if the operation is successful; otherwise, `NULL` is returned.

Table 1 The common C language functions that access the heap

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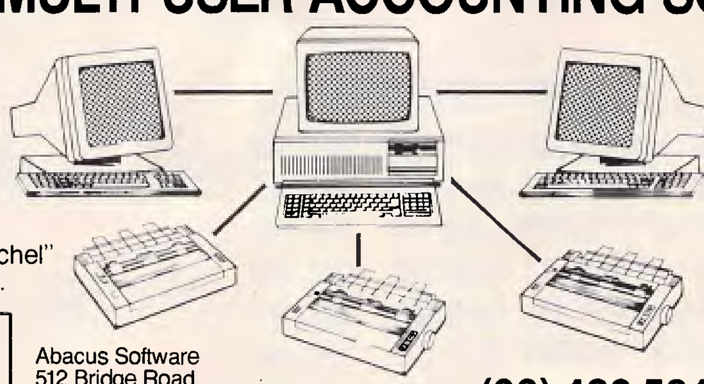

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but it corrupts the free list. As before, this causes problems when you attempt to allocate a new block of memory using the damaged portion of the free list, and the program may crash as a result — even while executing code that is far from the actual cause of the problem. This kind of bug is very difficult to locate.

The free list can also be damaged by calling *free()* with a pointer that wasn't obtained from *malloc()*. This error is easy to make when a program is allocating memory for many data structures. The seriousness of this error depends on the implementation of *free()*. Consistent with the lean and mean philosophy of C, most versions of *free()* do only minimal checking. This minimises the overhead of calling *free()* but transfers the responsibility of writing correct code to the programmer.

Avoiding bugs

Since programs using *malloc()* to manage memory are susceptible to nasty bugs, the best course is to write correct code in the first place. By far the most effective way to minimise the number of bugs in your code is to think before you write. The extra time spent on careful design of the program and its data structures will be repaid when debugging the code.

Programmers often reject programming techniques that result in more reliable code because they believe (rightly or wrongly) that these techniques result in slower programs. This concern for efficiency is doubly misplaced. First, it comes at the wrong time. You should consider efficiency during the design phase, particularly in the choice of the algorithm you use. Second, efforts to improve performance are usually done in the wrong place. Execution speed is relevant only to those parts of a program that execute for a significant amount of time during the program's operation. In most programs, this is only a small fraction of the code. Finally, speed is of little importance if the program does not work correctly. The choice between a program that produces the wrong answer quickly and one that gives correct results more slowly is obvious.

Now consider some ways to make the use of *malloc()* more reliable. Always check the value returned by *malloc()* to verify that memory was actually allocated. It's a nuisance to have to write if *(malloc(...)==NULL) error(...);* every time you need to allocate some memory, especially when you're certain there is enough memory. You can avoid this inconvenience by using the function supplied in listing 2.

```
/* getline.c -- Read a line. */
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>

/* getline -- Read one line from file */
/* infile into a string allocated by  */
/* malloc. Return NULL on error,      */
/* otherwise a pointer to the string. */

#define MEMINCR  256   /* Increment in
                 size of memory block. */

char *getline(infile)
FILE *infile;
{
  char *r;
  size_t n,m;
  int c;

  n = 0;           /* # of bytes read. */
  m = MEMINCR;     /* Available space. */
  r = malloc(m+1); /* Allow room for \0 */
  do {
    if (--m == 0) {
      if ((r = realloc(r, n+MEMINCR+1)) ==
        NULL) {
          return NULL;
      }
      m = MEMINCR;
    }
    if ((c = getc(infile)) == EOF) {
      return NULL;
    }
    r[n++] = c;
  } while (c != '\n');
  r[n] = '\0';  /* Terminate the string. */
  if ((r = realloc(r, n+1)) == NULL) {
    return NULL;
  }
  return r;
}
```

Listing 1 The source code for getline.c, a routine that reads a line and adjusts storage to hold the line, regardless of its length

The idea of encapsulating the error-checking in a separate routine is a simple example of the general principle of information hiding. *Malloc()* itself provides another example. The details of how *malloc()* keeps track of the size and location of available memory blocks are hidden from the program calling *malloc()*. This has several advantages: keeping the interface to the rest of the program simple, minimises the chance of making an error. The methods and data structures hidden inside a library routine can be thoroughly tested and verified, independently of any application.

A debugging tool

No matter how carefully you design and write your programs, sooner or later you will be bitten by one of the nasty bugs dynamic memory management makes possible. There is a debugging tool that will help you find the source of the problem.

The basic idea is this: before every call to a memory management function, insert code that will make a copy of the sizes and locations of blocks allocated by *malloc()*. This copy is compared with the information maintained by *malloc()*. Any discrepancy is reported immediately. This lets you locate the source of the error at once instead of waiting for the delayed and often disastrous results of overwriting adjacent memory.

The debugging code is in the form of three routines *(tmalloc(), trealloc(), and tfree())* that are called instead of the corresponding library functions. These routines are located in *memmchk.c*. The comments in *memmchk.c* tell you how to make these functions available to your program, and address implementation details.

To implement such a tool, you need to know how *malloc()* works. This violation of information-hiding results in a severe portability problem, since there are many ways to write a memory allocator. You would need a different version for every C compiler. I've used Kernigham and Ritchie's implementation of *malloc*, as published in their book, 'The C Programming Language' (Prentice Hall, 1978, page 173), to guide the implementation of the debugging routines presented here. Since this book should be in every C programmer's library, you can use it to assist you in porting the debugging routines to a new compiler.

As described by K & R, the basic data structure used by *malloc()* is the free list, which is a linked list of available memory blocks. Each block in the list has an associated header structure containing the size of the block and a pointer to the next block in the list. Blocks which have been allocated and which the program is using are not included in this linked list, but they still have a header containing the size of the block. A call to *malloc()* results in a search of the free list to find a block large enough to satisfy the request. This block, or a portion of it, is then removed from the free list, and a pointer to it is returned to the caller. *Free()* inserts the block pointed to into the free list at the correct location, and

```
/* mmalloc -- Allocate nbytes of memory using
malloc(). Exit if malloc() fails. */

#include <stdlib.h>
char * mmalloc(nbytes)
unsigned nbytes; {
  register char *s;

  if ((s = malloc(nbytes)) == NULL) {
    fprintf(stderr, "Out of memory!\n\
 Request for %u bytes failed.\n", nbytes);
    exit(1);
    /* Exit() could be replaced with a call
       to a garbage collection or compaction
       routine and the malloc retried. */
    }
    return s;    /* Return only if s points
              to a valid block of memory. */
}
```

Listing 2 A function to handle error-checking for calls to malloc(). If the request fails, the program is stopped after printing an error message; otherwise, the pointer returned by malloc() is passed to the program

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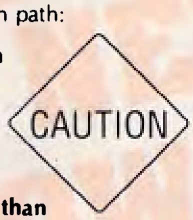

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updates the link pointers in the header structures to maintain the free list. To prevent memory fragmentation, adjacent free blocks are merged. Only the structure of the header is important to the debugging tool. This structure is

```
struct header (
struct header *ptr;
      /* Link to next block. */
unsigned int size;
      /* size of block. */
);
```

Although the details differ, all the versions of *malloc()* I have seen use a variation of this algorithm. I've used the debug functions in *memmchk.c* successfully with Ecosoft's C88 C compiler 4.05. I've also used Manx Software Systems' Aztec C86 C Compiler 4.10, although I had to add K & R's Version of *malloc* to use *memmchk.c* with it. If you have the source code for your library, you might want to tailor the *malloc()* checker in *memmchk.c* to your compiler.

In addition to checking the block size and location on every call to *free()* or *realloc()*, another check is performed: the number of blocks in the free list is counted every time a memory management routine is called. Since only one block at a time is added to or removed from the free list, any substantial change in the length of the free list between memory calls indicates that pointers connecting the linked list are corrupted.

Finally, there is a routine called *mem1st()* to list all the currently allocated memory blocks. This can be useful if called at the end of your program. If all the allocated blocks are freed, it should not produce any output. If some blocks are still allocated, it indicates that you do not have memory management under complete control. The uncertainty about which blocks are in use and which are not can be a source of serious errors.

Using C's dynamic memory management functions results in programs that are portable and adapt to the amount of memory available on the host computer. The disadvantages can be controlled by careful program design and the coding techniques I've described. Attention to program design and good programming style, especially important with dynamic memory management, will improve the reliability of any program.

END

David Fox is the chief scientist at Minimum Instruction Set Computer Inc. He has spent the last 4 years developing programmers' tools and expert systems.

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Itty-bitty MIDI

Despite the colour of the box, Apple's first MIDI interface isn't quite a platinum hit . . . says Paul Lehrman.

MIDI is here! Now, thanks to the wizards of Cupertino, your Macintosh can actually play music! This simple, $170 device will transport your favourite computer into a new, exciting world of music and sound — play like Heifetz, become a techno-rock star, write soundtracks for your home videos, and much, much more!

You probably won't see any ad copy like this for Apple's new MIDI (Musical Instrument Digital Interface) but don't rule out the possibility. Apple has brought out its very first peripheral device — for *any* of its computers — specifically designed for music applications (although the Apple IIGS has a built-in MIDI interface). And it seems Apple is very excited about it. Although Apple spokespeople have been breathlessly extolling the miracle of their company's entry into the music market, dozens of third-party developers (who have been dragging the Mac, kicking and screaming, into the MIDI world for over three years), are saying "Big deal." And a few of them are asking, "So where was Apple three years ago, when we really needed its support?"

The interface itself, however, is only the tip of what may turn out to be a significant iceberg. Two and a half years ago, Apple established an internal Advanced Technology Sound Group to research and develop ways for Macintoshes to deal with music, sound and speech. It has hit full steam, and we may see some interesting musical developments before long. The company is also embarking on a major marketing effort for musical applications, which can only help everyone doing music on the Mac, at all levels.

Simple but it works

But before we get into the implications, let's look at the interface. A MIDI interface is a box that translates digital data coming from a computer (for the Macintosh, from one of its serial ports), into data that conforms to the MIDI specification so it can be read by an external device that also speaks MIDI, such as a digital synthesiser. It also works the other way around, translating MIDI data from a synthesiser's keyboard into serial data that can be processed and stored in the computer. MIDI interfaces can be very simple; but if they are designed to deal with multiple data streams or to use some kind of external timing source, such as audiotape or videotape, they can be quite complex.

Apple's MIDI interface (which also works with the IIGS) is as simple as they get. It has one MIDI input and one output, located on one side of a small platinum-coloured box measuring 5 x 7.5 x 3 cms. On the other side is Apple's standard, circular, eight-pin socket, and the unit comes with a cable for connecting it to the Mac (an adaptor cable is necessary for use with an unenhanced 512k or 128k Mac) as well as two MIDI-to-MIDI cables. There are no pilot or data lights, power supplies, or switches of any kind on the box. It just sits there.

Although there is only one MIDI output, the interface can be used with multiple MIDI instruments, thanks to the MIDI Thru jack found on most synthesisers. The MIDI spec says that any data coming into a synthesiser must be echoed out the Thru jack without modification. This allows any number of instruments to be daisy-chained together. Some synths lack Thru jacks, however, and if you find yourself with a couple of those, you'll need a MIDI splitter box (which can cost as much as the interface box itself). Unlike analogue audio signals, you can't just use a Y connector to route MIDI data to two different places.

The single input is more of a constraint in that the interface will not let you use more than one MIDI controller. For a musician working alone, this is not a major drawback, but some software lets two or more players jam together. There are hardware solutions, 'MIDI mergers', but these are even more expensive than splitters.

If you keep these limitations in mind, Apple's MIDI interface works fine. Although some interfaces do have trouble with large amounts of MIDI data generated by some programs, this one does not. The MIDI data stream *will* get clogged up if you try to run data simultaneously from multiple controllers (such as pitchbend wheels, pedals, and breath controllers) through it, but it will start to choke at exactly the same point at which

other, professionally oriented interfaces do.

A MIDI interface has an internal oscillator, which means it needs electricity. Some interfaces get their juice through an AC power supply, but Apple's doesn't — instead, it draws what little current it needs directly from the Mac's serial port. This has created a minor scandal in some circles because Apple has never allowed third-party developers to do this with their peripheral devices. In fact, back in the days of 512k, Apple specifically warned against this practice, and several interface manufacturers, whose devices depended on a 5-volt line coming from the serial port, were caught with their pants down when the Mac Plus came out and that line was no longer provided.

Small amounts of current are available at other sources within the port, but Apple's present developers' guidelines don't say anything at all about using that current. The MIDI interface actually draws power from the differential voltage between the two data-out lines. But because this voltage apparently can vary markedly from one Mac to another, this is a practice that Apple pointedly does not encourage anyone else to try.

With a few exceptions, the interface works with all MIDI software on the market, including sequencers, patch librarians, editors, sample editors, algorithmic-composition software, and effects- list editors. The internal oscillator generates a timing reference, or clock rate, of 1MHz. MIDI applications are designed to operate using specific timing references, and unfortunately, at the dawn of the Macintosh-MIDI era, three different references were in use: 500kHz, 1MHz, and 2MHz. A program based on one clock rate won't work with an interface that generates a different clock rate.

The majority of applications either have a software 'switch' for choosing the clock rate or operate at 1MHz (which has now become the de facto standard). But there are some earlier programs that run only at 500kHz or 2MHz, and owners of such software (most of which is from companies no longer in business) can't use Apple's interface. The interface will also be useless for MIDI applications that require specifically 'keyed' interfaces or that need some kind of external timing reference.

One other technical note: the Apple

'With a few exceptions, the interface works with all MIDI software on the market, including sequencers, patch librarians and editors, and algorithm composition software.'

MIDI interface is FCC-approved, unlike most others. Strictly speaking, in the US the FCC must approve the design of any electronic device that contains a radio-frequency oscillator to ensure that it doesn't radiate any stray signals which could interfere with normal TV or radio reception nearby. The approval process, however, is expensive and time-consuming and is widely viewed as a needless formality. I've never heard of anyone missing 'Sale of the Century' because someone else was playing with Music Mouse in the next room.

Why Apple did it

Inexpensive MIDI interfaces are already available from other manufacturers. They range from simple ones like Apple's (at about the same price) to a two-in, six-out, AC-powered box for professional users. So why did Apple bother to introduce a me-too product?

One obvious reason was to respond to the introduction of Atari's ST line of computers, with their built-in MIDI interface. STs have been strong contenders in the professional music market since they first appeared, and music software developers have begun to take them seriously in the past year or so. More than one Macintosh developer who two years ago swore that he would have nothing to do with Atari computers was showing Atari products at this year's Winter NAMM show in the US.

Apple has figured out that many Macintosh owners — whom it calls 'young affluents' — are closet musicians who run Excel or Ready, Set, Go! all day but who would like to relax at night with a music program they can use with the Casio or Yamaha keyboard they got for Christmas. Although professionals have accepted MIDI on the Mac, the lack of a standard interface that ordinary Apple dealers can recommend to amateurs has slowed its acceptance by that part of the market. There is plenty of good music software designed for those users, such as Deluxe Music Construction Set and Concertware+. Maybe Apple figures its dealers will be able to support that market better if they can sell an interface from a company they know will still be in business a year from now.

What took so long

MIDI has been around for nearly five years, and Macintosh MIDI software for three, so why did Apple wait so long to get involved? Actually, it didn't — although its previous efforts in the field were less than effective.

In June 1985 the very first MIDI applications for the Mac were shown at the Summer NAMM convention in New Orleans. A visible presence at that conven-

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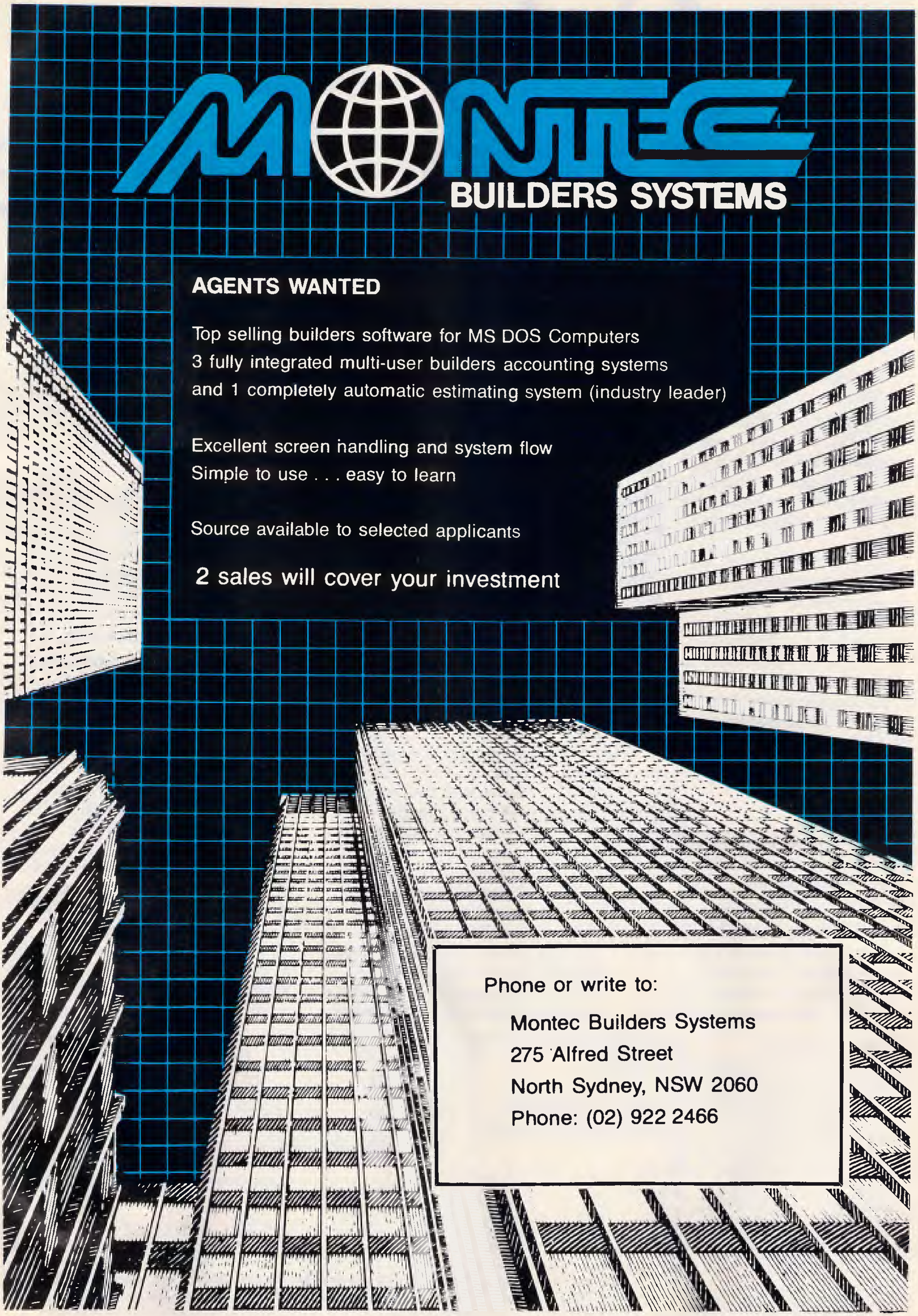

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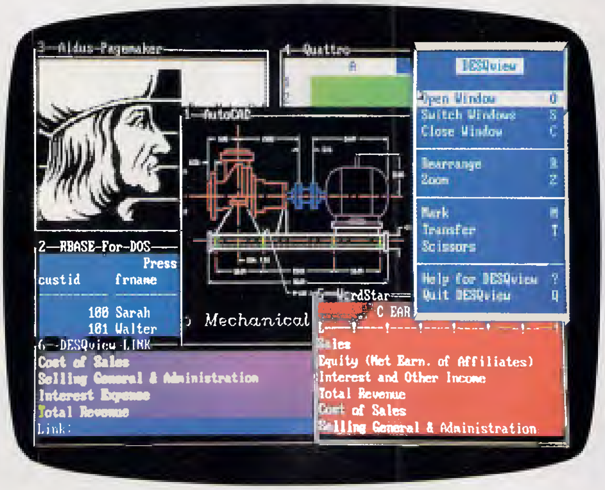

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Computer Peripherals Wellington, New Zealand Tel: 644. 734291 tion was one John (Jack) Sculley, Jr., college-age son of the former Pepsico president. Young Sculley's mission, he told everyone he met, was to establish contacts with developers and distributors so they could benefit from Apple's support. Although he was generously wined and dined by the infant companies, nothing ever came of his efforts. Today few at Apple remember anything about him or his activities, and no one knows why there were no results from his efforts. One source at Apple grumbled that the assignment was nothing more than "something to give the kid to do during summer holidays."

Around the same time, a company called Assimilation Process (known for peripheral devices such as trackballs) announced an inexpensive MIDI interface for the Mac. Claiming to be very close to Apple, Assimilation Process seemed to be developing MIDI Conductor with Apple's blessing. Developers and users who made enquiries to Apple about MIDI were referred to Assimilation, and the smaller company was apparently given favoured status with Apple dealers. The device was being designed for Assimilation by Digidesign, a company now known for its high-end sound sampling and production software, and built by Cambridge Automation.

Unfortunately, MIDI Conductor never made it out the door. According to a spokesman for Digidesign, Assimilation ran into technical problems when it wanted the device to be able to switch automatically between MIDI and standard serial duty whenever it sensed that a printer was on-line. By the time it figured out how to do it, the company, reportedly a victim of poor management in many areas, had gone under. Cambridge Automation, a major creditor to the now-bankrupt company, got the rights to sell the 500 or so units made, and some are still floating around. In the meantime, other companies' MIDI interfaces had appeared, and no one wanted to put a lot of effort into propping up what seemed like a very dead product.

The high end

These fiascos will not repeat themselves this year. Apple is serious. At a recent music show, Apple for the first time had its own booth, which was populated with exhibits from a dozen third-party developers (all of whom were given an Apple MIDI interface to use) showing an impressive array of products. Clearly, the MIDI interface is just a small indication of the opportunities Apple sees in the music market. The Sound Group, be-

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sides working on the Sound Manager program for the Mac II and programming leitmotifs for HyperCard stacks analysing Wagner operas, is also enthusiastic about using the Mac for creative audio tasks that were previously handled by dedicated machines costing well into six figures.

The processing power of the Mac, especially the Mac II, and the falling prices of RAM and hard-disk storage mean that the computer can become a 'digital audio workstation', in which recordings of *real sound* — not just MIDI data — including music, sound effects, and dialogue, can be stored, edited, manipulated, and played back directly from memory, thereby letting the Mac take on many of the functions of the traditional music and film-sounding editing studio. Several third-party suppliers are introducing digital signal-processing cards that go into the Mac II's NuBus slots expressly for this purpose.

To help move things along, Apple developed the Audio Interchange File Format (AIFF) in conjunction with several third-party manufacturers. AIFF is designed to let any software that works with recordings of real sounds — for sampling, resynthesis, voice-processing, or video or film-production applications — exchange data with any other program.

Do we need it?

Although no one is seriously against Apple entering the music market, there is a certain amount of resentment among those who have been working in the field for some time. One developer has said sarcastically: "I think Apple has shown a real commitment to the MIDI market-place by producing MIDI cables with its logo on them."

Another, who's been doing music applications since the original Apple II came out, said "It's easy to get mad at Apple for its arrogance — it thinks it can just move into a market and change history. I've been trying to get Apple to do this for eight years. But I'm delighted it's finally doing so. I think it will double the size of the music market, and I'll be happy to ride on its coat-tails."

Even developers who make cheap MIDI interfaces are welcoming Apple's participation. "We don't make money on those, anyway," said one manufacturer. "We make it on the professional interfaces and on software."

Another developer believes that Apple actually doesn't want to promote MIDI on the Macintosh (now a *business* machine) at all. Apple "would rather have all the musicians working with the IIGS," according to this developer. "But that's the way Apple has always worked: it looks at a market, makes some pronouncement, and then goes wandering off in the forest."

In any event, Apple has a lot to learn about the music market and what others working with its computers have already accomplished. This was illustrated by the rather crude presentations Apple gave at the interface's introduction, by people who seemed not to know their audience very well. One speaker said: "There's only one input and one output. I've just found out that it's important to tell you that."

Another presenter for the company could barely contain her excitement explaining how, through the miracle of MIDI, the folks on stage were about to combine live performance with sequenced music. Her audience, however, mostly giggled, inasmuch as most of them have been doing precisely that sort of thing for years.

Better late than never

So Apple is to be applauded, even if in some minds it is getting in a little clumsily and a little late. Although it's easy to "get ticked off at" (as one developer put it) its claim to have invented the wheel, there's general agreement that Apple's entry can only have a positive effect on the music market. It will draw in new customers who would otherwise be loath to purchase a MIDI interface that didn't bear Apple's seal of approval.

Of course, once customers *do* investigate MIDI, they'll find the other MIDI interfaces that offer far more features at the same price level, so Apple probably should not be too disappointed if sales of its box turn out to be slower than anticipated.

What might help would be the release of some *really* cheap MIDI software to get users going with a minimum of risk. When it was working on MIDI Conductor, Digidesign also designed a no-frills four-track sequencer called MIDIComposer (not to be confused with Professional Composer), which never saw the light of day. It's still the perfect companion software for an introductory interface, and if no one else brings it out, it's been suggested that Apple license it for a few cents and, in the tradition of MacPaint, give it away with the interface.

And the MIDI interface is only a small part of the picture. Besides coming up with the Audio Interchange File Format, the Advanced Technology Sound Group has made encouraging statements about how Apple's hardware and operating systems are being developed with at least one eye on MIDI and real-time music applications, and input/output and interrupt structures are being designed accordingly.

A logical first step in this direction would be the release of a background utility that would support multiple, simultaneous MIDI applications — a sequencer and an algorithmic-composition program (for example — for musical multi-tasking). Although Apple itself might not develop such a product, the company might take, according to a spokesman for the group, "at least a passive role" in it.

Judging from their first public appearances, Apple's music staff have their work cut out for them in learning about their market — where it's been and where it could go. But there is a lot of potential. If they are willing to solicit and respond to input from a broad base of users and developers in many areas of musical life, they and the developers they work with may come up with concepts and products that will make their first little platinum box seem quite insignificant indeed.

END

Mac MIDI alternatives

Apple's is not the first MIDI interface available for the Macintosh. The following products are available from third-party developers. Both have 1MHz clock rates, work on any Macintosh, and have their own AC power supply (unless stated otherwise). For each interface, the model name, number of MIDI in and out ports, and price are listed.

Hutchins Keyboards, 9 Edgecliff Road, Bondi Junction, NSW, 2022; (02) 387 5507. Hutchins MIDI Interface, one in, two out, $220. Studio Plus Two, two in, six out, modem/printer Thru switches, $560.

Sound Options, Suite 3, 45 Watkins Street, North Fitzroy, VIC, 3068; (03) 486 1701. MIDI Interface, one in, one out, powered from the Macintosh, $255. MIDI Transport, two in, four out, with SMPTE, 'Intelligent' FSK, and MIDI Time Code synchronisation, $895.

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DataPerfect

WordPerfect's DataPerfect is claimed to be a single or multi-user relational database which provides all the power and facilities you might need. The truth, as Simon Jones discovered when he ran the program, was rather different — and very expensive.

The WordPerfect Corporation (WP Corp) is most famous for the word processor which bears its name. This product is entering a new chapter in its life with the release of Version 5.0 for PCs. WP Corp programs have a similar user interface so users of one package can easily learn the others. WP Corp software uses the function keys extensively, and the DataPerfect relational database is no exception. Happily, most of the major functions such as print, cancel, exit, save, and so on, are on the same keys in all WP Corp programs.

The same company produces WordPerfect Library which contains a program called Note Book. This allows you to set up a simple cardfile database: that is, one file displayed onscreen as either one record per screen or a list of records one per line (the latter option can only show a few fields). Note Book is ideal for storing details such as names and addresses, and I expected DataPerfect to build on this. It does in a way; you still have the two main display modes of full record and list of a few fields, but in DataPerfect both can be onscreen at the same time.

Overview

DataPerfect is a relational database: that is, it has the facility to link different pieces of data together. These links are called relations because they can look like a family tree; for example, a father can have many sons and daughters but has, himself, only one father and one mother.

In exactly the same way, a school database would be based around pupils. There are many classes in the school. Each pupil will have many exam marks but will belong to only one class. In DataPerfect, information on the pupils, classes and exam marks would be held in separate panels. The links between them are called doors or doorways. (The difference between doors and doorways should become clear later.)

A 'panel' is a data entry area containing one or more pieces of data; for example, the pupil panel would have fields for surname, forename, date of birth, class, and so on. The class panel would similarly have fields for class number, teacher and classroom.

'DataPerfect is an interesting product which will appeal to business people who have an understanding of databases and want something they can put together in a few afternoons.'

Installation

The programs and some sample databases come on two 5.25in 360k floppy disks. The programs take the whole of one disk, the sample databases the other. For PS/2 or portable machines, the package also contains all the programs and sample data on one 3.5in disk.

Installing DataPerfect is very easy. All you have to do is copy the programs and sample databases from the floppy disks supplied onto your hard disk or working floppies. The manual gives precise instructions for novice users.

The Australian version of the manual was not ready when I started the review, but luckily I've been using WordPerfect 4.2 and WordPerfect Library for some time so I didn't have much difficulty getting DataPerfect to work.

DataPerfect can be started from the command line by typing 'DP [RETURN]', or from within the WordPerfect 'shell'. The shell is a multi-tasking device in the WordPerfect Library, and allows WP Corp programs to be suspended while another one is used. It works very well and, just like the Apple Macintosh or Microsoft Windows, allows data to be copied between programs via a clipboard. All WP Corp programs are (CTRL) (F1) to switch to the shell. You can also set up macros so that pressing (ALT) (SHIFT) W will always take you to the word processor from wherever you happen to be.

Using any WP Corp program from the shell increases its usefulness, as the data in one program is easily incorporated into another.

A panel can be a maximum of 78 characters by 15 lines. It is a shame you can't use the whole screen, but the remaining lines are used for the automatic and user-defined help and for the lookup lists.

Any database in DataPerfect is defined in terms of panels, fields and indexes, and there may be many panels in each database. Each holds a part of the data; thus, a database for a school may have

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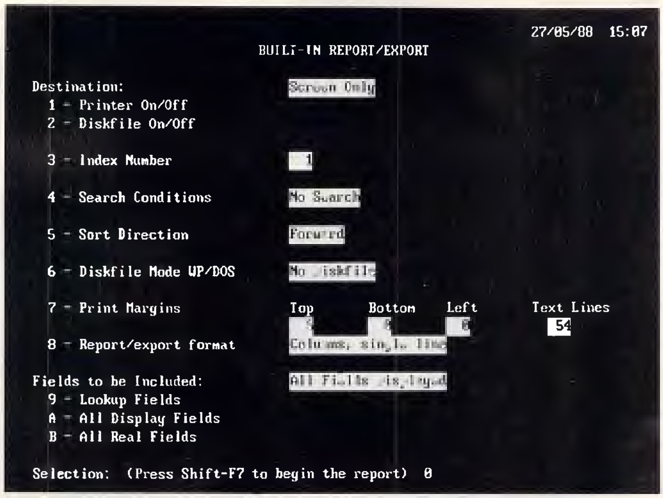
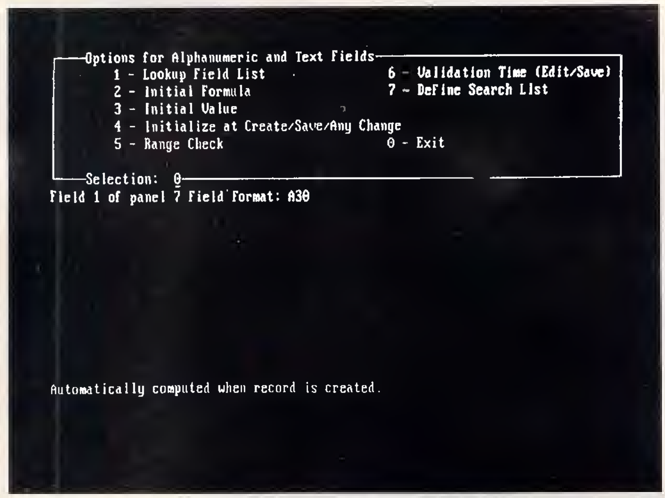


Report parameters include numerous options all with defaults. Without meaningful field names, however, modifying an existing report can be a challenging task



Look-up tables across the top of the screen are defined in terms of the fields displayed and their indexes. DataPerfect abounds with cryptic and numeric strings

three panels. The main one would show the names and addresses of the students, and the other panels would show examination marks and details of classes. Note that each panel in a database takes three or four files. All files must be backed up to keep the data secure.

Creating panels

When you are setting up your database, you first draw a panel. This simply involves typing the legends you want on the screen and then creating the fields. When you press the CREATE key (F9) you are asked to type in a field format which tells the computer whether to expect letters or numbers, and so on, and how long the field should be.

I found this to be one of DataPerfect's weak points. While it copes quite happily with virtually unlimited-length text fields, it seems quite unable to cope with Australian telephone numbers. All telephone numbers in the US are of the form (123) 456-7890; and, having defined a telephone number field, the user would actually type only the digits, the brackets and dash being supplied automatically. This helps reduce mistakes in input as any stray letters would not be accepted. Australian phone numbers, however, vary in format; for example, (02) 264 1266 or 03-5318411 or 075-333 4444. DataPerfect cannot cope with this variety of lengths and formats unless the field is set to accept all characters. It cannot be restricted to just digits, spaces, brackets and dashes. There are six categories of field format in DataPerfect:

A Alphanumeric fields can hold all characters. Follow the A with a number and you define a field that many characters long — for example, A25. If you give two numbers, the field will be as long as the first number and as deep as the second — for example, an address could be A30A4. This would show on the screen as four lines of 30 characters. You could actually type as many as 32,000 characters into a field defined like this, the text scrolling up in the 30x4 window. You can also use the letter 'U' instead of 'A'. U fields have all lowercase characters converted to uppercase as you type.

D Date fields can show the date in any form you can think of — you are not restricted to the US format mm/dd/yy. You can have the Australian dd/mm/yy or German dd.mm.yy or even ISO yyyymmdd. You choose the order of the parts and the separators. You can even choose to enter and show dates with just days and months and no year. If you do this, the program will helpfully decide that all those dates are in 1904. Beware that you cannot enter dates before 2 March 1900, so this package is not satisfactory for genealogy. Date arithmetic is provided, though.

T Time fields can be shown or entered in hours, minutes and seconds, or any combination. They are always in the 24-hour system, although you can omit the leading zero for hours less than 10.

G The general number format holds right-aligned digits with decimal and thousand separators, minus signs, parentheses, or currency symbols. Thus, defining a field with the format G-$ZZZ,ZZ9.99 will show a value in dollars with a minus sign if it is negative, and a comma if it is over a thousand dollars. Both the dollar sign and the minus will 'float' up to the numbers if not all of them are used. European currency symbols are also catered for.

N This number format takes digits only and the manual suggests it can be used for things like phone numbers and social security numbers. These fields are fixed length and all the digits show. If your data doesn't use all of a field defined like this, each extra digit will display and print as a zero. The only type of data that would fit this kind of field is Viatel Mailbox numbers which are all nine digits long. Punctuation which is shown but not stored in the file, and which cannot be changed by the user, may be put in N format fields.

DataPerfect fields can be designated as 'computation' fields. The values of these fields are not stored in the database but are calculated from the values in other fields. The formulae used for the calculation can be quite complex and involve mathematical '&' logical operators and IF . . . THEN . . . ELSE and CASE statements. There is also a limited range of functions which cater for date manipulation, stripping trailing blanks, finding the maximum and minimum of a list of numbers or character strings, and so on.

Indexes

When you have defined your fields, you can set up the indexes (pupils' names, for example). Each panel must have at least one index. DataPerfect insists that all records to be indexed have a unique key (that is, each name must be different). You must think carefully about the data you are storing before defining

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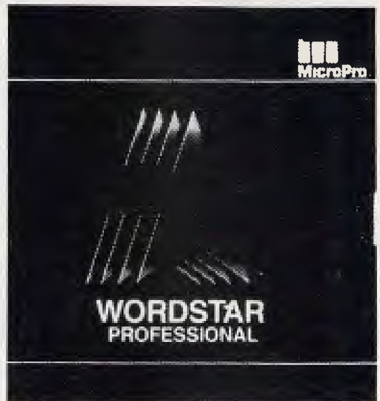

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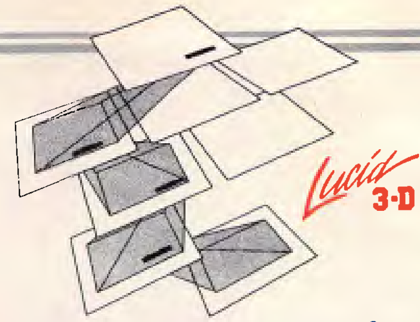

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"The Best idea I've seen for a spreadsheet in years"
Jim Seymour, Columnist, PC Magazine, PC Week

Lucid is as simple as the pictures show. And you don't have to write formulas to do that. All you do is look at the other file, navigating through easy, point and shoot directories. When you come back up (with one key) the link is made automatically for you.

Everything about Lucid works that way. Users say "*It is so intuitive that I really don't need a manual.*" That's because we use something we call a visual command menu. Jim Seymour, the noted PC columnist, talking about Lucid in a recent article said, "*If there ever was an interface idea so good it ought to be stolen and widely used, this is it.*"

Memory Resident

You can pop Lucid up instantly while working in your word processor or any other program. You can cut anything on the screen and paste it right into Lucid, or cut anything from a Lucid worksheet and paste into the application below. You can even run Lucid on top of 1-2-3 if you like, and cut and paste information from one to the other, including formulas.

Notepad Behind Every Cell

Another 3-D feature is that any cell can also contain a multiple page note window that you instantly access with a single keystroke. You can write notes, memos or letters that relate to your work, save them as individual files and even print them separately or with your spreadsheet.

Other Features

Lucid has over 100 innovations that cause users to say it is the best of all the spreadsheet offerings! Things like: **Speed** - background, minimal and visible recalc. **Macros** - learning macros, autoexecute macros, macros work between spreadsheets, user defined macro menus. **Mouseability** - total Mac-like mouse access, but easy keyboard control as well. **Color or Mono** - 17 user controlled color displays. **Audit** - six displays and printouts. **Windows** - multiple sheets on screen at same time. Multiple views of the same sheet. Pop-up windows of function formulas, range names, favorite labels, macro names, filenames, even a calculator. All let you select and insert right into your spreadsheet. All windows (even notes) resize and move where you want them. **Cut and Copy** - between spreadsheets, documents and between sessions. **Help** - press F1 anywhere, you get help specific to what you are doing.

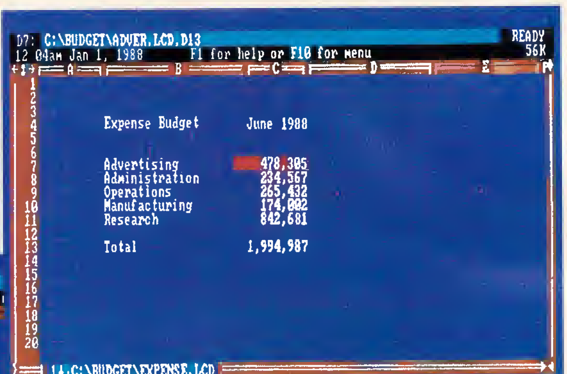

Fig. 1. Let's get the detail on those ad costs, just move the widebar to that cell and press one key (grey +).

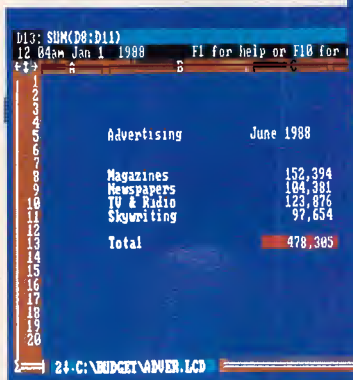

Fig. 2. Here we are instantly. Notice the lower left corner showing we are on level 2. Grey – takes you back. There is no limit to the levels you can go. Move right down to transaction level if you like.

Co-Winner of the 1987 PC Magazine Award for Technical Excellence
The other winner: Microsoft's Excel

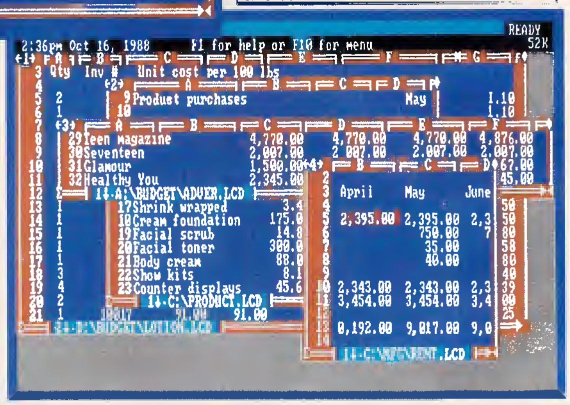

Fig. 3. Of course, Lucid does multiple windows. Notice, you can simultaneously open windows in different directories, different drives, even down as many 3-D levels as you like. No one else can do that.

Masterwork

Lucid is more than a bag of features. It is a masterwork. The overall feel is tight and polished. In fact, Paul Somerson, executive editor of PC *Magazine*, used one word to describe it, "*Slick*".

PCSG has built an excellent reputation as a developmental laboratory. Now those who have worked with Lucid 3-D tell us "*you have done it again. This is software everyone should have.*"

Even if you don't plan to abandon 1-2-3, Lucid makes sense. Files are converted between them with ease so there's not an interoffice compatibility problem. This means you can have the power and fun of Lucid 3-D, without having to upset your present systems.

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your indexes. If you don't, you may find that halfway through entering your data, DataPerfect will stop and tell you that it cannot save a record because the fields to be indexed are not unique.

The only way round this is to amend the record you are entering so that it is unique, or abandon it and change the index. If you happen to have two John Smiths in the school, then DataPerfect will stop and tell you it can't enter the second. You could get round this by adding the class into the index, but what if both John Smiths were in class 3B? Adding their date of birth into the index would probably work, but the index would become so complicated that it would slow the system down.

DataPerfect, however, allows you to define a field which is never displayed but is unique to each record. It is an auto-incrementing number, and you can add it to any index to overcome the difficulty of keeping indexes unique. Each record created has a different number, so John Smith on record 134 has a different index key to John Smith on record 597. You need never know what the number is.

Creating indexes is a simple operation. For each one, you point to the fields in the order they are to be considered and press the SELECT key (F4). You could, for instance, create three indexes for a school of pupils: Surname & Forename; Class, Surname & Forename; and Forename & Surname. This would allow you to list the pupils alphabetically by surname, lumping them together or splitting them up into separate classes, and also to find the record of a pupil given only his/her first name.

For each field on a panel you can also define a lookup list. This tells the computer which fields you want to see listed, and in what order. Thus, placing the cursor on 'surname' and pressing the LOOKUP key (UP ARROW) causes a list of the pupils' surnames to be displayed in the top third of the screen. A lookup list allows you to specify that you want the forenames and classes to be displayed at the same time. Just as with indexes, you merely have to point to the fields in question and press the SELECT key.

In the example given above. the lookup list for surname would be Surname, Forename & Class, indexed by Surname & Forename. You can only use an index that has been previously defined.

Doors and doorways

When all the fields, indexes and lookup lists have been defined, you can create the doorways through into other panels. This allows you, for example, to find a student using one panel and then move through the doorway to a second panel to show and amend that student's marks.

Doors show up on the panel as little chequered blocks or diamonds next to existing fields. Creating them is a two-stage process. You first define where on the panel they are to appear and then, when all the panels have been defined, you create the links between panels. This is the hardest part of the setting-up procedure; however, there is onscreen help should you need it, and the manual is reasonably clear.

One option available on creating a door or doorway is whether or not it should have a window (rather strange terminology). A window in a door allows you to see what is on the other side without having to move through the doorway. Thus, a database on personnel in a company might have a panel for staff details which has a doorway through to a panel on annual leave. There could then

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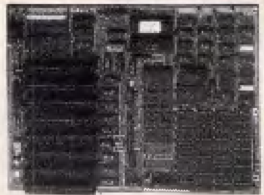

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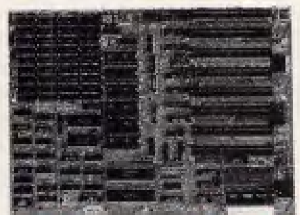

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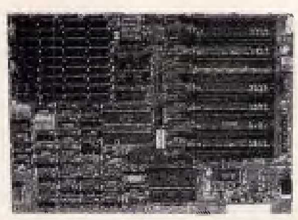

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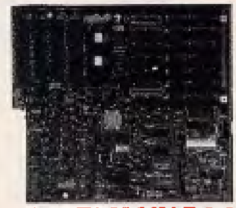

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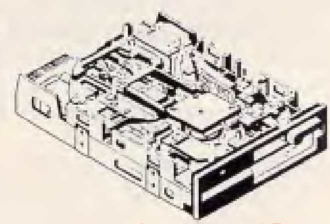

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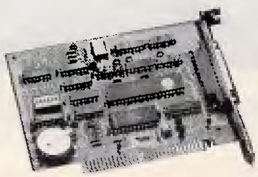

RS232 & CLOCK CARD

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This RS232 card supports 2 asynchronous communication ports. Programmable baud rate generator allows operation from 50 baud to 9600 baud. Fully buffered. Clock includes battery back-up and software.

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This combination card features printer and monitor interface. It has 1 parallel printer port, RGB CTTC outputs.

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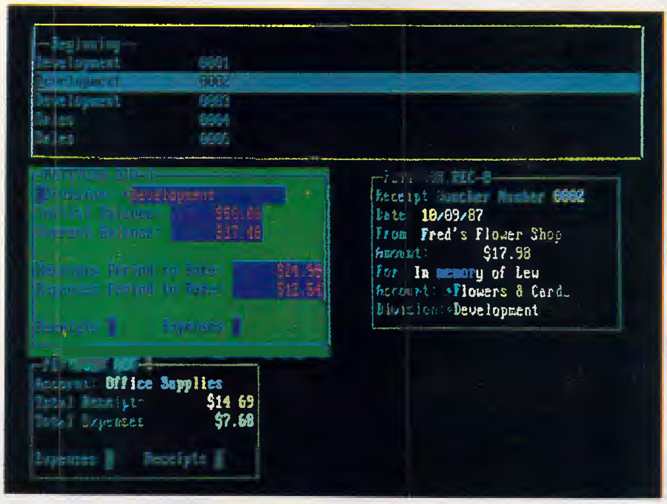
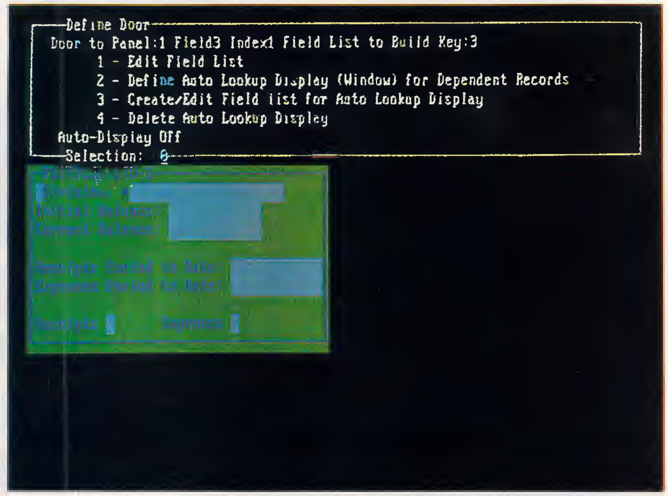


Records can be selected, as in the top box here, from a one-record-per-line display. The complete record is automatically displayed in the relevant panel below



Panels can be used to show records from related files. The 'Door to Panel' formula determines which field from one file is to be used as a key to the next panel

be a window from the first panel allowing you to see, but not amend, the annual leave data. To amend that information, you would have to put the cursor on the doorway and press the DOWN PANEL key (F5 or DOWN ARROW).

In use

DataPerfect is quite straightforward once you are accustomed to its general principles. Selecting the database and panel to use is simply a matter of choosing from a list of those available. Entering and editing data is easy, and the lookup lists are a good method of finding the record you want.

All you have to do is place the cursor in the field you want to search and press the UP ARROW key. The top area of the screen, which normally holds the help information, is replaced with a list of the records in the file showing the field you are in and some associated fields. You can use the up and down arrows to move through this list until the record you want is highlighted. Pressing RETURN will bring that record into the panel you are working on.

Moving through doors and doorways is quite intuitive. In the school database, once you have input details about a class (class identity, form teacher, room, and so on), you could move through the door into the pupils' panel and enter the details about the pupils in that class. The class field on the pupils' panel will be filled in automatically.

Moving from field to field in a panel is accomplished by pressing TAB, SHIFT UP ARROW, or '+' (on the numeric keypad) to go forward. To move back a field you can use SHIFT TAB, SHIFT DOWN ARROW or '-' (on the numeric keypad). You can use the RETURN key to step through the fields, but there is a snag. If you are in a text field, an alphanumeric field taking more than one line, RETURN will create new lines within that field. The only way out is to use one of the other alternatives. You cannot use the up or down arrow keys as they will perform lookup or down panel functions.

A drawback on the use of the keyboard is that sometimes you have to press a key twice for it to function. Occasionally, the first press stops what you were doing and the second starts the new function. This can be quite annoying, as you are never sure when it will take one press or two.

Response times are acceptable on a PC with a couple of hundred records in a simple file. If your database is going to be large or complex you might find that you need either a hard disk, an AT or both.

If you have WordPerfect Library, you can use the clipboard facility to transfer fields or records to DataPerfect from other WP Corp programs. Data written to the 'clipboard is in WordPerfect Merge format, and can be combined quite easily with a standard letter or form in the WordPerfect word professor.

Reports

Reports in DataPerfect are quite flexible, giving the definer the ability to use two levels of totalling, multi-line report bodies and search conditions to report on specified records only. Reports may be sent to a disk file in WordPerfect Merge format or DOS text format, to a printer, screen or any combination of these. You can include on the report any variable in the current database, not just from one panel. The variables can be reformatted with new file formats, and character variables can be trimmed to fit neatly into other text. Creating a report is a complex operation, but it is quite logical and there is adequate online help.

To invoke a report, you press SHIFT F7 and select the report format you want from a list. When the 'options' menu is displayed, you can change any of the options and then press SHIFT F7 again to run the report. Using DataPerfect's reports for the first time can be quite bewildering because there are so many options to set. Luckily, all reports have built-in defaults so you can accept those and let the chosen report run.

The main options you can set are Destination (screen, printer, file), Index, Search Conditions, Sort Direction, and Print Margins. Some of the main options will then produce further options if you elect to change them.

There is a standard report available for all panels which can be used for *ad hoc* or one-off reports. This report can also be used to export all or some of a database to another package.

DataPerfect scores highly for the complexity of its reporting, but sometimes it might be just a little too much for the end user. The reports function is powerful and flexible but is not that easy to use to its full advantage.

Documentation

The DataPerfect manuals come in two parts, and both are bound in one three-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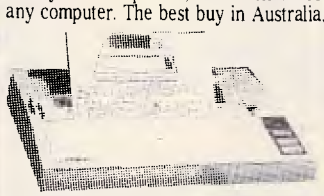

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F1  Shift  Get Field from Clipboard     F2  Shift  Reverse Search
    Alt    Get Record from Clipboard        Alt    ——
    F1     Cancel                           F2     Search

    Ctrl   Screen                           Ctrl   Move
F3  Shift  Edit Help                    F4  Shift  ——
    Alt    Reveal                           Alt    Block
    F3     Help                             F4     Select

    Ctrl   Import                           Ctrl   ——
F5  Shift  Remove                       F6  Shift  Report Attributes
    Alt    Multiple Record Remove           Alt    ——
    F5     ↓Panel                           F6     Edit

    Ctrl   Report Options                   Ctrl   Define Index
F7  Shift  Report/Export                F8  Shift  Define Field
    Alt    ——                               Alt    Define Panel
    F7     Exit                             F8     Lookup

    Ctrl   ——                               Ctrl   Put Panel to Clipboard
F9  Shift  System Operations            F10 Shift  Put Field to Clipboard
    Alt    ——                               Alt    Put Record to Clipboard
    F10    Create                           F10    Save
```

The use of function keys will be familiar to users of WordPerfect. A knowledge of that program is almost essential to grasp the complexities of DataPerfect

ring binder. The *Definer Manual* is standard, loose-leaf format but the *User Manual*, which shows you how to run databases that have already been set up, is a glue-bound paperback book with three ring-binding holes. Both manuals are clearly-written with some diagrams and screenshots. Both contain sections on getting started, a tutorial, and a reference section.

The getting started sections are succinct. They tell you how to install DataPerfect on your computer, and how to start it running; however, there is little information about the keys used. The Definer manual also describes, rather briefly, how to go about designing a database and the concepts of panels and linking through doors.

The tutorial sections are more lengthy and harder to read. Much emphasis is put on *doing* what is being described.

The two reference sections cover all aspects of using DataPerfect. Each command or action is explained clearly and in detail, but again, the lack of screenshots to illustrate what is being explained hampers understanding.

Conclusion

DataPerfect is an interesting product which will appeal to business people who have an understanding of databases and want something they can put together in a few afternoons. There are certainly some unique features in the package to make it even more attractive. The lookup lists and the intuitive system of doors and doorways are things I'd like to see in professional database management systems.

Apart from the lack of adequate data validation, DataPerfect has two faults which will stop it being used more widely. One is the lack of a 'language'. As an entire database system is constructed from screen-painting, menu choices and 'point & press' selections, there is no way of describing or documenting the finished product. You can see what it does but there is no way to print out all the field formats, formulae, doors/doorway links, and so on.

The other fault is that although the human designers and users of DataPerfect know that a particular field holds the name of a class teacher, DataPerfect knows it only as P2F3 — that is, field three of panel two. Any references to the teacher's name in formulae for reports have to be expressed like this as there are no field names. You type legends when defining the panels but you never actually name the fields.

This lack of descriptive field names could potentially lead to the creation of unmaintainable systems. The report formulae could be so complex and full of P1F2 and P2F1 that it would be a lot quicker to construct a new report from scratch than make a small change to an existing one.

Finally, one must question the pricing of this product. At $978 it is at the high end of relational database packages, yet it lacks the programming language and third-party support of dBASE III, or that product's Assistant mode. There is no way to produce turn-key applications or menu-driven front ends for complex tasks.

DataPerfect has much to recommend it to people who know what they want from a database package and are prepared to invest a few days in designing a system for themselves. It is not for newcomers to computing or for software houses to design bespoke systems with.

END

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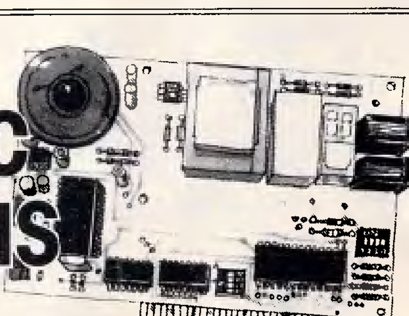

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OS/2's answer to TSRs

Well-defined rules for device monitors and screen pop-ups in OS/2 replace the messy, undocumented shenanigans perpetrated by many DOS TSR utilities, according to Dan Rollins.

In the past few years, pop-up utilities have evolved from a curiosity to a necessity. Today, the power user's PC is fully loaded with a calculator, notepad, outliner and keyboard macro, all of which can be terminate-and-stay-resident (TSR) utilities. A vital part of any such pop-up utility is a routine that waits for and reacts to the event that triggers the pop-up. This is a complex problem that was never satisfactorily solved under DOS.

OS/2, however, provides a class of programs known as device monitors that simplify, standardise, and enhance this process. A device monitor is a program that tracks (or monitors) the data stream being processed by a character device driver.

The problem with pop-ups under DOS is that multiple resident programs represent a form of multi-tasking, a capability that DOS was never meant to support. Even when dormant, a pop-up must perform some processing to examine the events occurring in other processes (for example, keyboard input or the state of the timer) and to decide whether or not to spring into action.

Because DOS does not provide nor enforce rules for the interaction of multiple programs, most pop-ups use undocumented DOS functions (interrupt 28-H), hardware idiosyncrasies (video controller registers), and even hard-coded addresses within DOS (the critical error flag) to perform their magic. No two manufacturers use these in the same way, and the resulting difficulties have been described many times: some pop-ups are incompatible with some application programs or have unpleasant side effects (such as crashing the system) when used in combination with other pop-ups.

As a multi-tasking operating system, OS/2 can regulate and oversee multiple concurrent programs. For the first time, developers have a legitimate interface for writing pop-up utilities without underhanded shenanigans. Further, with a few lines of C code in OS/2, a programmer can complete a task that takes pages of assembly language, spaghetti logic in DOS.

The OS/2 pop-up interface involves two functions. First, the pop-up must be able to recognise a trigger — perhaps a timer-based event or the pressing of a mouse button. Most pop-ups are triggered when a selected key is pressed. This ability is provided by the keyboard device driver in the form of device-monitor support.

Second, most pop-up utilities need access to the screen when they are triggered. This ability is provided by the OS/2 video system, and allows for any program to take control of the screen and keyboard, and move itself into the foreground.

In one respect, OS/2 gives pop-up features to every program written for this operating system. The user can press a hot-key to toggle between screen groups to access a program. Unless the programs are specifically written to co-operate, however, they will be totally isolated from one another.

Of course, a primary use of a pop-up is to affect the interrupted program in some way. A keyboard macro utility would be useless if it could not feed keystrokes into an application. A pop-up calculator is convenient, but one that can type a result into the document being edited would be more valuable. A real-time spelling checker must be able to see the words you type *as* you type them.

Example programs (see listings) illustrate a keyboard device monitor, video system pop-up control, and a combination of the two.

Device monitors

A device monitor is simply a program that uses a set of OS/2 functions to gain access to an I/O stream within a device driver (see Fig 1). This program may be written in assembly language or any high-level language that supports OS/2 application program interface (API) calls. The monitor effectively becomes part of the device driver. It examines every piece of information or packet processed by the driver. The monitor can remove a packet, pass it in its original or modified form, or add new packets to the data stream.

Each device driver can have multiple monitors, which are arranged in a chain. The first monitor receives data from the driver and passes on its output to the next monitor; the last one in the chain passes any output back to the device driver.

The device driver can allow or disallow monitoring. Of the OS/2 device drivers,

```
DosMonOpen     obtains a monitor handle to be used in subsequent
               monitor calls.

DosMonOpen( DeviceName, MonHandle );
 char far *DeviceName;      ASCIIZ string, eg, "KBD$"
 unsigned *MonHandle;       Receives the handle


DosMonReg      Setup monitoring buffers and select the logical
               device index.

DosMonReg( MonHandle, InBuf, OutBuf, PositionCode, Index );
 unsigned  MonHandle;       Handle obtained from DosMonOpen()
 char far *Inbuf;           Address of buffer for DosMonRead()
 char far *OutBuf;          Address of buffer for DosMonWrite()
 unsigned  PositionCode;    1=front, 2=back, 0=don't care
 unsigned  Index;           Device-dependent (screen group for KBD$)


DosMonRead     Read (optionally wait for) a data packet from the
               device driver.

DosMonRead( InBuf, WaitFlag, DataBuf, ByteCount );
 char far *InBuf;           Same address as InBuf used in DosMonReg()
 unsigned  WaitFlag;        0=await next packet, 1=no wait
 char far *DataBuf;         Buffer receives incoming data packet
 unsigned *ByteCount;       Entry: size of DataBuf; Return: size of packet
```

```
DosMonWrite    Read (optionally wait for) a data packet from the
               device driver.

DosMonWrite( OutBuf, DataBuf, ByteCount );
 char far *OutBuf;          Same address as OutBuf used in DosMonReg()
 char far *DataBuf;         Buffer containing outgoing data packet
 unsigned  ByteCount;       Size of the packet in DataBuf


DosMonClose    Terminate a monitor.

DosMonClose( MonHandle );
 unsigned  MonHandle;       Handle obtained from DosMonOpen()

VioPopup       Move calling process into foreground and allocate
               a temporary screen.

VioPopup( WaitFlag, 0 );
 unsigned  *WaitFlag;       0=no wait, 1=wait for screen availability
 unsigned   (reserved);     Must be 0

VioEndPopup    Release control of the popup session.  The process
               interrupted by VioPopup() is returned to the
               foreground and its screen is restored.

VioEndPopup( 0 );
 unsigned  (reserved);      Must be 0
```

A program that uses monitors and pop-ups can be written in assembly language or any high-level language that supports OS/2 API calls. The C language protocol for calling the monitor and pop-up API functions is shown here. Prototypes for these and all other OS/2 functions are available in header files that are supplied with Microsoft's OS/2 Software Development Kit

only the printer (LPT*n*), mouse (MOUSE$), and keyboard (KBD$) provide monitor support. No support is provided for monitoring asynchronous communications (COM*n*) or the real-mode console device (CON). A program can issue an I/O control (IOCTL) function (category OBH, function 60H) to determine whether a given device supports monitors.

A monitor can be a detached process, tracking I/O for other processes, or it can be local to a particular application. Any process can split off a monitoring thread to watch for and preprocess keyboard events without affecting other programs. Thus, a monitor can be used as an equivalent of the BASIC ON KEY . . . command, but with more flexibility. For example, a word processor could use a built-in keyboard monitor to handle all command and function keystrokes, removing them from the normal keyboard input stream.

A device monitor is installed and activated in three phases. First, the monitor notifies the driver that it wants to be installed into the monitor chain. Second, it registers its input and output buffers for receiving data from the driver and passing them back. Third, it monitors the I/O stream by reading from and writing to these buffers.

The monitor is opened with a call to DosMonOpen. This call requires the address of an ASCIIZ device name and returns a monitor handle, which is used during subsequent registration and closing operations. A non-zero return code indicates an error: either an invalid device name was used or the device does not support monitors.

A 'C' program using any OS/2 API calls should include the header files DOSCALLS.H and SUBCALLS.H. The function prototypes in these headers not only check for the correct number and type of arguments, but also cast parameters into the correct data types. Near pointers are coerced into far pointers — an essential programming shortcut and safety device.

The next step is to register the monitor. The monitor process uses the DosMonReg call to: notify the device driver that a monitor is about to become active; indicate the location and size of two monitoring buffers; and provide additional information used in setting up the monitoring process.

The monitoring buffers must be large enough to hold the packets passed by the device driver; this size is established when the device driver first creates an empty monitor chain. The monitor process uses an unusual technique to determine this size. When DosMonOpen is called, the first 16-bit word in each buffer must contain the size (in bytes) of the buffer. Should the specified size be too small to contain a packet, the call will return with an error code, and the *second* word of each buffer will contain the size of an I/O packet. Adding 20 bytes to this value gives the actual minimum size of the monitor buffer. The extra 20 bytes are for operating system overhead in buffer management.

After these buffers are registered, the process should not access them again; OS/2 controls all transfer of data to and from these areas. The monitor will receive copies of each packet and will pass the buffer addresses in subsequent API calls, but it must not access the data in the buffers directly.

The fourth parameter to the DosMonReg call is a position code that indicates where this monitor wants to be placed in the chain. The monitor can ask to be first or last, or it may indicate 'don't care' to accept any placement. A monitor at the front of the chain has the first chance to modify or remove a packet. It has the most direct control over the data as they come from the device. A monitor at the back of the chain can see (and modify or remove) any packets inserted by other monitors. It has the most control over the actions of other monitors and over the final appearance of the packet passed back to the driver.

Monitors have one problem reminiscent of a common difficulty of keyboard interrupt handlers used in DOS: two or more processes fighting for a particular keystroke. There is no way of knowing if a particular hot-key has been used by another monitor. The monitor receives no notification of its position in the chain, and it cannot determine whether the

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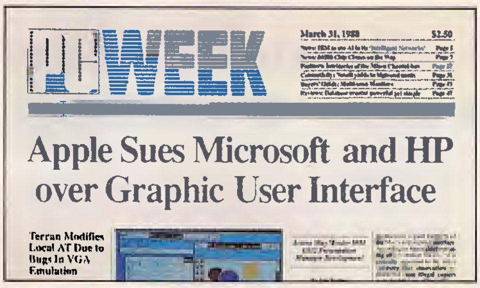
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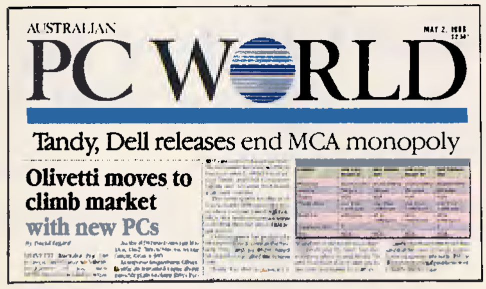
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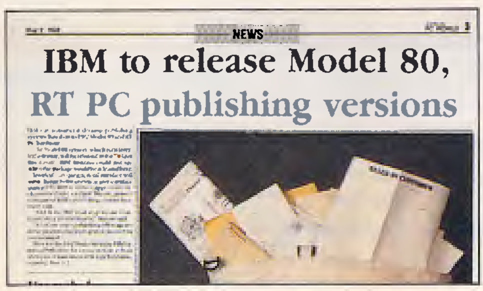
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source and destination of the packets it handles are those of the driver itself or those of another monitor. The first monitor to ask to be put at the front of the chain is actually placed there. Monitors registered later are always placed later in the chain, in order of request. The ones requesting the end of the chain are treated similarly.

For example, if a keyboard macro program uses Alt-Z as a hot-key, it normally removes that key from the data stream. Monitors installed later in the chain never see Alt-Z. This problem has no obvious solution — it is impossible to 'steal back the vector'.

Several ways to avoid hot-key collisions are available; most of them are the same as those in DOS. The simplest way is to instruct the user that this monitor must be installed before any other monitors. This method obviously breaks down if more than one monitor needs to be first. Another method is to have the user pick a non-conflicting keystroke and configure the program accordingly. Another alternative is to reconfigure dynamically by initially looking for several hot-keys, then nullifying all but the first one to make it into the monitor: the user is told to try all the hot-keys and to stick with the first one that works. To increase the chances of selecting a unique keystroke, OS/2 makes it easy to recognise unusual Shift-key combinations or even to use time-stamp sensitivity; for example, the program could look for a double click of a Shift key.

The fifth DosMonReg parameter, the index, is used in conjunction with logical devices. Because a character device driver may be handling several logical devices, it needs to know which instance of the driver should be monitored. The meaning of this index can vary from driver to driver. For printer monitors, the index should be O. For keyboard and mouse monitors, the index should specify which screen group the process wants to monitor.

The process of specifying a screen group involves a separate subplot. When a monitor is executed as a detached process, it is not associated with any screen group. It must learn the ID of the active screen group (for example, the CMD.EXE session from which the DETACH command was executed), and it must use that value as the index. The DosGetInfoSeg call can be used to determine the current screen group.

A program can always pass an arbitrary value in the index parameter. For example, the screen group ID for the session manager menu is 1. The real-mode screen group is 2 (although, as described below, there are problems in monitoring the 3xBox keyboard). The VioPopup session for video pop-up utilities has an index of 3. Such arbitrary values are not documented and may change in the future.

A process can monitor more than one instance of a logical device. A keyboard monitor could keep track of several screen groups; for example, it could provide a cut-and-paste capability between sessions, or maintain a common set of keyboard macros. To do so, a program would just open the monitor and use the same monitor handle to register two or more separate sets of buffers. Each monitor should execute as an independent thread and should be registered for the desired device index (screen group).

Once the monitor has been opened and registered, the final step is to begin the read/process/write loop. The monitor calls DosMonRead to read incoming data packets from its registered input buffer. Depending on the value of the

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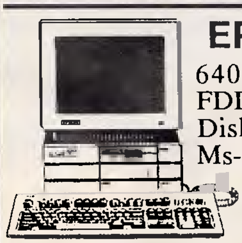

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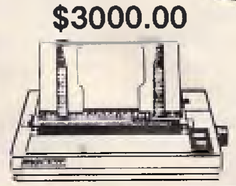

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wait-flag parameter, this call can block the monitor until data are in the buffer, or it can return with an error code. When successful, DosMonRead copies the packet from the input buffer into the monitor's local buffer. The monitor can then examine and process the packet. Typically, this involves testing for the hot-key and reacting appropriately.

A call to DosMonWrite sends packets down the monitor chain; this copies data from the local buffer to the registered output buffer. If a program needs to consume a keystroke, it can read it without writing it. If a program needs to insert keystrokes into the stream, it can create data packets and write them before it reads the next keystroke.

The read/process/write operation should be a tight loop. The monitor code effectively becomes part of the device driver. Thus, lengthy delays must be avoided, such as waiting for a semaphore or handling any sort of disk I/O. If a printer monitor were to wait on a semaphore, all printing performed by that driver would come to a halt.

If such delays are likely, the monitor should start a thread dedicated solely to the read/write/process loop. If a potentially time-consuming operation is indicated, it should be handled by other threads of the process.

The keystroke packet

Writing a device monitor requires having access to the device-driver specifications for the layout and content of data packets passed into the monitor chain. The data packet used by the OS/2 keyboard driver is shown in Fig 2. The first word contains monitor flags (see Fig 3) that are present in some form in all monitor data packets. For keyboard packets, the first byte contains the hardware-level scan code of the key described by the packet; the driver may choose to examine this byte to recognise the hot-key. This word should be set to 0 for packets inserted by the monitor.

Although the example keyboard monitors presented later in this article ignore it, the flag word can be important in other monitor implementations. Besides information specific to the device driver (this should be documented in the driver specifications), the flag word indicates whether the packet is a normal data packet that is part of the device I/O stream, or a request for special processing. Each monitor must pass on each special-request packet after performing whatever processing is appropriate to open or close the device or flush any internal character queues.

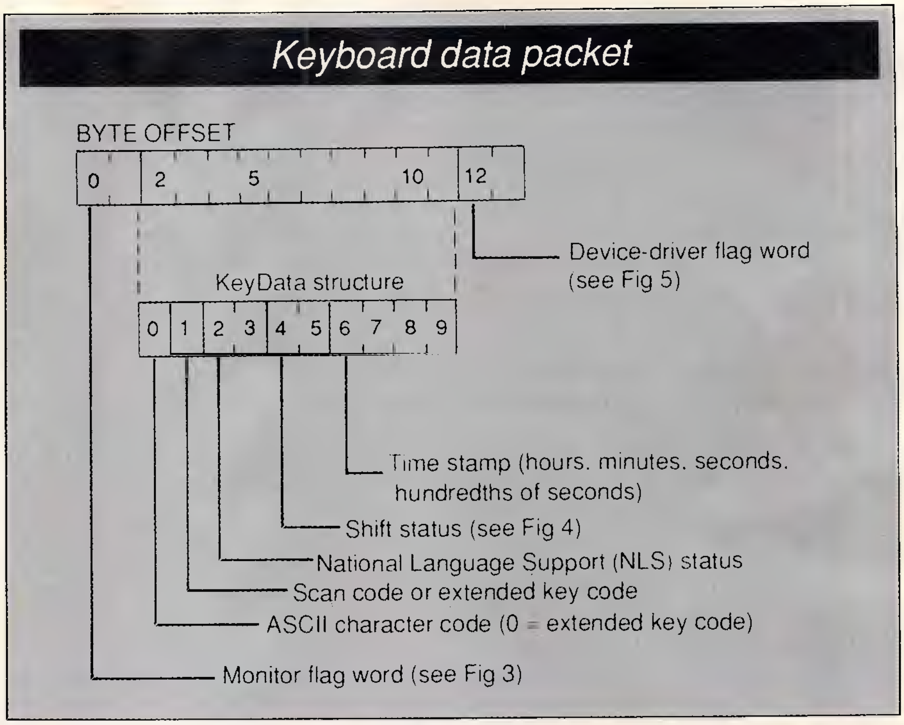

Fig 2 The keyboard device driver KBD$ passes the data packet (record) into the monitor chain for each keystroke. A programmer who wants to write a device monitor must know the layout of data packets created by the device driver

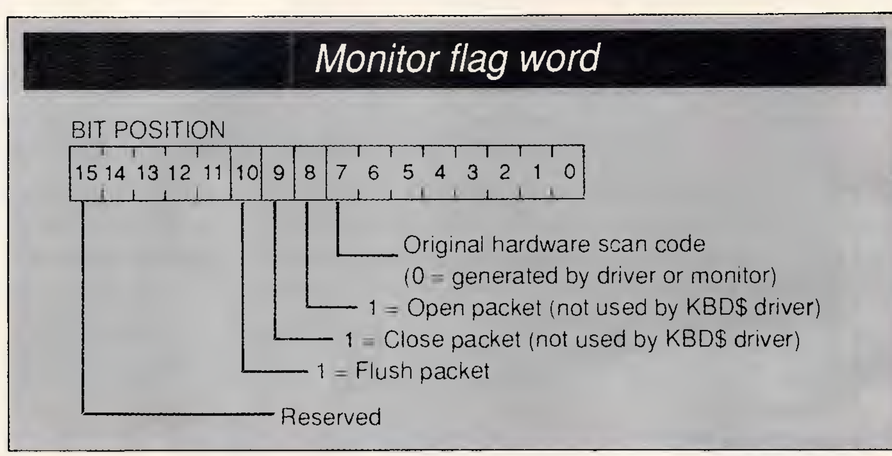

Fig 3 The first word of any driver's data packet contains system-defined and driver-specific flags. A packet with bits 7, 8 or 9 set identifies a request for special processing; such a packet must be passed down the chain by every monitor

The flush request must be handled expeditiously, because the monitor chain does not accept input until the flush packet traverses the entire chain and reaches the driver. The flush operation is not implemented in any of the example drivers because they pass character packets singly without queuing them. Therefore, there is nothing left to flush.

The body of the packet is similar to the data obtained from a call to the API function KbdCharIn. This 10-byte structure is defined in the SUBCALLS.H include file and is named KeyData. It contains the ASCII character code, scan code, shift status, and information about 2-byte characters from foreign-language code sets.

The KeyData.shift_state field (Fig 4) is of special interest. A program can monitor for an undefined keystroke by checking for a selected shift state together with another key.

The KeyData.time field shows the time when the packet was generated to the nearest hundredth of a second. Most

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monitors can ignore this field, but it does present some practical possibilities. For example, a process that monitors both the keyboard and the mouse can use the time field to check for simultaneous events.

The final word of the data packet, KbdDDFlagWord (Fig 5), contains significant information. Bits 0 through 5 indicate one of the special types of packets, as shown in table 1. If the pattern in these bits is 3FH, the packet describes an undefined keystroke that a monitor might intercept for its own purposes; a pattern of 13H indicates that the user pressed PrtSc. A keyboard monitor can simulate any of these special codes by inserting a packet with the desired values into the keyboard data stream.

Bit 6 of KbdDDFlagWord is set to 1 on packets generated by the release of a key. By checking this bit, you can differentiate the key break from the key make. In other respects, the make and break packets are identical.

A simple monitor example

CLICKMON.C (Listing 1) illustrates the fundamental operations of a keyboard device monitor. It opens the monitor, sets an arbitrarily large buffer size, determines the current screen group, and registers the buffers. Finally, it drops into the read/process/write loop.

ClickMon is compiled and linked with the command

```
cl -Lp -Zp clickmon.c
```

Depending on the configuration of your system, you may need to specify a **–I** option to help the compiler find the include files, and you may need to set a **LIB** = variable into the environment to help the linker find the libraries. The **–Zp** compiler option prevents the insertion of slack bytes to align on word and double-word boundaries; this option should be used in nearly all programs that use OS/2 kernel calls, because many system structures are defined with byte-level alignment.

After successful compilation, the monitor is executed with the command

```
detach clickmon
```

ClickMon simply beeps the speaker each time the keys are pressed. It closes the monitor and terminates whenever the Esc key is pressed. Experimentation with ClickMon shows why such a simple exit mechanism is provided — a detached process must supply its own exit or remain resident permanently. That can cause undesirable side effects as a detached program is developed. For example,

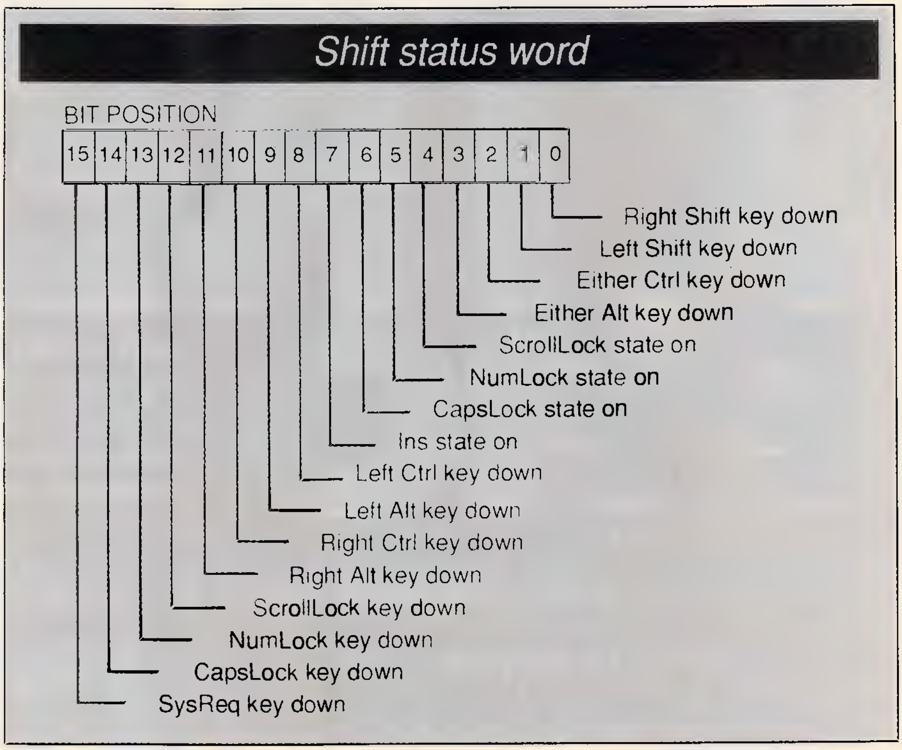

Fig 4 The information in the shift status word is the same as that in bytes 40:17 and 40:18 of the BIOS data area. This information is sent in every packet so that it reflects the status when the key was pressed, not when the monitor processes it

you cannot delete or rename the running version, so you cannot create another version with the same name. Users should also appreciate the ability to de-install monitors cleanly after they have outlined their usefulness; under DOS in most cases, that was possible only by rebooting the system.

ClickMon pares off as much complexity as possible, making it perfect for experimental purposes. In the DosMonReg call, you might try to hard-code an index value of 1. Now ClickMon has no effect in the screen group where it is started. When you hot-key into the session manager menu (Ctrl-Esc), however, notice that the keyboard is clicking in this screen group.

If screen group 2 (the real-mode session) is monitored, some curious behaviour becomes apparent. Each keystroke causes a click, indicating that the monitor is reading correctly. However, the write operation seems to fail because the keystroke never makes it down the chain to the 3xBox application. The official word from Microsoft is that device monitors are not supported in real-mode.

ClickMon clicks on all keystrokes, including the Shift key. It is programmed to ignore the release of a key, but it also could monitor for that. Furthermore, ClickMon responds to undefined keystrokes, such as Alt-NumLock. In other words, you can monitor nearly every possible low-level keyboard event. The exceptions include the session-manager hot-keys (Ctrl-Esc and Alt-Esc) and Ctrl-Alt-Del: these are handled by the device driver or passed directly to the session manager and never make it into the monitor chain.

Using just the tools of a simple keyboard monitor along with the standard C library functions, you can extend the monitor to carry out such tasks as logging keystrokes to a disk file, remapping areas of the keyboard, performing real-time spelling checking, and intercepting keystokes that might cause problems (such as Ctrl-Break or Ctrl-PrtSc).

ClickMon lacks the ability to act like the archetypal pop-up; programmers need a way to construct fancy windows and interact with the user. In real-mode, a program can just start writing to the screen; in protected mode, it first must politely ask the operating system's permission and then use only the tools provided.

Pop-up services

The VioPopup and VioEndPopup functions are designed expressly for use in pop-up utilities. When a process senses

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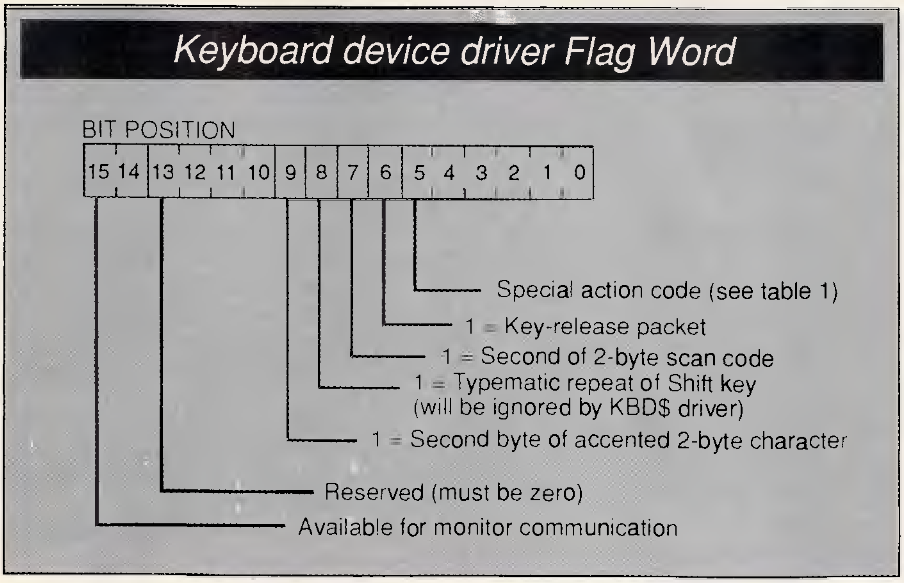

Fig 5 The flag word marks packets that need special processing, such as combining several packets into one character (which is used in national language support)

a pop-up trigger, it can call VioPopup to move itself pre-emptively into the foreground. Whatever process was visible is switched into the background, and the pop-up program takes control. The effect is similar to that of going through the session manager to get to a new screen group. When a process pops up, it runs with a separate logical keyboard, mouse, and screen.

TIMEPOP.C (listing 2) illustrates the basic techniques. Like CLICKMON.C, TIMEPOP.C is designed to be executed as a detached program. This program lurks in the background and periodically pops up to remind you time is passing. While the pop-up window is on the screen, pressing the Esc key de-installs the program; any other key closes the pop-up window, restarts the timing interval, and returns to the interrupted task.

Notice how short the program is. TIMEPOP.C contains no code for saving and restoring the screen of the interrupted application. In text modes, that task is handled by the operating system. The operating system also saves and restores the screen mode, the cursor shape and position, and any IBM EGA/VGA palette programming. However, OS/2 requires graphics-based applications to provide their own screen save-and-restore functions.

As illustrated by the TimePop program, pop-ups can occur over both real or protected modes in the foreground. The pop-up program must be loaded in protected mode, however, because the pop-up API functions are not supported in real-mode.

A program is limited in what it can do while popped up. For instance, it cannot access either the logical or physical video buffers directly, but must use the API calls. Fortunately, the performance of the OS/2 video calls is quite good — a far cry from the sluggish real-mode BIOS and DOS screen handling.

In general, a program can write text and attributes, scroll or clear the screen, set the cursor position, and get current screen-mode information. It cannot change the screen mode, re-program the EGA/VGA palette, install a video subsystem, re-define a font, print the screen, or perform other more advanced tasks.

One important limitation is that only one VioPopup can be active at a time. There is exactly one VioPopup session. If another process controls the VioPopup screen, any other program is barred from access to that screen.

In the pre-release version of OS/2, VioPopup's operation was seriously flawed. This version always selected an 80-by-25 text mode, cleared the screen, and homed the cursor. Of course, that eliminated much of what pop-ups are all about. The production versions from both Microsoft and IBM provide a 'transparent' option that allows you to overlay a smaller window over the background text. It also provides access to the data on the overlaid screen (consider how many pop-up utilities gain information from the cursor position and the text beneath the cursor).

Putting it all together

The CHARMENU.C program (listing 3) juxtaposes the concepts of device monitors and video system pop-up control. Besides illustrating the tools in a real-life program, it is a useful utility.

CharMenu monitors the keyboard, looking for either of two hot-keys — Alt-C or Alt-Spacebar. When Alt-C is recognised, it pops up a menu of hard-to-type ASCII characters, such as box-drawing characters, smiling faces, and Greek characters. The cursor keys point to the desired character, and is selected by pressing Enter. The character is then inserted into the keyboard data stream, as if a series of Alt-NumPad keystrokes had been given.

Alt-Spacebar is a shortcut. It inserts the most recently selected character into the data stream without displaying the menu. This feature is most handy after a horizontal bar character (ASCII 196 or 205) has been selected. Just press Alt-Spacebar and let it repeat across the screen.

Like ClickMon, CharMenu begins by opening the monitor for the KBD$ device. The monitor handle is saved and used in subsequent monitor calls. The next step is a more elaborate, generalised version of the registration process. First, the program checks for

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Special action codes in KbdDDFlagWord

VALUE	MEANING
00H	**No special action.** This packet contains a normal or extended-ASCII keystroke that will be placed into the keyboard input buffer (KIB).
01H	**ACK:** Low-level keyboard acknowledgement; for example, this packet is sent after hard reset.
02H	**Secondary prefix** Generated by enhanced keyboard as a prefix. The scan-code field in the KeyData structure is usually OEH. The *next* packet will have KbdDDFlagWord bit 7 set.
O3H	**Keyboard over-run.** Generated when the keyboard hardware issues a signal indicating internal buffer overflow.
04H	**Resend.** Generated when the keyboard hardware requests that low-level command data be resent.
05H	**Reboot.** Used when Ctrl-Alt-Del is pressed. This packet will *not* be sent through the monitor chain.
06H	**Standalone dump.** Generated on the second consecutive press of Ctrl-Alt-NumLock. The driver is supposed to dump memory and CPU status to disk. This packet is not sent to the monitor chain.
07H	**Shift key.** Indicates that the packet is one of the defined shift keys (Shift, Ctrl, Alt, NumLock, etc). The packet will affect the values of subsequent shift status fields, but it will not put a value in the KIB.
08H	**Pause key.** Generated on Ctrl-NumLock (or Pause on the enhanced keyboard).
09H	**Pseudo-Pause key.** Generated when Ctrl-S is pressed.
0AH	**Wake-up key.** Indicates completion of previous Pause action. The keystroke is not placed into the KIB.
0B-0F	(Reserved).
10H	**Accent key.** This packet contains an accent key, as defined in the current keyboard translation table. Setting KbdDDFlagWord bit 9 will generate the accent character itself. Otherwise, this packet will be combined with the *next* packet to generate an accented character such as à or ñ.
11H	**Break key.** Generated when Ctrl-ScrollLock (or Ctrl-Break on the enhanced keyboard) is pressed.
12H	**Pseudo-Break key.** Generated when Ctrl-C is pressed.
13H	**PrtSc key.** Generated whenever Shift-PrtSc (or PrintScreen on the enhanced keyboard) is pressed.
14H	**Print-echo key.** Indicates toggle of screen-to-printer echo function. Generated when Ctrl-PrtSc is pressed.
15H	**Pseduo-print-echo key.** As above, but it is generated whenever Ctrl-P is pressed.
16-2FH	(Reserved).
30H	**Status change.** Generated when keyboard shift status is modified externally; for example, via KbdSetStatus or DosDevIOCtl. The character-code and scan-code fields in the KeyData structure are undefined and should be ignored.
31H	**Written key.** This packet is generated by a DosWrite call when the KBD$ device is the destination. The KeyData packet will always be placed into the KIB.
32-3EH	(Reserved).
3FH	**Undefine.** Generated by a keystroke that cannot be translated by the driver. This value is used on packets containing undefined keystrokes such as Alt-PrtSc, Ctrl-Shift-Z, and Atl-Del.

Table1 The values in bits 0 through 5 of the device driver flag word (see Fig 5) identify the kind of special processing needed by certain keyboard packets

the correct buffer size by making a call to DosMonReg, specifying a buffer size of 0. When this call returns with an error, the second word in the buffer contains the required data packet size. The next call, requesting 20 bytes more than the packet size, then succeeds in registering the buffers.

The program then goes into the monitoring loop. The DosMonRead call is performed with the wait option, so execution is blocked until a packet comes in. Once the packet has been read, it is checked to see if it contains either of the hot-keys.

To sense Alt-C, the program compares the packet's character and scan code with the desired values. However, the second hot-key, Alt-Spacebar, is an undefined key — Spacebar always returns the same character and scan code, regardless of the state of the Shift keys. CharMenu tests for the keystroke by checking for the character code and then testing for the Alt-Shift key bit in the packet's Shift-key flags.

When an Alt-Spacebar packet arrives, the program writes a packet containing the most recently selected character. Several fields are set to 0 on such an inserted packet, similar to what happens on packets that are generated when Alt is pressed followed by a series of NumPad keys.

CharMenu looks for both the press and the release packets of its hot-keys, removing both from the I/O stream. For a key-press packet, the program takes action and discards the packet without passing it down the chain. When a release packet is encountered, the program ignores and discards it. This prevents spurious key-release packets from being sent down the chain. Although such extra packets pose no problems to the driver, they could confuse intervening monitors.

When CharMenu sees an Alt-C, it calls the function DoMenu. This function illustrates a more complex use of VioPopup. It attempts a no-wait pop-up. If this fails, the program beeps out a tune and resumes without taking control of the screen. This sequence may be needed if a program has locked the screen or if another VioPopup session is already active. This precaution is probably unnecessary here — CharMenu is not active while any VioPopup is active, because it monitors only its original screen group. It is a good practice to use this technique, however, especially in timer-triggered pop-ups that are not tied to any one logical device.

Next, the menu is drawn and the interactive portion of the program begins. This program uses standard techniques introducing

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for handling a cursor-bar menu. Perhaps most interesting is the use of VioWtrNAttr to remove and redraw the cursor bar highlight with each keystroke. The beauty of this function is that the text at the cursor does not need to be rewritten; only its video attribute needs to be changed.

The arrow keys move the highlight. The Enter key selects the currently highlighted character; Esc aborts the menu without selecting a character; and Q causes CharMenu to terminate itself. Whatever key is pressed, the VioEndPopup service is called to release the pop-up screen and return the interrupted program to the foreground.

An examination of the interactive code reveals that the standard library function, Getch, is used in preference to the KbdCharIn call. This illustrates an important facet of OS/2 programming: just because a kernel call exists does not mean it must be used. Getch is convenient and it works, so there is no reason to use the lower-level system call.

This simplicity comes at some cost in performance, however. Getch eventually calls KbdCharIn, which takes longer than if the program called the API function directly. This could be a consideration in extremely time-critical applications. The greater portability of standard library functions is not an issue, because an OS/2 pop-up utility is specific to its operating environment, regardless of which function it uses.

> *'Monitors have a problem reminiscent of keyboard interrupt handlers used in DOS: two or more processes fighting for a keystroke.'*

Flexible monitors

As mentioned earlier, a monitor can be used as an equivalent of the BASIC ON KEY . . . command, but one with far more flexibility. Because a keyboard monitor sees all key presses and releases, it can allow an application to act on a variety of unusual keyboard events — a double-click of a Shift key or a super-shift combination such as LeftShift-RightShift-Z. A keyboard monitor can perform useful services, such as speeding up typematic repeats and eliminating keyboard run-on. An intelligent keyboard monitor can recognise and mask differences between various types of keyboards.

Another idea is to cross-monitor two different devices. A keyboard monitor could be used to simulate mouse events or vice versa, by monitoring both for unique combinations of keyboard and mouse events. For example, a program could detect mouse movement or a button press that occurs while a Shift key is pressed and differentiate it from normal mouse events.

In OS/2, IBM and Microsoft have designed a system that incorporates the best features of DOS while providing multi-tasking and multi-threaded operation. They moved all the old BIOS operations under the operating system's umbrella, made them faster, and provided new and better tools for creating the next generation of applications. The OS/2 pop-up tools illustrate the extensive planning and creativity that went into the new operating system.

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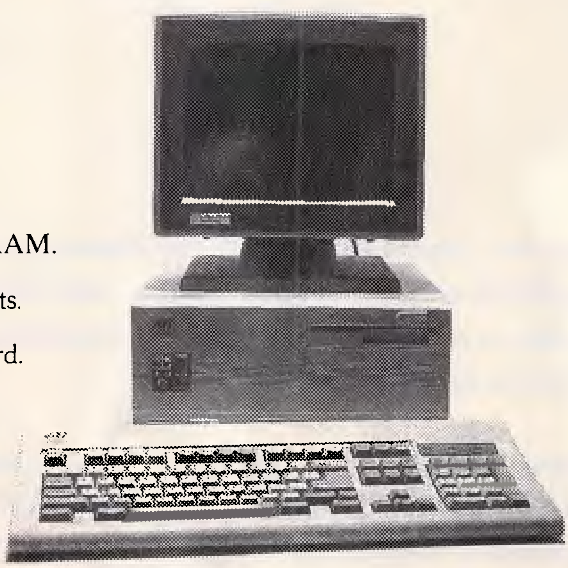

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Sending an n-gram

Roy Kimbrell explains how short character strings called n-grams give every document a unique signature.

Here's the problem: you maintain a full-text database of all the stories printed by a large daily newspaper. With several hundred issues stored, you want to find all the stories relating to a particular subject. How do you do it?

The keyword approach is too limited; the database contains too many subjects. Artificial intelligence (AI) won't help much; machines and programs aren't that smart yet. You could use special pattern-recognition hardware, but the cost is prohibitive. The solution to the problem might be a novel approach developed by Raymond D'Amore and Clinton Mah at PAR Government systems in the US. Their technique is simple, elegant, and it works. It uses pieces of words which they call n-grams.

Fingerprinting documents

An n-gram in a sequence of a specified number of characters occurring in a word. For example, the two-character n-grams (or 2-grams) in the word 'duck' are 'du', 'uc', and 'ck'. An n-gram vector is a list of the n-grams found in a document and the number of times each was found, as shown in Fig 1.

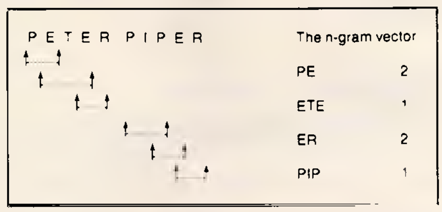

Fig 1 In this n-gram extraction, four kinds of n-grams are included in the vector for the phrase 'Peter Piper'. This vector contains two 2-grams (each of which occurs twice) and two 3-grams. Note that n-grams can overlap

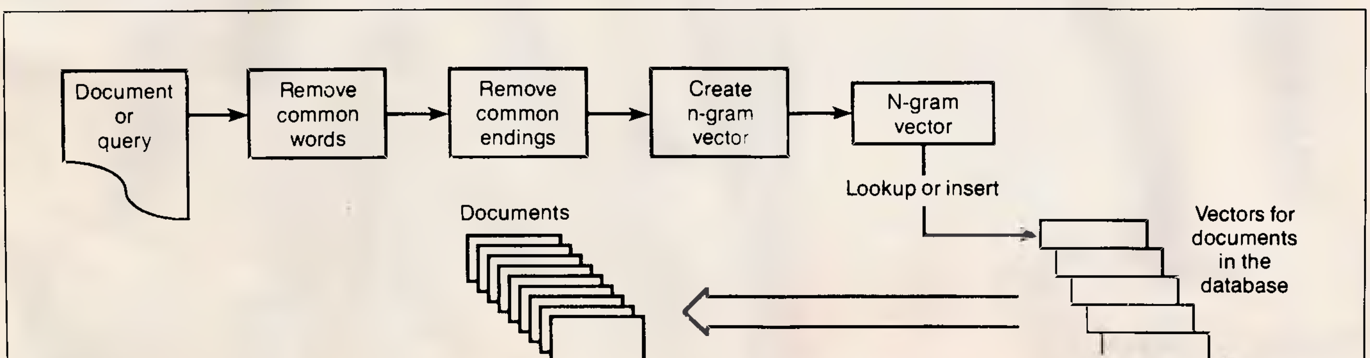

Fig 2 An n-gram vector is a list of the n-grams in a text document, minus all common words and common endings. The n-gram vector is stored with a pointer to the location of the full-text document. By comparing the n-gram vector of a query to those of stored documents, you can find documents likely to contain what you're looking for

To set up a document-retrieval system using n-grams, you derive an n-gram vector for each document as you are storing it. The n-gram vector comes from the text. It is an index of the document, a unique 'fingerprint' that you can use to identify it. To create the n-gram vector, you remove the common words from the text, then remove the common endings from the remaining words. Finally, count selected n-grams in the word fragments that are left and keep them in a list.

You then store the n-gram vector with a pointer to the location of the full-text document. You might want to store the vector along with other vectors that are similar to it.

Now you are ready to retrieve documents using words, phrases, or sentences that describe the subjects of interest. You can even use a sample document as a query to find others similar to it. To do this, you create an n-gram vector of the query and compare it to the vectors of the documents. The retrieval program computes the degree of similarity between the query's n-gram vector and those of the documents. When the similarity is great enough the program selects the document, as shown in Fig 2.

Beyond 2-grams

To differentiate all but the shortest documents, counting only 2-grams is not sufficient. Some 2-grams are very common, such as 'te'. Others, like 'qz', never occur. The common 2-grams don't have much value in indexing a document. For an index to be useful, it must differentiate between dissimilar documents. But if an n-gram occurs often in every document, it doesn't tell you anything. Similarly, those that don't occur at all also have no value.

Rather than throwing away the common 2-grams, we can extend them to 3-grams. For example, rather than using 'te', you would count all possible 3-gram combinations that use 'te'; that is, 'tea', 'teb', 'tec', and so on.

D'Amore and Mah say that about 200 of the 676 possible alphabetic 2-grams (26 x 26) occur frequently enough to be candidates for extension. Unfortunately, many 3-grams are also very common; but you can extend the common 3-grams to 4-grams, and so on. Extending the n-grams improves the system's performance. However, you don't always need to go to 4-grams to index a document. The shorter the document, the smaller the size of the n-gram necessary to index it. Short documents of a few hundred words might need only 2 or 3-grams (as common as they are) to differentiate them from one another. For example, 2-grams alone work well enough with directories, such as telephone books.

D'Amore and Mah use about 12,000 different 2, 3 and 4-grams to index documents. An n-gram vector created using all these terms won't have 12,000 n-grams in it, however. The number of n-grams occurring in a document increases slowly as the number of words in it rises; a 3000-word document, for example, might have only 600 different n-

```
/* this structure holds a directed graph
   used to recognize common words */
#define GRAFSIZE  405
struct {
  char c;
  char wordend;
  int next;
  int alt;
    } stopgraf[GRAFSIZE] { }
/* The data used to initialize stopgraf is
   given later


*/
int stopword(word,wl)
     char word[]
     int wl;    /* word length */
/*
     stopword enters the common word graph
     with the value in word[]; if word[] is
     in the graph, return 1, else 0
*/
{
int j=0, p;
  p = word[j] - 'a' + 1;  /* the first
           entry is 1, not zero */
  while (j < wl-1 && p) {
    j++;
    p = stopgraf[p].next;
    while (p && stopgraf[p].c < word[j])
              p = stopgraf[p].alt;


    if (stopgraf[p].c != word[j]) p = NULL;
    }
  return(p && stopgraf[p].wordend);
  }
```

Listing 1 COMMON.C, a C program used to recognise common words

a	before	each	got	just	more	or	should	things	well
about	began	earth	great	keep	most	other	show	think	went
above	being	end	had	kind	mother	our	side	this	were
after	below	enough	hand	know	Mr.	out	since	those	what
again	between	even	hard	land	much	over	small	thought	when
air	big	ever	has	large	must	own	so	three	where
all	both	every	have	last	my	page	some	through	which
almost	boy	eyes	he	left	name	paper	something	time	while
along	boys	far	head	let	near	part	sometimes	times	white
also	but	father	help	life	need	parts	soon	to	who
always	by	feet	her	light	never	people	sound	together	why
an	called	few	here	like	new	picture	still	too	will
and	came	find	high	line	next	place	story	took	with
animals	can	first	him	little	night	put	study	two	without
another	children	following	his	live	no	read	such	under	word
any	come	food	home	long	not	right	take	until	words
are	could	for	house	look	now	said	tell	up	work
around	country	form	how	looked	number	same	than	us	world
as	day	found	I	made	of	saw	that	use	would
asked	days	four	if	make	off	say	the	used	write
at	did	from	important	man	often	school	their	very	year
away	different	get	in	many	old	second	them	want	years
back	do	give	into	may	on	see	then	was	you
be	does	go	is	me	once	sentence	there	water	your
because	don't	going	it	men	one	set	these	way	
been	down	good	its	might	only	she	they	we	

Table 1 This list contains 258 of the most common words in English. Such words fail to help distinguish documents from one another, and removing them makes documents' n-gram vectors more unique

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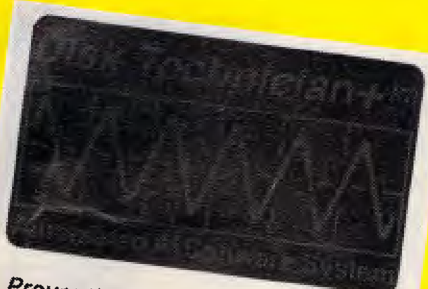

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While there is a current index and you haven't run out of characters in the word,
  Get the next character from the word.
  Set the current index to the *next* value.
  While you have a current index and your current character in the word is greater than the character stored in the current table entry,
    Set the current index to the value at *alt*.
  Endwhile.
  If the character at the entry for the current index isn't the same as the current character in the word, you don't have a common word.
Endwhile.
When you finally come to the end of the word, if the current table entry's *wordend* flag is set and you haven't otherwise eliminated this word, it is a common word.

Table 2 The logical operation of the function in listing 1 after establishing a beginning current index

grams. But if you have to keep track of 12,000 different n-grams, it would seem to make sense to use 4-grams instead. Not so — there are too many of them. There are 676 2-grams if you use only alphabetic characters. But there are 17,576 alphabetic 3-grams, and almost half a million alphabetic 4-grams.

You can also include non-alphabetic characters in n-grams. The only ones generally useful are numbers, which occur frequently in documents and are often the subject of queries. 'Commodore 64', '256k of RAM', and 'The Acme Hard Disk with 40Mbytes of storage' could all occur in a document and thus be the subjects of a query.

None of the numeric and alphanumeric n-grams possible are considered common. You should probably store purely numeric n-grams as 3-grams. There are only 1000 possible numeric 3-grams. Compared to the number of alphabetic n-grams, this is a relatively small number.

Cut out the noise

Another way to reduce the number of n-grams you need to differentiate documents is by noise reduction. Noise, for purposes of indexing, is information contained in a document that doesn't add much to your ability to find that document. Punctuation is considered noise. Common words such as 'a', 'the', 'by', and 'for' are also noise.

Table 1 contains a list of 258 of the most commonly used words in English. They comprise about 55 per cent of the words used in the written language. Your database may have different common words. (If your database consists of articles about computers for example, such words as 'mother' and 'father' might occur less frequently.) Because they are so common, these words add little information to text analysis. However, you must carefully consider their elimination. 'Mother', 'Father', 'children', and 'school' might be quite common in some contexts, but eliminating them might remove important information, particularly in an academic or sociological-factors database. Also, some words are homonyms. 'Begin', the name of the

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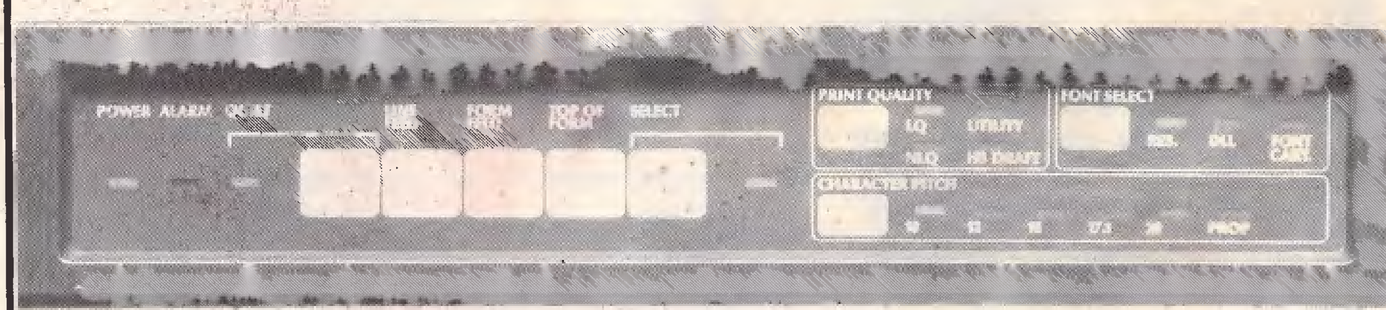

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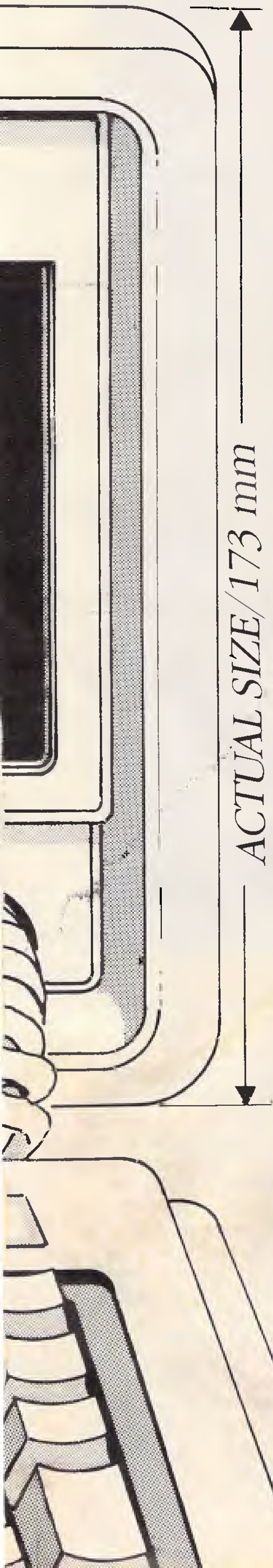

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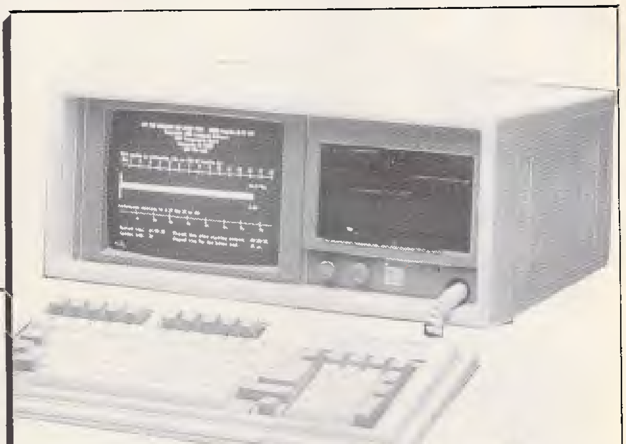

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```
/* A Conflating Function in C */

#define LT -1
#define EQ  0
#define GT  1
slteqgt(s1,s2)
  unsigned char *s1, *s2;
/* compares two strings */
{
  for(;;){
    if (*s1 < *s2) return(LT);
    if (*s1 > *s2) return(GT);
    if (*s1 == *s2 && !*s1) return(EQ);
    s1++; s2++;
    }
  }

/* the following are locations in
   the conflation table */
#define SSend    3
#define Eend     10
#define IONend   12
#define ARYend   14
#define ABLend   20
#define IVend    22
#define ATend    23
#define ISend    24
#define FIN      27
#define ENDINGS  28
struct{
  char *ending;  /* ending string */
  int   offset;  /* length */
  char *replace; /* replacement */
  int   replen;  /* length */
  int   next;    /* goto */
   } endings[ENDINGS] {
        "ably",    4,   "",     0,  ISend,
        "ibly",    4,   "",     0,  FIN,
        "ily",     3,   "",     0,  SSend,
/*SS*/  "ss",      2,   "ss",   2,  FIN,
        "ous",     3,   "",     0,  FIN,
        "ies",     3,   "y",    1,  ARYend,
        "s",       1,   "",     0,  Eend,
        "ied",     3,   "y",    1,  ARYend,
        "ed",      2,   "",     0,  ABLend,
        "ing",     3,   "",     0,  ABLend,
/*E*/   "e",       1,   "",     0,  ABLend,
        "al",      2,   "",     0,  IONend,
/*ION*/"ion",      3,   "",     0,  ATend,
        "",        0,   "",     0,  FIN,
/*ARY*/"ary",      3,   "",     0,  FIN,
        "ability",7,    "",     0,  ISend,
        "ibility",7,    "",     0,  FIN,
        "ity",     3,   "",     0,  IVend,
        "ify",     3,   "",     0,  FIN,
        "",        0,   "",     0,  FIN,
/*ABL*/"abl",      3,   "",     0,  ISend,
        "ibl",     3,   "",     0,  FIN,
/*IV*/ "iv",       2,   "",     0,  ATend,
/*AT*/ "at",       2,   "",     0,  ISend,
/*IS*/ "is",       2,   "",     0,  FIN,
        "ific",    4,   "",     0,  FIN,
        "olv",     3,   "olut",4,   FIN,
/*FIN*/"",         0,   "",     0,  FIN+1};

stem()
/*  if the ending of word[] is in
   endings.ending, it is removed and any
   replacement string is tacked on the
   end; search and replacement is
   controlled by endings.next */

{
int i;
extern char word[];
extern int wl;
  i = 0;
  while(i<ENDINGS){
    if (slteqgt(&word[wl-
              endings[i].offset],
          endings[i].ending) == EQ){
      cpystr(
          &word[wl-endings[i].offset],
          endings[i].replace,NULL);
      wl += endings[i].replen -
          endings[i].offset;
      i = endings[i].next;
      }
    else
      i++;
    }
  }
```

Listing 2 CONFLATE.C. This routine will stem a word down to its root

former Israeli prime minister, is spelled the same as 'begin'. Eliminating 'begin' also, unfortunately eliminates 'Begin'.

Listing 1, COMMON.C, provides an efficient method for recognising these common words. A large table at the end of COMMON.C (not shown in listing 1) was taken from a spelling checker written in Pascal (thus the need for the program to offset subscripts by 1). It contains an array of structures, each with a single character, a 'wordend' flag, a 'next' index, and an 'alt' index.

A word fragment enters the table by converting the first character in the word to an index. This is simple: *a* is 1, *b* is 2, and so on. The 'next' index for this entry is taken to be the current index. From this point, the characters of the word aren't used as indices; they're just compared to the characters in each table entry. The function now works as in table 2.

This method is fast, and you can expand it to include more words. You can also compact the table if you wish.

You can even consider common word endings to be noise. 'Ended' and 'endings' have some root: 'end'. If you reduce both words to their common root, you eliminate superfluous differences, and the similarity measurements will improve. This process of stemming a word down to its root is known as 'conflation'.

Digging up the roots

Whenever a program must extract meaning from individual words of English text, the word forms are often conflated — that is, normalised or transformed into a simple, common form. Words such as 'civilisation', 'fishing', and 'halted' are transformed into their basic forms: 'civilise', fish', and 'halt'. At least that is the goal. To accomplish this, you need a set of rules similar to those used in knowledge-based systems. If you use only a few (20 or 30) rules, some transformations won't be accurate. 'Civilisation' might truncate to 'civilis'. A word like 'the' truncates to 'th', as do 'they' and 'these', when such words really shouldn't be conflated at all.

To deal accurately with this problem, you need 1000 or more rules that specify, for the most part, exceptions and special cases. When very high precision isn't necessary, a few rules will suffice, and the odd cases don't really matter.

The C function in CONFLATE.C (see

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	Peter Piper picked a peck of pickled peppers	How many pickled peppers did Peter Piper pick?	Pied Piper of Hamlin	Peter Piper	'Twas brillig, and the slithy toves did gyre and gimble in the wabe
Peter Piper picked a peck of pickled peppers	31.5	30.9	16.4	26.0	−2.2
How many pickled peppers did Peter Piper pick?	30.9	28.2	17.2	33.8	−1.9
Pied Piper of Hamlin	16.4	17.2	32.9	23.5	−9.9
Peter Piper	26.0	33.8	23.5	48.9	−1.7
'Twas brillig, and the slithy toves did gyre and gimble in the wabe	−2.2	−1.7	−0.9	−1.9	20.8

Fig 3 This table shows the similarities between five phrases, four of which resemble one another. The similarities were computed using the method shown in the accompanying box 'Making it work'. Higher values indicate greater similarity, while lower (or negative) numbers indicate dissimilarity. If, for example, you set the threshold to 25 and the query was 'Peter Piper', the system would select the first two phrases. If the query was 'Pied Piper of Hamlin', the system would select neither of those phrases

listing 2) does a simple-minded job of conflation. The table 'endings' is an array of structures that contains the rules. Each structure has the text of a word ending, its length, a possibly zero-length replacement string, *its* length, and the index of the next table entry so the program can check whether the current word ending matches one stored in the structure.

A word enters the table at 'ending[0]'. If the word ends in 'ably', the program truncates it. The process repeats, starting at 'ending.next'. However, if the word does not end in 'ably', then 'ibly', 'ily', 'ss', and so on are checked in order. The checking (and replacing) continues until the program reaches the end of the table. Notice that there are three endings where the check string is zero-length. The first two are traps to prevent falling through to the lower part of the table. The last terminates execution of the function.

For example, the word 'readabilities' passes the first few rules and then matches 'ies'. The program removes 'ies' and replaces it with 'y'. The word becomes 'readability'. Matching then continues at 'ending[14]'. The program matches and removes 'ability'. The word becomes 'read'. The 'endings' table is checked at location 24, but matching fails to the end. Notice that these rules don't always create reasonable stems. 'Movabilities' conflates to 'mov', 'invisibilities' to 'invis'. However, the program also conflates 'move' and 'invisible' to 'mov' and 'invis'. In other words, all forms of the same word conflate to the same root, although the root may not be the one you would expect.

Useful n-grams: worth the weight

Rare n-grams are more useful in discriminating between different documents than are common ones because the rare ones are weighted more heavily during similarity computations. The system's performance determines the weighting scheme used. D'Amore and Mah have found the following to work well: $W_i = 1/\sqrt{P_i}$ where W_i is the weight to be used for n-gram number i, and P_i is that n-gram's probability of occurrence.

> *'False similarity can occur when the similarity threshold is too low. You're less likely to miss a document but more apt to get dissimilar ones.'*

You can calculate the probability that a specific n-gram will occur by counting all the occurrences of that n-gram in a large, representative body of documents. Then you divide this count by the total number of n-grams. You must calculate a weight for each n-gram used as an indexing term, but you do it only once; after that, the weight is a constant you look up in a table.

Computing similarity

To determine the similarity between two n-gram vectors, you multiply the frequencies of corresponding n-grams by their weights and sum the results. When two n-grams are dissimilar, the sum of the products of the corresponding frequencies is small: where one vector has some of a particular kind of n-gram, the other hasn't any or has only a few. When the two numbers are multiplied, the result is zero or a small number. If two n-gram vectors are similar, they have more of the same n-grams, and the result is larger.

There is a scale of similarity then, from small similarity values to large ones. When responding to queries against a set of n-gram vectors for documents, you must determine the threshold above which you wish to select a document and below which you wish to reject it. Fig 3 represents the system's ability to discriminate between text items using similarity values.

You can get raw similarity values by multiplying corresponding n-gram counts and weights and adding the products. The size of these raw values depends as much on the n-gram vector size as on the counts in the vectors. That is, two documents might be equally similar to the third, but similarity computations will probably produce different values. The

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longer document will probably have a longer n-gram vector (because of the greater chance for having some of the rarer n-grams in it). In a longer vector, there is a greater opportunity for matching corresponding n-grams in another vector during similarity computations. This means the similarity value will be larger.

The method for reducing the similarity values to a common measure, called the normalisation process, is a little complicated. You need to compute an estimate of the standard deviation and the expected value of the similarity values. The standard deviation is a measure of the variability of raw similarity values, and the expected value is a mean, or average value.

Many of the values needed to compute the standard deviation are constants for a particular set of n-gram indexing terms. In addition, you need the total number of n-grams counted in each vector (the lengths of the vectors). For the formulae to use in normalising the raw similarity values, see the accompanying box 'Making it work'.

The n-gram system is large, complicated and can malfunction. A malfunction occurs when a similarity computation produces a value unexpectedly large enough to cross the similarity threshold you have set for document selection. Few, if any, of the words from the query might actually appear in the document. When a query contains mostly common n-grams, the chance for false-similarity matching is relatively high. This happens more frequently when you use only 2-grams or 3-grams as indexing terms. The purpose of extending the n-grams to longer strings is to reduce their frequency and therefore the chance of false similarity.

False similarity can also occur when the similarity threshold is set too low. This reduces the chance of missing a document, but increases the chances of getting documents that don't apply to the query. In a mature system, false similarity can be well controlled and is relatively rare.

Using a thesaurus

Synonyms can be a problem, particularly in short documents. For example, in a newspaper story about an aircraft accident the word 'aeroplane' might never appear. Instead, words such as 'craft', 'jet', and 'Boeing 747' might be used. Further, 'mishap' might not appear, while 'accident' or 'crash' does. In other words, a query of 'aeroplane mishaps' might fail to produce this story from the database.

To circumvent this problem, you can implement a thesaurus containing groups of words with similar or related meanings as well as synonyms. You create an n-gram vector for each word group. You only need to keep the vectors on-line; you don't need to use the words themselves during similarity matching. You can now compare the query to the n-gram vectors representing the thesaurus.

Those vectors that are similar to the query probably contain some of the words in it. Then you can use the query's n-gram vector and the thesaurus's n-gram vectors that are similar to the query and compare them to the documents' n-gram vectors. A similarity above the threshold indicates which documents to retrieve.

Creating the thesaurus is no small task. There are a lot of words to collect into groups and a lot of decisions to make. Your best bet might be to build the thesaurus a little at a time, as problems appear.

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Natural clusters

One alternative to the thesaurus is clustering. There is a natural tendency for documents with related subject matters to have similar n-gram vectors. You can look at one document as a complicated query, and other similar documents as the results of that query. The documents similar to one another are clustered. You can create an n-gram vector for a cluster of documents by adding the corresponding n-gram counts in each vector to create a new vector that represents the cluster of documents.

When one document in a cluster is selected because the similarity between its vector and that of the query is greater than the threshold, the rest of the documents in that cluster are better candidates for selection. You might want to reduce the similarity threshold for the other documents so more of them will be selected. This helps prevent the synonym problem. However, if only one or very few of the documents in the cluster exhibit any similarity to the query, it is probably a spurious match. Using clustering can avoid false matching and missing valid documents.

When a database contains many documents, computing similarity between a query and each of the vectors can take a long time. Clustering can reduce the search time. Instead of scanning individual n-gram vectors during a search, you look at the vectors representing the clusters. When a cluster is similar to a query, you can either retrieve each document in the cluster or scan the vectors of the cluster documents for similarity. To place a new document in a cluster, you must scan existing cluster vectors for similarity and, when you find one that meets or exceeds your threshold, add the n-gram counts in the new vector to the existing cluster vector. If you can't find a similar cluster, you can create a new one.

Fine-tuning

Once you select a document's n-gram vector, you can retrieve the document. In a large database, you may select many documents. A few may have similarity with only part of the query or may be completely spurious. Rather than present the documents immediately, you can re-scan each of the selected documents, eliminating the common words and stemming the rest. This time you compute n-gram vectors for individual words and compare them to the query's n-gram vector. This is a rapid process because a vector for a single word will be short; there are only a few n-gram types and therefore only a few multiplications to do. If there is sufficient similarity, the program considers the word significant and displays it with the document's identification. Then you can see how close the document comes to satisfying the query and choose which documents to select.

You can tune the retrieval operation to ignore mild mis-spellings in either the queries or the documents. Dropping a character or transposing two characters, for example, "spelling mistkaes," is considered a mild mis-spelling. If, during the search, you lower the similarity threshold a bit, you will select documents with word variations. Some n-grams will match, though probably not the mis-spelled ones. If you have done some form of stemming, the word variations will not be due to grammatical differences, but to mis-spellings.

The theoretical model

D'Amore and Mah developed a model based on these concepts to convince doubters that these methods are valid and to predict the performance of new systems.

In testing their system, D'Amore and Mah used a variety of documents: about 1700 from the Associated Press, 1200

Making it work

Step 1: Select the 10,000 to 15,000 2, 3, and 4-grams to be used as potential members of n-grams vectors. If the documents are short (such as telephone directories), you may need only 2 and 3-grams, or even just 2-grams.

One way to select the n-grams is to find a large body of text representative of the text you want to store and search. Count the various 2-grams in it. Take the 200 or so most common 2-grams and add characters (at the end). Each common 2-gram will expand to 26 3-grams. Count the number of 3-grams that occur in your representative documents. Expand the 150 or so most common 3-grams to 4-grams. (If you want somewhat better performance, you can also expand the 100 most common 4-grams to 5-grams.)

If your documents are anything like ordinary text, you will end up with about 12,000 n-grams. You won't find many of the expanded n-grams in your representative text; they are either nonsense or very rare — you won't be able to tell which in most cases. For these n-grams, just assign an arbitrary count of 1.

Step 2: Compute the probability of occurrence of each n-gram in the indexing set you've just created. This is the number of times the n-gram was found divided by the total number of n-grams counted.

Step 3: Compute weights for each n-gram. The weight is used to emphasise rarer n-grams and de-emphasise more common n-grams when computing similarity. They improve the performance of the system.

D'Amore and Mah found that the following formula works well: $W_i = 1/\sqrt{P_i}$, where i indicates an individual n-gram W_0 is the weight for the first n-gram in the set, W_1 is the weight for the second, and so on; P_i is the probability computed for the individual n-grams.

Step 4: Compute the following constants (they will be used during the calculation of similarity values):

$$C_0 = sum_i[W_i * P_i^2]$$

$$C_1 = sum_i[W_i * P_i^3]$$

$$C_2 = sum_i[W_i * P_i^4]$$

$$C_3 = sum_i[sum_j[W_i * P_i^2 * W_j * P_j^2]]$$

where i not $= j$

The *sum* here means 'compute the value inside the brackets for each n-gram and add up the values'. In the last, C_3, the weight times the probability squared for each n-gram is multiplied by the weight times the probability squared for every other n-gram. That is, the first is multiplied by the second, third, fourth, etc; the second by the third, fourth, etc; and so on. The values for all these multiplications are added together.

Step 5: Create an n-gram weight table. This table will contain the n-grams to be used in n-gram vectors and the as-

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They used about 12,000 n-grams of various lengths to index the documents. They started with one document and gradually increased the size of their database. As they added documents, the model counted the number of unique n-grams it encountered. This number was proportional to the logarithm of the number of documents in the database.

Much of the work went to developing a theoretical framework for characterising the statistical properties of n-gram indices. This is important because D'Amore and Mah wanted to be able to describe the noise in n-gram indexing and calculate an n-gram vector's relevance to a document. This is critical if you are to retrieve documents using an n-gram vector created from a query and to collect similar documents.

Based on some assumptions about how text is generated, they described the statistical distribution of n-grams mathematically. Using this distribution, you can compute the similarity between two text items and statistical significance of that similarity.

To validate their model, D'Amore and Mah took pairs of vectors from random text items to approximate a noise level. They also took pairs from different segments of the same text item to estimate the difference between similar vectors (those from the same text item) and dissimilar vectors (those randomly chosen). They conducted many such experiments and calculated statistical measures for each batch to compare against the model's predictions.

'The n-gram indexing system is adaptable to several different situations . . .'

In their words: "The statistical model was validated in extensive experiments with a broad variety of text. The results were especially noteworthy because one seldom can make any good predictions about the general statistical characteristics of language . . . and n-gram description of text does contain significant information about its content." For an example of how to program an n-gram vector, see the accompanying box 'N-gram vectors in C'.

Plusses and minuses

There are some drawbacks to this new indexing method. First, it's complicated, in terms of both implementation and computation. Getting a new n-gram system up and running requires isolating and selecting thousands of n-gram indexing items and going through many processing steps.

Second, the n-gram method is memory and processor-intensive. Creating a vector requires the expensive lookup of many more n-grams than there are words. Computing similarity requires many floating-point multiplications and square-root calculations. These take time, especially if you use software to do the floating-point mathematics. Without considerable optimisation, looking up individual n-grams can be expensive.

Then, too, the system isn't exact. The meaning of the document isn't used to index it. Without this understanding, similarity computations can go astray and either find similarity where none exists or fail to find it when it does exist.

sociated weight for each n-gram. The table will be large, so storage and lookup might be a problem. While creating the n-gram vector for a document, n-grams are created and looked up in the table. If an n-gram is in the table, it is counted. When computing similarity, an n-gram's associated weight is used.

Step 6: Implement the algorithm to create an n-gram vector. (This is not the optimal way, but it is a simple way.) Scan each word in the text. Try the longer n-grams before the shorter ones. You can do this by sliding a window across the word. At first the window is four characters wide. Look this up in the n-gram weight table. If you find this n-gram, count it. If you don't, narrow the window to three characters and try again. Keep narrowing and trying until you find a countable n-gram.

Expand the window to four characters again, shift it to the right, and continue looking for countable n-grams. When narrowing the window, be sure you don't narrow the window so much that it falls completely within the previous window. It should (if possible) overlap the previous window, but extend outside it as well.

The n-gram vector is just a list of the n-grams found and their counts. Rather than saving the character-string representation of the n-gram, you might want to save its index in the n-gram weight table. This makes it easy to compare two n-gram vectors and to look up their respective weights.

Step 7: Implement the algorithm to compute the similarity between two n-gram vectors and thus the similarity between a query and a document or between two documents. Start by computing R, the raw similarity value between them. If you have vectors a and b, then $R = sum_i [W_i * N_i^a * N_i^b]$ where W_i is the weight for each n-gram, and N_i^a and N_i^b are the counts for the individual n-grams in each of the n-gram vectors (a and b are superscripts, not powers).

Step 8: Implement the algorithm to normalise the raw similarity value. Because the size of the raw value will depend on the relative sizes of the source documents for the vectors, you have to compensate for the document sizes. You do this by subtracting the expected similarity value from the raw similarity value and dividing by the estimated standard deviation of the raw similarity value.

The formula for the expected similarity value is $E = T^a * T^b * sum_i [W_i * P_i^2]$

where T^a is the total number of n-grams in the a vector, and T^b the total number in the b vector.

The formula for the standard deviation squared is $D^2 = T^a * T^b * (C_0 + (T^{ab}-2) * C_1 - (T^{ab}-1) * C_2 - (T^{ab}-1)) * C_3)$ where T^{ab} is $T^a + T^b$ and C_0, C_1, C_2, and C_3 are the constants computed in step 4.

The normalised similarity between the two vectors is then $S = (R-E)/D$. The normalised similarity values computed in this fashion seem to be stable and can be compared to one another and to constant thresholds.

Optional step: Rather than using raw n-gram counts, in each step where n-grams are counted, you can substitute the square root of the count. This transformation seems to improve performance somewhat.

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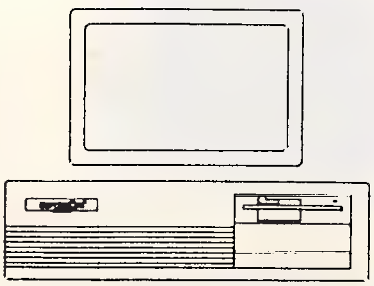

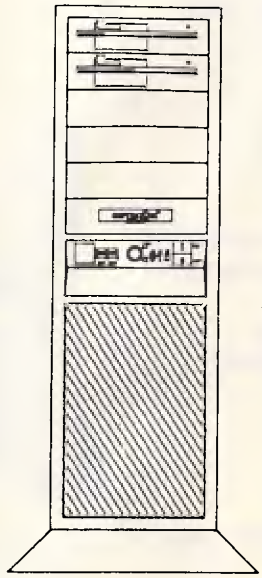

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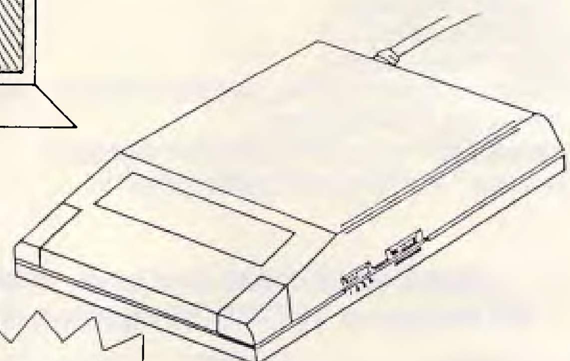

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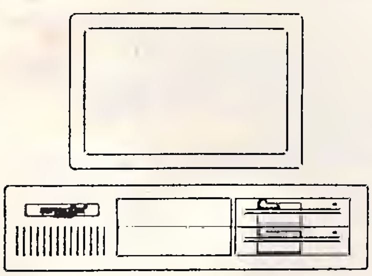

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N-gram vectors in C

N-gram.C in listing A is a central fragment of a real n-gram vector generator. The technique used here to extract n-grams from the text isn't used in practice; it's too slow. D'Amore and Mah use a highly optimised set of bit maps and tables to identify the n-grams to be used as indexing terms and to compute an index into a table of weights. This index also serves as a short, unique identifier for later use in an n-gram vector. Despite this deviation, this fragment of a program explains how to extract n-grams from text.

The program first defines a few constants and static variables. MAXNGLEN and MINNGLEN define the longest and shortest n-grams considered, respectively. The structure NGDATA defines an element of the n-grams array of 108,000 bytes that contains the n-gram strings used as index items and their weights.

The purpose of 'ngfind' is to extract n-grams from words. The word ('word') and word length ('w1') are inputs to 'ngfind', which uses a variable-size window to frame possible n-grams. Its rules are:

- Try a maximum-size window first. The maximum size MAXNGLEN or the word length, whichever is shorter. Look up this size n-gram in the 'ngrams' array using the 'lookup' function.
- If 'lookup' returns 0, shorten the window from the right and continue to look up n-grams.
- If you can't find an n-gram of length MINNGLEN (this is considered an error), shift the beginning of the window to the right and expand it to maximum length. The shortest n-gram should be a 2-gram, and if you can't find any longer n-grams, you should at least be able to find a 2-gram.
- When you find an n-gram, shift the window one position to the right and expand the window to maximum length.
- Don't allow the current window to fall completely within an older window — that is, don't look at the same data twice. When the end of the current window falls within the previous one, move its start to the right.

When you call 'lookup', it must find the input string in 'ngrams'. This is not a trivial task. Several methods are usable — B-trees, hashing, and so on. I used a hashing technique. The 'ngrams' array is static (lookups only), so you can change hashing parameters until you obtain an optimal storage profile. The value returned by 'lookup' is either 0, if the n-gram is not found, or the address of the string equal to the input n-gram string in the 'ngrams' array, if it is found.

```
#define MAXNGLEN  1
#define MINNGLEN  2
#define VECTORSIZE 12000
unsigned vector[VECTORSIZE];
#define WL  43
char word[WL];
/* longest English word
   is 42 chars */
int wl = 0; /* word length */
#define NNGRAMS 12000
struct NGDATA {
        char ngram[MAXNGLEN];
        float weight;
        } ngrams[NNGRAMS];
int ngcount(gramid)
        unsigned gramid;
{
vector[gramid]++;
}
int ngfind(word,wl)
        char word[];
        int wl;
{
int oldend, len, start;
unsigned gramid;
if (wl < MINNGLEN) return;
oldend = wl;
len = MAXNGLEN;
if (len > wl) len = wl;
start = 0;
for(;;){
 if (gramid =
  lookup(&word[start],len)){
   ngcount(gramid);
   oldend = start + len;
   if (oldend == wl) return;
   start++;
   len = MAXNGLEN;
   if (start + len > wl)
        len = wl - start;
       }
   else{
       if (len == MINNGLEN){
       /* didn't find 2-gram */
         start++;
         len = MAXNGLEN;
         if (start + len > wl)
             len = wl - start;
         if (len < MINNGLEN)
             return;
         }
  else{
       len--;
       if (start-len <= oldend)
           start++;
           }
       }
  }
main()
{
init();
while(wl=getword(word)){
       if (!stopword(word,wl)){
            stem(word,wl);
            ngfind(word,wl);
            }
     }
outvec();
}
```

Listing A: NGRAM.C, a fragment of a vector generator in C

The function 'ngcount' uses the return value from 'lookup' as an address in 'vector'. This works fairly well because 'ngrams' is much larger than 'vector'. There are many more locations in 'vector' than you need, but this unused space is your trade-off for speed.

In 'main', 'init' initialises 'ngrams'. The function 'getword' obtains the next word from the input stream. All characters have been converted to spaces. The function 'stopword' returns a 1 if 'word' is common; 'stem' conflates 'word'. Finally, 'outvec' writes the completed vector to a temporary file.

Trying to prevent this adds even more complexity to the system.

There are, however, good reasons for using n-gram indexing. For one thing, it works. I know of no better method for doing what n-gram indexing can do. Keyword solutions, the next best thing, are highly limited. Searching thousands of keywords is computationally more intense than n-gram indexing, and the system is biased toward whatever keywords you use. Appropriate keywords may also be inadvertently omitted. When you add new keywords to the system, you must re-index the database. Scanning the entire text to answer queries is costly in terms of time and equipment and doesn't work as well as n-grams do.

The n-gram indexing system is adaptable to several different situations, and you don't need to re-index the system to answer completely new questions.

Source code listings for COMMON.C, CONFLATE.C, and NGRAM.C are available for downloading through Microtex (*6663#) on Telecom'sViatel; or by sending a blank formatted 5.25in disk with a stamped, self-addressed package to: N-Gram, C/- APC, 124 Castlereagh Street, Sydney, 2000.

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COMPARE simplifies file matchups

COMPARE.COM takes the time and tedium out of finding the differences between two versions of either text or binary files, even when they have different lengths. Michael Mefford explains how.

When you've got two versions of the same document, how can you quickly find the differences between them? If your first thought is to use the DOS COMP utility, you've probably never tried to use it. If two files aren't exactly the same length, COMP won't even begin to compare them. And even if the files have the same number of bytes, COMP gives up after ten mismatches, which it reports in a disorienting hexadecimal format that assumes your files are binary executables.

What I wanted was to compare the original drafts of the articles I write for this column with their edited versions. The editing process catches more than gross mistakes, like the all-too-easy misuse of apostrophes in 'it's' that drives grammar fanatics crazy. Good editing also introduces subtler changes that eliminate ambiguities and prevent possible misunderstandings the author did not anticipate. Unlike old-fashioned blue-pencil edits, however, the emendations made electronically with a word processor are invisible. So if a writer is to improve his craft by learning from what his editors do, he needs a program to show him what those editors did. COMPARE.COM is my solution.

COMPARE.COM does what I think a practical compare program should do. It presents both documents simultaneously in on-screen windows, with only the individual differences highlighted. Differences between the two files are preceded with a few lines of the matching text to provide context. To make it a complete utility, it can also do binary compares for those occasions when you want to compare executable files. But above all, it is not confused by word-wrapped text.

This last requirement eliminated the existing compare utilities I've seen that work with text files. These all emulate the UNIX DIFF command, which compares files by lines. That's great for comparing program source files, since most compilers digest source code a line at a time. But a modern editor will almost invariably use a word processor that implements word-wrap and restructures the copy while editing. With word-wrap, a single word deletion or insertion can create a ripple effect that runs through the entire paragraph. This will confuse a line comparer, causing it to report that *all* the lines from the change to the end of the paragraph are different. Indeed, if a single change were made to each paragraph, a line comparer could conclude that the entire document was different! Thus, COMPARE.COM was designed not only to point out differences within a line, but also to be word-wrap aware.

The easiest way to obtain a copy of RECORDER.COM is to download it from Microtext on Telecom's Viatel (see page *6663#). Alternatively, you can create the .COM file either by assembling its source code, RECORDER.ASM, or by loading and running the RECORDER.BAS program. Both these listings are printed here and are also available for download from Microtex. And lastly, you could send a blank formatted 5.25in disk with a stamped, self-addressed package to: RECORDER, c/- *APC*, 124 Castlereagh Street, Sydney, 2000.

The syntax for using COMPARE is

```
COMPARE filespec filespec[/B][/W]
```

By default, COMPARE assumes that the two *filespecs* designate ASCII text files. COMPARE can digest non-ASCII elements in a file (for example, word processors' formatting commands for headers and margins and special character sequences that control saved cursor position and soft carriage returns), but it can't use them to control the screen display. For the purpose at hand, this should not be a major obstacle.

If you do encounter difficulties from any word processor formatting commands, remember most of the word processors that might cause trouble also have some kind of export or save facility that produces a straight ASCII format. With one prominent case in mind, I built in the optional /W switch, which instructs COMPARE to strip the high bit before doing a compare on WordStar document files so

```
                TITLE   COMPARE.ASM
                PAGE    60,132

;-----------------------------------------------;
;  COMPARE - Compares text and binary files     ;
;            - Michael J. Mefford               ;
;-----------------------------------------------;

_TEXT           SEGMENT PUBLIC 'CODE'           ;*******************************;
                ASSUME  CS:_TEXT,DS:_TEXT       ;*                             *;
                ASSUME  ES:_TEXT,SS:_TEXT       ;*  Requires MASM 2.0 or later *;
                                                ;*     Remember to EXE2BIN     *;
                ORG     100H                    ;*                             *;
START:          JMP     MAIN                    ;*******************************;

;
                DATA AREA
;               ---------
SYNTAX_MSG      DB      CR,SPACE,SPACE,SPACE,CR,LF

COPYRIGHT       DB      "COMPARE 1.0 (C) 1988 Ziff Communications Co.",CR,LF
PROGRAMMER      DB      "             ",BOX," Michael J. Mefford",CR,LF,CR,LF

                DB      "Syntax:  COMPARE filespec filespec[/B][/W]",CR,LF
                DB      "/B = Binary   /W = WordStar$",CTRL_Z

TAB             EQU     9
CR              EQU     13
LF              EQU     10
CTRL_Z          EQU     26
SPACE           EQU     32
BOX             EQU     254

CRT_MODE        EQU     49H
CRT_COLS        EQU     4AH
ADDR_6845       EQU     63H
TEN_K           EQU     10 * 1024
_64K_PARA       EQU     64 * (1024 / 16)
SPEC_LENGTH     EQU     80

LINE_CHAR       EQU     0CDH
LF_BAR_CHAR     EQU     0B5H
RT_BAR_CHAR     EQU     0C6H
BLINKING        EQU     10000000B

STATUS_REG      DW      ?
VIDEO_SEG       DW      0B000H
COLS            DW      ?
ROWS            DB      24


NORMAL_ATTRIB   DB      07H
INVERSE_ATTRIB  DB      70H
STRIP_MASK      DB      0FFH
SYNTAX_FLAG     DB      0
DISPLAY_FLAG    DB      1
MISMATCH_FLAG   DB      0
WINDOW_FULL     DB      0

FILE_START      DW      FILE1_BUFFER2, FILE2_BUFFER2  ;CONSTANT
FILE_POS        DW      2 DUP (?)
FILE_END        DW      2 DUP (?)
BUFFER_END      DW      FILE1_BUFFER2 + TEN_K, FILE2_BUFFER2 + TEN_K
WINDOW_POS      DW      2 DUP (?)
WINDOW_COL      DW      2 DUP (?)
WINDOW_LINE     DW      2 DUP (?)
WINDOW_SIZE     DB      ?

SAVE_COL        DW      80,80
SAVE_POS        DW      FILE1_BUFFER2, FILE2_BUFFER2
SYNC_POS        DW      2 DUP (?)


LINE_ARRAY      DW      2 DUP (4 DUP (?))
LINE_CAPACITY   DW      ?
STATUS_LINE     DW      ?
HEX_SEGMENT     DW      2 DUP (0)
HEX_OFFSET      DW      2 DUP (0)

FILENAME        DW      FILESPEC + 2, FILESPEC + SPEC_LENGTH + 2
FILE_HANDLE     DW      2 DUP (?)

NOT_ENOUGH      DB      "Requires 64K free RAM$"
BAD_MODE_MSG    DB      "Unsupported video mode$"
BINARY_NAME     DB      "COMEXE"
PROMPT          DW      PROMPT1, PROMPT2
PROMPT1         DB      CR,LF,LF,"Enter first file name",CR,LF,"$"
PROMPT2         DB      CR,LF,LF,"Enter second file name",CR,LF,"$"
NOT_FOUND_MSG   DB      CR,LF,"File not found$"

MENU            DB      "Press any key for next compare   Esc to Exit",0
MENU_LENGTH     EQU     $ - MENU - 1
WORKING_MSG     DB      "Working",0
WORKING_LENGTH  EQU     $ - WORKING_MSG - 1
DIFF_MSG        DB      "Files significantly different",0
DIFF_LENGTH     EQU     $ - DIFF_MSG - 1
SAME_MSG        DB      "Files are effectively identical",0
SAME_LENGTH     EQU     $ - SAME_MSG - 1
DONE_MSG        DB      "Compare completed",0
DONE_LENGTH     EQU     $ - DONE_MSG - 1

                CODE AREA
;               ---------
MAIN            PROC    NEAR
                                                ;String instructions forward.
                CLD
                                                ;Make sure we have 64K to
                MOV     BX,_64K_PARA            ; to work in.
                MOV     AH,4AH
                INT     21H
                MOV     DX,OFFSET NOT_ENOUGH    ;Exit if cramped, else continue.
                JNC     CK_SWITCH
                JMP     ERROR_EXIT

;-----------------------------------------------;
; Check for /B Binary and /W WordStar switch characters. ;
;-----------------------------------------------;

CK_SWITCH:      MOV     SI,81H                  ;Point to command line.
NEXT_SWITCH:    LODSB                           ;Get a byte.
                CMP     AL,CR                   ;Is it carriage return?
                JZ      PARSE                   ;If yes, done here.
                CMP     AL,"/"                  ;Is it switch delimiter?
                JNZ     NEXT_SWITCH             ;If no, next byte.
                MOV     BYTE PTR [SI-1],0       ;Else, ASCIIZ it out.
                LODSB                           ;Get the switch character.
                CMP     AL,CR                   ;Make sure it's not CR
                JZ      PARSE                   ; so we don't go past end.
                MOV     BYTE PTR [SI-1],0       ;ASCIIZ switch character also.
                AND     AL,5FH                  ;Capitalize.
                CMP     AL,"W"
                JNZ     CK_BINARY               ;If it's not "W", then skip.
                MOV     STRIP_MASK,7FH          ;Else, we will strip high bit.
CK_BINARY:      CMP     AL,"B"                  ;Is it "B"?
                JNZ     NEXT_SWITCH             ;If no, next byte.
                MOV     LINE_CAPACITY,16        ;Else, do hex compare.
                JMP     SHORT NEXT_SWITCH       ;Next byte.

;-----------------------------------------------------------------;
; Parse the command line for filespecs.  If one or both missing  ;
; or file can't be opened, prompt the user for filespec.         ;
;-----------------------------------------------------------------;

PARSE:          MOV     SI,81H                  ;Point to command line again.
                XOR     BP,BP                   ;Initialize filespec counter.
NEXT_PARSE:     LODSB                           ;Get a byte.
                CMP     AL,SPACE                ;Parse off leading delimiters
                JA      LEADING_END
                CMP     AL,CR                   ; as long as it's not ending
                JNZ     NEXT_PARSE              ; carriage return.
LEADING_END:    DEC     SI                      ;Adjust pointer.
                MOV     DI,SI                   ;Save as filespec start position.
                MOV     DX,SI

FIND_END:       LODSB                           ;Get a byte.
                CMP     AL,SPACE                ;Are we at end of filespec?
                JA      FIND_END
                MOV     BYTE PTR [SI-1],0       ;If yes, make ASCIIZ.
                PUSH    SI                      ;Save our place.
                PUSH    AX                      ;And save the character.
                CALL    OPEN_FILE               ;Try to open the file.
                JNC     RESTORE_PARSE           ;If successful, get next filespec
                CALL    PROMPT_USER             ; else, prompt user for filespec.
```

continued . . .

COMPARE.ASM The assembly language source code for COMPARE.COM

they will be displayed in normal ASCII characters. Fig 1 shows a sample of COMPARE's text output.

The optional /B switch forces COMPARE to do a binary compare on the two files. As shown in Fig 2, the mismatches in a binary compare are displayed in a hexadecimal format similar to that of DEBUG. However, there are a couple of slight differences between the output of COMPARE and DEBUG. For one, in the right-hand column, DEBUG substitutes a place-taking period for any non-alphanumeric character. COMPARE, more helpfully, displays each byte just as it appears in the ASCII symbol table. Further, COMPARE's segment offset starts at zero, whereas DEBUG uses the segment of the memory location and an offset starting at 100h. COMPARE is intelligent enough to do a binary compare automatically on .COM and .EXE files; for these, you don't have to remember to use the /B switch. The /B option enables you however, to instruct COMPARE to do a binary compare on any file you choose.

COMPARE will automatically help you if you misremember its syntax or misspell either of the filespecs. If you enter the syntax improperly, the correct syntax will be displayed. You will also be prompted for missing filenames. Once two filenames have been accepted, two windows are opened and a 'Working' message appears at the bottom of the screen while COMPARE goes about its business of looking for differences. Differences are displayed in reverse video. Both windows are filled with contiguous text, starting with a couple of lines prior to the highlighted mismatch, so you can see the differences in context. Press any key and COMPARE will search for the next difference.

When you've seen enough, pressing Esc will return you to DOS, keeping the last mismatch on-screen to serve as a reference. COMPARE will work in any display format except graphics. It's worth noting that you can display almost twice as much information on the screen if you first change the video mode to 43-line EGA before running COMPARE.

The compare algorithm

COMPARE doesn't use any of the complicated block matching, recursive 'longest matching sequence', 'longest common sequence', or symbol-building

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```
RESTORE_PARSE: POP     AX                        ;Restore last parsed character
               POP     SI                        ; and position.
STORE_START:   MOV     FILENAME[BP],DI           ;Store pointer to filename.
               ADD     BP,2                      ;Next filespec.
               CMP     BP,2
               JA      CAP
               CMP     AL,CR                     ;Was last character parsed CR?
               JNZ     NEXT_PARSE                ;If no, get next.
               CALL    PROMPT_USER               ;Else prompt user for filespec
               JMP     SHORT STORE_START         ; and store pointer to it.

;-----------------------------------------------------------------------;
; Capitalize filenames so parameter parsing can be done with one compare. ;
;-----------------------------------------------------------------------;

CAP:           MOV     BP,2                      ;Two filenames to capitalize.
CAPITALIZE:    MOV     SI,FILENAME[BP]           ;Point to filename.
NEXT_CAP:      LODSB                             ;Get a byte.
               CMP     AL,0                      ;Is it ASCIIZ?
               JZ      LOOP_CAP                  ;If yes, next name.
               CMP     AL,"a"                    ;Is it a lower case a - z?
               JB      NEXT_CAP
               CMP     AL,"z"
               JA      NEXT_CAP
               AND     BYTE PTR [SI-1],5FH       ;If yes, capitalize.
               JMP     SHORT NEXT_CAP

LOOP_CAP:      SUB     BP,2                      ;Capitaliza both names.
               JNC     CAPITALIZE

;-------------------------------------------------------------------------;
; Automatically do a binary compare if filespec has a .COH or .EXE extension. ;
;-------------------------------------------------------------------------;

               HOV     BP,2
BINARY:        MOV     SI,FILENAME[BP]           ;Point to filename.
NEXT_BINARY:   LODSB                             ;Get a byte.
               CHP     AL,0                      ;Is it ASCIIZ?
               JZ      LOOP_BINARY               ;If yes, done here.
               CHP     AL,"."                    ;Is it delimiting dot char?
               JNZ     NEXT_BINARY               ;If no, next byte.
               MOV     BX,2                      ;Two possible binary names --
               MOV     DI,OFFSET BINARY_NAME     ; .COM and .EXE.

NEXT_EXEC:     PUSH    SI                        ;Sava our place.
               PUSH    DI
               HOV     CX.3                      ;Do we have a match?
               REP     CHPSB
               POP     DI                        ;Restore our place.
               POP     SI
               JZ      BINARY_FILE               ;If match, mark a binary compare.
               ADD     DI,3                      ;Else point to next extension
               DEC     BX
               JNZ     NEXT_EXEC                 ; and check if it matches.
               JMP     SHORT NEXT_BINARY

LOOP_BINARY:   SUB     BP,2                      ;Do both filenames.
               JNC     BINARY
               JMP     SHORT READY

BINARY_FILE:   MOV     LINE_CAPACITY,16          ;Else, do hex compare.

;------------------------------------------------------------------;
; Line array is used to keep track of the start of file line displays ;
; so we can display three lines preceeding mismatch for context.    ;
;------------------------------------------------------------------;

READY:         MOV     AX,FILE_START[0]          ;Initalize current line-starts
               MOV     LINE_ARRAY[6],AX          ; of array to start of file.
               MOV     AX,FILE_START[2]
               MOV     LINE_ARRAY[14],AX

               CALL    VIDEO_SETUP               ;Prepare for video environment.
               CALL    DISPLAY_SETUP             ;Initialize display with heading
                                                 ; and window delimiting lines.

;----------------------------------------------------------------------;
; We will loop here filling the window with mismatchea until all displayed. ;
;----------------------------------------------------------------------;

DO_SEARCH:     CALL    SEARCH                    ;Search for mismatches.
               JNC     GET_KEY                   ;If not carry, not done yet.
               CALL    CLS_MENU                  ;If done, clear menu.
               MOV     DI,STATUS_LINE
               ADD     DI,COLS
               MOV     BH,NORMAL_ATTRIB
               CMP     MISMATCH_FLAG,1           ;Display appropriate message
               JZ      DO_DONE_MSG
               MOV     SI,OFFSET SAME_MSG
               SUB     DI,SAME_LENGTH AND NOT 1
               JMP     SHORT MESSAGE_EXIT
DO_DONE_MSG:   MOV     SI,OFFSET DONE_MSG
               SUB     DI,DONE_LENGTH AND NOT 1
               JMP     SHORT MESSAGE_EXIT

GET_KEY:       CALL    DISPLAY_MENU              ;If not done, display menu.
               CALL    CLEAR_KEY                 ;Clear any awaiting keystroke.
               CALL    READ_KEY                  ;Get a keystroke.
               CMP     AH,1                      ;Is it Esc?
               JNZ     DO_SEARCH                 ;If no, search for next mismatch.
               CALL    CLS_MEHU                  ;Else, clear menu
               JMP     SHORT GOOD_EXIT           ; and exit.

;------------------------------------------------------------;
; Exit with appropriate message and put cursor back on screen. ;
;------------------------------------------------------------;

ERROR_EXIT:    CALL    PRINT_STRING              ;Print error message.
               MOV     AL,1                      ;Exit with error level one.
               JMP     SHORT EXIT

MESSAGE_EXIT:  CALL    WRITE_STRING              ;Display exit message.
GOOD_EXIT:     MOV     DH,ROWS                   ;Move cursor to next to last
               DEC     DH                        ; line of screen.
               XOR     DL,DL
               XOR     BH,BH
               MOV     AB,2
               INT     10H
               XOR     AL,AL                     ;Error level zero.

EXIT:          MOV     AH,4CH                    ;Terminate.
               INT     21H

MAIN           ENDP

;              ***************
;              * SUBROUTINES *
;              ***************

;--------------------------------------;
; INPUT                                ;
;   None                               ;
;                                      ;
; OUTPUT                               ;
;   Carry flag = 1 if search complete  ;
;   Carry flag = 0 if more to search.  ;
;                                      ;
;   All registers destroyed.           ;
;--------------------------------------;

SEARCH         PROC    WEAR

;-----------------------------------------------------;
; Display "Working" message and initialization variables ;
;-----------------------------------------------------;

               CALL    CLS_MENU                  ;Clear the menu.
               HOV     SI,OFFSET WORKING_MSG     ;Display "Working"
               MOV     DI,STATUS_LINE
               ADD     DI,80 - WORKING_LENGTH AND NOT 1
               HOV     BH,NORMAL_ATTRIB
               OR      BH,BLINKING               ; with blinking attribute.
               CALL    WRITE_STRING

               MOV     AX,COLS
               SHL     AX,1                      ;Double for attribute.
               MOV     DI,AX
               SHL     DI,1                      ;Second line.
               MOV     WINDOW_POS[0],DI          ;Initialize window pointers
               MOV     DL,WINDOW_SIZE
               INC     DL
               MUL     DL                        ; to top left corner of
               ADD     DI,AX                     ; each window.
               MOV     WINDOW_POS[2],DI

               MOV     BP,2                      ;Restore the window columns,
RESTORE_WIN:   MOV     AX,SAVE_COL[BP]           ; window lines and file
               MOV     WINDOW_COL[BP],AX         ; positions to what they were
               HOV     AX,SAVE_POS[BP]           ; when one of the windows
               MOV     FILE_POS[BP],AX           ; was filled last search.
               MOV     AL,WINDOW_SIZE
               XOR     AH,AH
               MOV     WIMDOW_LINE[BP],AX
               SUB     BP,2
               JNC     RESTORE_WIN

               MOV     DI,OFFSET LINE_ARRAY      ;Initialize the array of
               MOV     AX,LIME_ARRAY[6]          ; line starts to the last
               MOV     CX,4                      ; line start from previous
               REP     STOSW                     ; search.
               MOV     AX,LIHE_ARRAY[14]
               MOV     CX,4
               REP     STOSW

               MOV     WINDOW_FULL,0             ;Flag that windows are not ful
               HOV     DISPLAY_FLAG,0            ;No display during search.

;--------------------------------------------------------------------------
; Check to see if End of File has been reached and/or windows have been filled ;
;--------------------------------------------------------------------------;

NEXT_SEARCH:   MOV     SI,FILE_POS[0]            ;Get current file position.
               MOV     DI,FILE_POS[2]
               CALL    STORE_WINDOW              ;See if current postion to be
               CALL    CK_EOF1                   ; frozen for next search.
               JNC     CK_WINDOW2                ;If both End of Filas reached
               CALL    CK_EOF2                   ; then compare complete.
               JNC     CK_WIN_FULL
               STC
               RET

CK_WINDOW2:    CALL    CK_EOF2                   ;If neither EOF then continue.
               JNC     BOTH_WINDOWS
CK_WIN_FULL:   TEST    WINDOW_FULL,111B          ;If one EOF and windows full
               JZ      COMPARE                   ; then return, else continue.
               JMP     SNORT SEARCH_END

BOTH_WINDOWS:  CMP     WINDOW_FULL,111B          ;If both windows full, return.
               JZ      SEARCH_END

;-----------------------------------------------------------------------;
; Files are compared a byte at a time until mismatch is found.           ;
; In comparing text files, if one byte is a carriage return and it is    ;
; mismatch with a space then both are ignored (line wrap); else just     ;
; the CR is ignored (word wrap).  No special treatment for binary files. ;
;-----------------------------------------------------------------------;

COMPARE:       MOV     BH,NORMAL_ATTRIB          ;Use normal attribute.
               CALL    CK_EOF1                   ;If either EOF then match
               JC      DO_MISMATCH               ; not possible.
               CALL    CK_EOF2
               JC      DO_HISMATCH
               MOV     AL,[SI]                   ;Get a byte from each file.
               MOV     AH,[DI]
               CMPSB                             ;Are they the same?
               JZ      FORMAT_BOTH               ;If yes, format display.
               CMP     LINE_CAPACITY,16          ;If no, is it a binary compare?
               JZ      DO_MISMATCH               ;If yas, mismatch.
               CMP     AL,LF                     ;Else, is it linefeed?
               JZ      ADJUST_2A                 ;If yes, ignore.
               CMP     AL,CR                     ;If CR, check if matched
               JZ      CK_ADJUST_2A              ; with a space character.
               CMP     AH,LF                     ;Do the same for both files.
               JZ      FORMAT_1A
               CMP     AH,CR
               JNZ     DO_HISMATCH
```

continued . . .

techniques associated with line-compare programs. These algorithms involve examining an entire file before reporting mismatches, so even transposition of large blocks can be detected. COMPARE's task is a little less ambitious and is limited to detecting smaller individual differences within files. Thus, it can use a variation of the simple 'scan until next matching sequence' algorithm. COMPARE examines corresponding bytes of each file until a mismatch is found. Using the mismatched positions as anchors, COMPARE then tries to re-synchronise the files by looking up to 400 bytes

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CK_ADJUST_1A:  CMP     AL,SPACE                 ;If CR matched with space,
               JZ      FORMAT_BOTH              ; format both characters.
ADJUST_1A:     JMP     SHORT FORMAT_1A          ;Else, just format the CR.

CK_ADJUST_2A:  CMP     AH,SPACE                 ;Do the same for other file.
               JZ      FORMAT_BOTH
ADJUST_2A:     XOR     BP,BP                    ;File one index.
               JMP     SHORT FORMAT_2A

FORMAT_BOTH:   XOR     BP,BP
               CALL    FORMAT
FORMAT_1A:     MOV     BP,2                     ;File two index.
               MOV     AL,AH                    ;Call format with character
FORMAT_2A:     CALL    FORMAT                   ; in AL.
               JMP     NEXT_SEARCH              ;Check next bytes.

DO_MISMATCH:   MOV     MISMATCH_FLAG,1          ;Flag that mismatch found.
               CALL    MISMATCH                 ;Go highlight the mismatrh.
               JMP     NEXT_SEARCH              ;Check next bytes.

SEARCH_END:    CLC
               RET

SEARCH         ENDP

;-----------------------------------;
; INPUT                             ;
;   AL = Character to format.       ;
;   BP = Index to file.             ;
;                                   ;
; OUTPUT                            ;
;   WINDOW_COL[BP]  WINDOW_LINE[BP] ;
;   WINDOW_FULL     FILE_POS(BP)    ;
;           are updated.            ;
;                                   ;
;   AX, BX, CX, SI and DI preserved.;
;-----------------------------------;

FORMAT         PROC    NEAR

               PUSH    AX                       ;Preserve registers.
               PUSH    CX
               PUSH    SI
               PUSH    DI
               MOV     CX,WINDOW_COL[BP]        ;Retrieve current column.
               CMP     LINE_CAPACITY,16         ;Are we working on a binary file?
               JZ      DO_HEX                   ;If yes, do a hex display.
               CALL    LINES                    ;Else, display text lines.
               JMP     SHORT CK_LINE_START

DO_HEX:        CALL    HEX

CK_LINE_START: INC     FILE_POS[BP]             ;Increment file position.
               JCXZ    LINE_START               ;End of a display line?
               HOV     WINDOW_COL[BP],CX        ;If no, store column postion
               JMP     SHORT FORMAT_END         ; and return.

LINE_START:    MOV     AX,LINE_CAPACITY         ;Else, go to next column.
               MOV     WINDOW_COL[BP],AX
               CMP     AX,16                    ;Are we doing a binary compare?
               JZ      CK_ARRAY                 ;If yes, skip CR check.
               OR      BP,BP                    ;Else, check if EOF.
               JNZ     CX_CR2
               CALL    CX_EOF1
               JMP     SHORT CK_CR
CK_CR2:        CALL    CK_EOF2
CK_CR:         JC      CK_ARRAY                 ;If EOF, skip CR check.
               MOV     DI,FILE_POS[BP]          ;Else, if byte at end of an 80
               CMP     BYTE PTR [DI],CR         ; column display is CR, bump
               JNZ     CK_ARRAY                 ; file postion past it so
               INC     FILE_POS[BP]             ; don't double space display.

CK_ARRAY:      CMP     DISPLAY_FLAG,1           ;Are we displaying?
               JNZ     ADJUST_ARRAY             ;If no, skip line check.
               CMP     WINDOW_LINE[BP],0        ;Else, is window full?
               JZ      FORMAT_END               ;If yes, done here.
               DEC     WINDOW_LINE[BP]          ;Else, decrement line display.
               JNZ     ADJUST_ARRAY             ;If window not full, skip next.
               MOV     CX,BP                    ;Else, mark appropriate
               ADD     CL,2                     ; WINDOW_FULL bit as full.
               OR      WINDOW_FULL,CL
               JMP     SHORT FORMAT_END

ADJUST_ARRAY:  TEST    WINDOW_FULL,001B         ;Has window been stored?
               JNZ     FORMAT_END               ;If yes, skip array indexing.
               CALL    ARRAY_INDEX              ;Else, index into array.
               MOV     SI,DI
               ADD     SI,2
               MOV     CX,3
               REP     MOVSW                    ;Move all line starts up one
               MOV     AX,FILE_POS[BP]
               MOV     [DI],AX                  ; and store new line start.
FORMAT_END:    POP     DI                       ;Restore registers.
               POP     SI
               POP     CX
               POP     AX
               RET

FORMAT         ENDP

;-----------------------------;
; INPUT                       ;
;   AL = Character to display.;
;   CX = current column.      ;
;   BP = Index to file.       ;
;                             ;
; OUTPUT                      ;
;   CX = new column.          ;
;   WINDOW_POS[BP] is updated.;
;                             ;
;   BX preserved.             ;
;-----------------------------;

LINES          PROC    NEAR

               CHP     AL,CR                    ;Carriage return?
               JZ      PAD_SPACES               ;If yes, pad balance of line.
               CHP     AL,TAB                   ;Is it tab character?
               JZ      EXPAND_TAB               ;If yes, expand to spaces.
               CMP     AL,LF                    ;Is it linefeed?
               JZ      LINES_END                ;If yes, skip.

               PUSH    CX                       ;Save column.
               MOV     CX,1                     ;Display one character.
               CALL    CK_DISPLAY
               POP     CX                       ;Restore column and decrement.
               DEC     CX
               RET

EXPAND_TAB:    PUSH    CX                       ;Save column.
               DEC     CX                       ;Adjust column counter.
               AND     CX,7                     ;Get bottom three bits.
               INC     CX                       ;Adjust.
               PUSH    CX                       ;Save.
               CALL    PAD_SPACES               ;Move to next tab position.
               POP     AX
               PDP     CX
               SUB     CX,AX                    ;Adjust column counter.
               RET

PAD_SPACES:    MOV     AL,SPACE                 ;If CR display spaces.
CK_DISPLAY:    CMP     DISPLAY_FLAG,1           ;Are we to write it to screen?
               JNZ     DISPLAY_END              ;If no, return.
               CMP     WINDOW_LINE[BP],0        ;Window full?
               JZ      DISPLAY_END              ;If yes, return.
               MOV     DI,WINDOW_POS[BP]        ;Else, retrieve display position.
WRITE_VIEW:    CALL    WRITE_SCREEN             ;Write character CX times.
               LOOP    WRITE_VIEW
               MOV     WINDOW_POS[BP],DI        ;Store new display position.

DISPLAY_END:   XOR     CX,CX
LINES_END:     RET

LINES          ENDP

;-----------------------------;
; INPUT                       ;
;   AL = Character to display.;
;   CX = current column.      ;
;   BP = Index to file.       ;
;                             ;
; DUTPUT                      ;
;   CX = new column.          ;
;   WINDOW_POS(BP) is updated.;
;                             ;
;   BX preserved.             ;
;-----------------------------;

HEX            PROC    NEAR

               CMP     DISPLAY_FLAG,1           ;Are we to write to screen?
               JNZ     DEC_COLUMN               ;If no, just update column.
               CMP     WINDOW_LINE[BP],0        ;Else, is window full?
               JNZ     GO_HEX                   ;If yes, continue.
DEC_COLUMN:    DEC     CX                       ;Else, update column and retu
               RET

GO_HEX:        PUSH    CX                       ;Save some registers.
               PUSH    AX
               PUSH    CX

               MOV     DI,WINDOW_POS[BP]        ;Retrieve window position.
               CMP     CX,16                    ;Is it first column?
               JNZ     DISP_NUMBERS             ;If no, just display the byte
               PUSH    AX                       ;Else, save character and
               PUSH    BX                       ; attribute.

               MOV     AX,FILE_POS[BP]          ;Retrieve file position
               SUB     AX,FILE_START[BP]        ;Subtract the starting positi
               ADD     AX,HEX_OFFSET[BP]        ;Add the 64K offset.
               PUSH    AX                       ;Save the offset.
               MOV     AX,HEX_SEGMENT[BP]       ;Retrieve segment.
               JNC     DISP_SEGMENT             ;Did offset carry?
               ADD     AX,1000H                 ;If yes, add 1000h to segment

DISP_SEGMENT:  MOV     BH,NORMAL_ATTRIB         ;Yes normal attribute.
               MOV     CX,1                     ;Segment and offset counter.
NEXT_ADDRESS:  XCHG    AH,AL                    ;AL = byte to display.
               CALL    DISPLAY_HEX
               XCHG    AH,AL                    ;Get second byte to display.
               CALL    DISPLAY_HEX
               OR      CX,CX                    ;Segment and offset displayed
               JZ      ADDRESS_END              ;If yes, done here.
               MOV     AL,":"                   ;Else, display delimiting col
               CALL    WRITE_SCREEN
               POP     AX                       ;Retrieve offset.
               DEC     CX                       ;Decrement counter.
               JMP     SHORT NEXT_ADDRESS       ;Display segment.

ADORESS_END:   ADD     DI,4                     ;Move right two spaces.
               POP     BX                       ;Retrieve attribute.
               POP     AX                       ;Retrieve character.

DISP_NUMBERS:  CALL    DISPLAY_HEX              ;Display the hex number.
               MOV     AL,SPACE                 ;Delimit with a space.
               POP     CX                       ;Retrieve column counter.
               CMP     CX,9                     ;Is it half way?
               JNZ     DELIMITER
               MOV     AL,"-"                   ;If yes, display delimiting d
DELIMITER:     PUSH    BX                       ; with normal attribute.
               MOV     BH,NORMAL_ATTRIB
               CALL    WRITE_SCREEN
               POP     BX                       ;Restore attribute.
               MOV     WINDOW_POS[BP],DI        ;Store window position.
               SHL     CX,1                     ;Multiply column by 8.
               SHL     CX,1
               ADD     DI,CX                    ;Add to current window postio
               ADD     DI,30                    ;Tab over additional 15.
               POP     AX                       ;Retrieve character and displ
               CALL    WRITE_SCREEN
               POP     CX                       ;Restors column counter
               DEC     CX                       ; and update.
               JNZ     HEK_END                  ;If last column, bump window
               MOV     AX,COLS                  ; to next line.
               SUB     AX,59
```

continued . . .

ahead from each anchor position to find a match in the other file.

The easiest way to explain the algorithm is to follow the program's path step by step through the short example presented in Fig 3. COMPARE begins by comparing bytes starting with the first byte of each file. The comparison proceeds smoothly as long as corresponding bytes can be paired up. A mismatch occurs, however, at the 'a' in 'an' and the 'n' in 'not'. This is saved as the anchor position.

COMPARE then attempts to get back in sync by checking to see if the 10-byte

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```
CK_EOF1:        XOR     BP,BP                   ;File index pointer.
                CMP     SI,FILE_END[BP]         ;Is position = EOF?
                JB      NOT_EOF                 ;If no, not EOF.
                CMP     SI,BUFFER_END[BP]       ;Else, is it at end of buffer?
                JB      EOF                     ;If no, EOF.
                JMP     SHORT MOVE_BUFFER       ;Else, more to file; read it.

CK_EOF2:        MOV     BP,2                    ;Do same for file 2.
                CMP     DI,FILE_END[BP]
                JB      NOT_EOF
                CMP     DI,BUFFER_END[BP]
                JB      EOF

MOVE_BUFFER:    PUSH    AX                      ;Save registers.
                PUSH    BX
                PUSH    CX
                PUSH    DX
                PUSH    SI
                PUSH    DI
                MOV     SI,FILE_START[BP]       ;Retrieve buffer start address.
                MOV     DI,SI
                SUB     DI,TEN_K
                MOV     CX,TEN_K / 2            ;And move data to buffer
                REP     MOVSW                   ; 10K below.

                CALL    READ_FILE               ;Read the next 10K.
                SUB     SAVE_POS[BP],TEN_K      ;Adjust all the pointers by 10K.
                SUB     SYNC_POS[BP],TEN_K
                SUB     FILE_POS[BP],TEN_K
                ADD     HEX_OFFSET[BP],TEN_K    ;Add 10K to offset.
                JNC     DO_ARRAY                ;If carry, add 1000h to segment.
                ADD     HEX_SEGMENT[BP],1000H
DO_ARRAY:       CALL    ARRAY_INDEX             ;Adjust line start array.
                MOV     CX,4
SUB_ARRAY:      SUB     [DI],TEN_K
                INC     DI
                INC     DI
                LOOP    SUB_ARRAY
                POP     DI
                POP     SI
                POP     DX
                POP     CX
                POP     BX
                POP     AX
                OR      BP,BP                   ;If file 1, adjust DI and DX.
                JZ      ADJUST_FILE1
                SUB     DI,TEN_K
                SUB     DX,TEN_K
                JMP     SHORT NOT_EOF
ADJUST_FILE1:   SUB     SI,TEN_K                ;Else, adjust SI and BX.
                SUB     BX,TEN_K

NOT_EOF:        CLC
                RET

EOF:            STC
                RET

CK_EOF          ENDP

;----------------------------------------;
; INPUT                                  ;
;   BP = file index.                     ;
;                                        ;
; OUTPUT                                 ;
;   DI = start of line-start array.      ;
;                                        ;
;   All registers preserved.             ;
;----------------------------------------;

ARRAY_INDEX     PROC    NEAR

                MOV     DI,BP
                SHL     DI,1                    ;Multiply file index by 4
                SHL     DI,1                    ; to index into index.
                ADD     DI,OFFSET LINE_ARRAY
                RET

ARRAY_INDEX     ENDP

;----------------------------------------;
; INPUT                                  ;
;   BP = file index                      ;
;   DX = points to ASCIIZ filename.      ;
;                                        ;
; OUTPUT                                 ;
;   Carry flag = 1 if failed.            ;
;   Carry flag = 0 if successful.        ;
;                                        ;
;   BP preserved.                        ;
;----------------------------------------;

OPEN_FILE       PROC    NEAR

                MOV     AX,3D00H                ;Open file for reading.
                INT     21H
                JC      OPEN_END
                MOV     FILE_HANDLE[BP],AX      ;Save file handle if successful
                CALL    READ_FILE               ; and read 10K.
OPEN_END:       RET

OPEN_FILE       ENDP

;----------------------------------------;
; INPUT                                  ;
;   BP = file index                      ;
;   DX = points to ASCIIZ filename.      ;
;                                        ;
; OUTPUT                                 ;
;   Carry flag = 1 if failed.            ;
;   Carry flag = 0 if successful.        ;
;                                        ;
;   BP preserved.                        ;
;----------------------------------------;

READ_FILE       PROC    NEAR

                MOV     BX,FILE_HANDLE[BP]      ;Retrieve filehandle.
                MOV     DX,FILE_START[BP]       ;Point to storage buffer.
                MOV     SI,DX                   ;Save it.
                MOV     CX,TEN_K                ;Read maximum of 10K.
                MOV     AH,3FH                  ;Read file.
                INT     21H
                JC      READ_FILE_END           ;If failed, exit.
                ADD     DX,AX                   ;Else, add bytes read to buffer
                MOV     FILE_END[BP],DX         ; address and store as file end

                MOV     CX,AX                   ;Bytes read in counter.
                JCXZ    READ_END                ;Skip if zero bytes read.
                MOV     AL,STRIP_MASK           ;Else, retrieve strip mask.
                CMP     AL,0FFH                 ;If not WordStar, skip.
                JZ      READ_END
WORDSTAR:       AND     DS:[SI],AL              ;Else, strip the high bit
                INC     SI                      ; of all bytes read.
                LOOP    WORDSTAR

READ_END:       CLC
READ_FILE_END:  RET

READ_FILE       ENDP

;----------------------------------------;
; INPUT                                  ;
;   None                                 ;
;                                        ;
; OUTPUT                                 ;
;   None                                 ;
;                                        ;
;   ES preserved.                        ;
;----------------------------------------;

VIDEO_SETUP     PROC    NEAR

                PUSH    ES                      ;Preserve ES.
                MOV     AX,500H                 ;Make sure active page is zero.
                INT     10H
                MOV     AX,40H                  ;Point to the ROM BIOS data area
                MOV     ES,AX

                MOV     AL,ES:CRT_MODE          ;Retrieve current video mode.
                CMP     AL,7                    ;Is it mono mode?
                JZ      SUPPORTED               ;If yes, continue.
                CMP     AL,3                    ;Is it text?
                JBE     SUPPORTED               ;If yes, continue.
UNSUPPORTED:    MOV     DX,OFFSET BAD_MODE_MSG  ;Else, do not pass GO.
                JMP     ERROR_EXIT              ;Go directly to jail.

SUPPORTED:      MOV     AH,12H
                MOV     BL,10H
                INT     10H
                CMP     BL,10H                  ;Is there an EGA?
                JZ      CK_CGA                  ;If no, check if CGA.

                TEST    ES:BYTE PTR [87H],8     ;Else, EGA_info; Is it active?
                JNZ     CK_CGA                  ;If no, check CGA.
                XOR     BH,BH                   ;Else, retrieve CRT rows.
                MOV     AX,1130H
                PUSH    ES
                INT     10H
                POP     ES
                MOV     ROWS,DL                 ;Save CRT rows.

CK_CGA:         MOV     AL,ES:CRT_COLS          ;Retrieve CRT cols.
                XOR     AH,AH                   ;Zero in high half.
                MOV     DX,AX                   ;Save it.
                MOV     BX,LINE_CAPACITY        ;Retrieve line capacity.
                CMP     BX,16                   ;Are we displaying hex?
                JNZ     CAPACITY                ;If no, store.
                MOV     DX,BX                   ;Else, use 16 as capacity.
                CMP     AL,40                   ;Are we in 40 column mode?
                JZ      UNSUPPORTED             ;If yes, useless display.

CAPACITY:       MOV     LINE_CAPACITY,DX        ;Store capacity and initialize
                MOV     SAVE_COL[0],DX          ; columns.
                MOV     SAVE_COL[2],DX
                MOV     COLS,AX                 ;Store columns.
                SHL     AX,1                    ;Times two for attribute.
                MOV     DL,ROWS                 ;Retrieve rows
                MUL     DL                      ; and multiply.
                MOV     STATUS_LINE,AX          ;Save as address of status line.
                SUB     DL,4                    ;Subtract 4 from CRT rows
                SHR     DL,1                    ; and divide by two
                MOV     WINDOW_SIZE,DL          ; and save as window size.

                MOV     AX,ES:ADDR_6845         ;Retrieve display card.
                ADD     AX,6                    ;Add six to get status register
                MOV     STATUS_REG,AX           ;Store as status register.
                CMP     AX,3BAH                 ;Is it monochrome?
                JZ      VIDEO_END               ;If yes, done here.
                ADD     VIDEO_SEG,800H          ;Else, adjust video segment.
                MOV     AH,8                    ;Get attribute at cursor postion.
                INT     10H
                MOV     NORMAL_ATTRIB,AH        ;And save as forground.
                XOR     AH,01110111B            ;Flip color bits.
                MOV     INVERSE_ATTRIB,AH       ;And save as highlight attribute.
VIDEO_END:      POP     ES                      ;Restore ES.
                RET

VIDEO_SETUP     ENDP

;----------------------------------------;
; INPUT                                  ;
;   AL = character to write.             ;
;   BH = attribute.                      ;
;                                        ;
; OUTPUT                                 ;
;   None                                 ;
;                                        ;
;   AL, BH, CX preserved.                ;
;----------------------------------------;

WRITE SCREEN    PROC    NEAR

                PUSH    ES
                MOV     DX,VIDEO_SEG
                MOV     ES,DX                   ;Point to screen segment.
```

continued

string 'an original' (the space isn't counted) in FILE1 exists somewhere beyond the mismatching 'n' in the 'not' in FILE2. The search is done a byte at a time for two reasons which I'll explain further on. The 'a' is first compared with 'o' in 'not'. Since it does not match, COMPARE next tries matching the 'a' with the 't' in 'not'. Again no luck. COMPARE continues the process and shortly finds that the 'a' in 'an' in FILE1 matches the 'a' in 'original' in FILE2.

This *might* be the signal that the two files are back in sync. To make sure, however, the program insists that the

[redacted]

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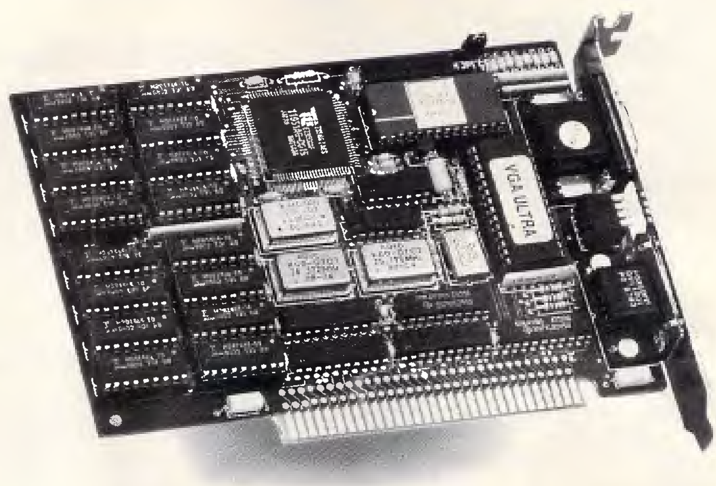
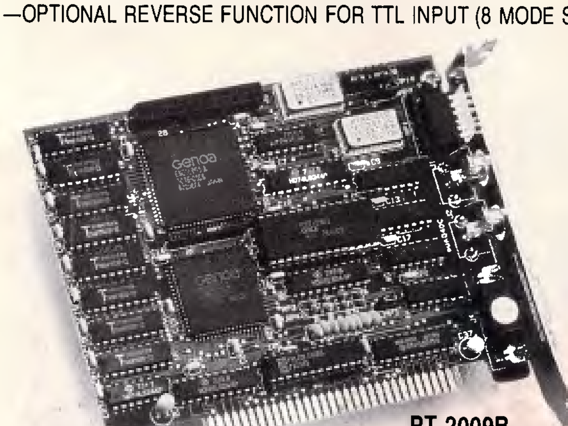
A4, FULL PAGE

—15" CLINTON CRT (PHOSPHOR P192)
—HOR/VER MOUNTED HOUSING DESIGN
—VIDEO BANDWIDTH 30MHZ MINIMUM
—HOR. SCAN RATE FROM 15 TO 36KHZ
VER. SCAN RATE FROM 45 TO 90HZ
AUTO SYNC. CONTINUED SCANNING
—1024 x 768 RESOLUTION UP TO 4096 SHADES (ANALOG)
—TTL VIDEO SINGLE INPUT AUTOSWITCH
—WY-700 AMDEK-1280 COMPATIBLE
—ADJUSTABLE VERTICAL SIZE, HORIZONTAL PHASE
VERTICAL CENTER AND FUNCTION
—FOR CGA, HERCULES, MDA, EGA, VGA, DISPLAY ADAPTER
—APPLE MAC II SUITABLE
—OPTIONAL REVERSE FUNCTION FOR TTL INPUT (8 MODE SELECTABLE)

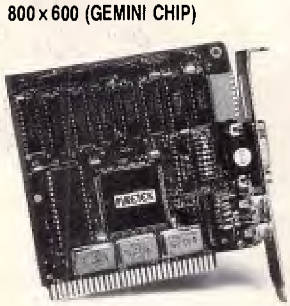


PT-2011A, 512K
1024 x 768 pixel resolution in 16 colors (800 x 600 in 256 colors)



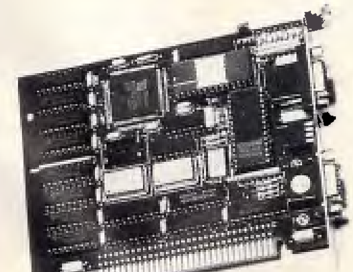
PT-2009B
800 x 600 (GENOA CHIP)

PT-2009C
800 x 600 (GEMINI CHIP)



EGA ULTRA
—Fully compatible with EGA, CGA, MDA. and Hercules Graphics hardware and softwave compatible (down to register level)
—Supports 640 x 480, 912 x 480 (level B) up to 800 x 600 (level B) resolution on multi-frequency high resolution monitors.
—Includes "Advanced mode" drivers for Auto CAD, MS-Windows, GEM, Ventura Publisher, Framework, Lotus 1-2-3 & Symphony.

VGA ULTRA
—register level VGA compatible
—16-bit CPU data bus with zero wait state
—Three 132 Column modes
—80 x 60 and 100 x 40 text modes
—Translation ROM supports to ensure forward compatibility
—Mixed graphics and text windows
—Hardware zoom
—Panning/scrolling in text and graphic modes
—Interlaced display support
—IBM 8514A emulation
—Simultaneous display of up to 8 fonts
—65 MHz maximum dot clock speed



PT-2011B, 256K
800 x 600 pixel resolution in 16 colors (320 x 200 in 256 colors)

```
                MOV     DX,STATUS_REG           ;Retrieve status register.
                MOV     BL,AL                   ;Store character in BL.

HORZ_RET:       IN      AL,DX                   ;Get status.
                RCR     AL,1                    ;Is it low?
                JC      HORZ_RET                ;If not, wait until it is.
                CLI                             ;No more interrupts.

HWAIT:          IN      AL,DX                   ;Get status.
                RCR     AL,1                    ;Is it high?
                JNC     HWAIT                   ;If no, wait until it is.

                MOV     AX,BX                   ;Retrieve character; now it's OK
                STOSW                           ; to write to screen buffer.
                STI                             ;Interrupts back on.
                POP     ES
                RET                             ;Return

WRITE_SCREEN    ENDP

;-----------------------------------;
; INPUT                             ;
;   None                            ;
;                                   ;
; OUTPUT                            ;
;   None                            ;
;                                   ;
;   All registers destroyed.        ;
;-----------------------------------;

DISPLAY_SETUP   PROC    NEAR

                CALL    CLS                     ;Clear screen.
                MOV     DH,ROWS                 ;Retrieve CRT rows.
                INC     DH                      ;Move one line below off screen.
                XOR     DL,DL                   ;Column zero.
                XOR     BH,BH                   ;Page zero.
                MOV     AH,2                    ;Set cursor position.
                INT     10H

                XOR     DI,DI                   ;Point to top left of display.
                MOV     SI,OFFSET COPYRIGHT     ;Point to copyright message.
                MOV     BH,NORMAL_ATTRIB        ;And display it.
                CALL    WRITE_STRING
                MOV     DI,COLS                 ;Retrieve columns.
                SHL     DI,1                    ;Double for attribute.
                SUB     DI,64                   ;Right justify my name.
                INC     SI                      ;Bump pointer past linefeed.
                CALL    WRITE_STRING

                MOV     BP,0                    ;Initialize counter.
NEXT_LINE:      MOV     CX,COLS                 ;Write line characters
                PUSH    DI                      ;Save position.
                MOV     AL,LINE_CHAR            ; to screen.
NEXT_WRITE:     CALL    WRITE_SCREEN
                LOOP    NEXT_WRITE

                POP     DI                      ;Retrieve position.
                CMP     BP,2                    ;Do two windows.
                JA      SETUP_END
                PUSH    DI                      ;Save screen pointer.
                ADD     DI,10                   ;Tab in five spaces
                MOV     AL,LF_BAR_CHAR          ; and print a left bar char.
                CALL    WRITE_SCREEN
                MDV     SI,FILENAME[BP]         ;Point to filename and print it.
                CALL    WRITE_STRING
                MOV     AL,RT_BAR_CHAR          ;Finish frame with right bar char
                CALL    WRITE_SCREEN
                POP     DI                      ;Restore display pointer.
                MOV     AX,COLS
                SHL     AX,1
                MOV     DL,WINDOW_SIZE
                INC     DL                      ;Multiply line length by window
                MUL     DL                      ; size plus one and add to
                ADD     DI,AX                   ; current position to get to
                ADD     BP,2                    ; next position to display line.
                JMP     SHORT NEXT_LINE
SETUP_END:      RET
DISPLAY_SETUP   EMDP

;-----------------------------------;
; INPUT                             ;
;   None                            ;
;                                   ;
; OUTPUT                            ;
;   None                            ;
;                                   ;
;   All registers destroyed.        ;
;-----------------------------------;

DISPLAY_MENU    PROC    NEAR

                MOV     SI,OFFSET MENU          ;Point to menu.
                MOV     DI,STATUS_LINE          ;Point to status line.
                MOV     BH,NORMAL_ATTRIB        ;Use normal attribute
                CALL    WRITE_STRING            ; and display menu.
                RET

DISPLAY_MENU    ENDP

;-----------------------------------;
; INPUT                             ;
;   BP = file index                 ;
;                                   ;
; OUTPUT                            ;
;   None                            ;
;                                   ;
;   All registers destroyed.        ;
;-----------------------------------;

PROMPT_USER     PROC    NEAR

                CMP     SYNTAX_FLAG,1           ;If first time through, display
                JZ      NEXT_PROMPT             ; syntax message.
                MOV     SYNTAX_FLAG,1
                MOV     DX,OFFSET SYNTAX_MSG
                CALL    PRINT_STRING

NEXT_PROMPT:    MOV     DX,PROMPT[BP]           ;Retrieve appropriate prompt
                CALL    PRINT_STRING            ; and display.
                MOV     DI,FILENAME[BP]         ;Retrieve address of filename
                MOV     DX,DI                   ; storage and save.
                SUB     DX,2                    ;Put in first byte of filename
                MOV     BX,DX                   ; buffer, the buffer length (80).
                MOV     BYTE PTR [BX],SPEC_LENGTH
                MOV     AH,0AH
                INT     21H                     ;Buffered Keyboard Input.
                PUSH    DI                      ;Save filename pointer.
                MOV     AL,CR                   ;Carriage return points
ASCIIZ:         SCASB                           ; to last byte of input.
                JNZ     ASCIIZ
                MOV     BYTE PTR [DI-1],0       ;Replace it with zero (ASCIIZ).
                POP     DI                      ;Retrieve filename pointer.
                MOV     DX,DI
                CALL    OPEN_FILE               ;Attempt to open the file.
                JNC     PROMPT_END              ;If successful, done here.
                MOV     DX,OFFSET NOT_FOUND_MSG ;Else, display "Not found"
                CALL    PRINT_STRING            ; message
                JMP     SHORT NEXT_PROMPT       ; and prompt user again.
PROMPT_END:     RET

PROMPT_USER     ENDP

;-----------------------------------;
; INPUT                             ;
;   SI = points to string to display. ;
;   Entry point is WRITE_STRING.    ;
;                                   ;
; OUTPUT                            ;
;   None                            ;
;                                   ;
;   All registers destroyed.        ;
;-----------------------------------;

WRITE_IT:       CALL    WRITE_SCREEN            ;Write a character.
WRITE_STRING:   LODSB                           ;Retrieve a character.
                CMP     AL,SPACE                ;Keep writing until a carriage
                JAE     WRITE_IT                ; return or space encountered.
                RET

;-------------------;
; BIOS Keyboard I/O ;
;-------------------;

READ_KEY:       MOV     AH,0                    ;Wait for next keyboard
                INT     16H                     ; input.
                RET

CK_KEY:         MOV     AH,1                    ;See if character ready.
                INT     16H
                RET

CLEAR_IT:       CALL    READ_KEY                ;If characters are ready
CLEAR_KEY:      CALL    CK_KEY                  ; read them to clear keyboard
                JNZ     CLEAR_IT                ; buffer.
                RET

;----------------------------;
; Screen clearing routines.  ;
;----------------------------;

CLS:            XOR     CX,CX                   ;Top left corner.
                MOV     DX,COLS                 ;Right corner
                DEC     DL
                MOV     DH,ROWS                 ;Bottom row.
                JMP     SHORT CLEAR_WINDOW      ;Clear the screen.

CLS_WINDOWS:    MOV     CX,0200H                ;Row 3; column zero.
                MOV     DX,COLS                 ;Right corner.
                DEC     DL
                MOV     DH,WINDOW_SIZE          ;Bottom of window one.
                INC     DH
                CALL    CLEAR_WINDOW            ;clear the window.
                ADD     CH,WINDOW_SIZE          ;Increment a window size
                INC     CH                      ; and a delimiting line.
                ADD     DH,WINDOW_SIZE
                INC     DH
                JMP     SHORT CLEAR_WINDOW      ;Clear second window.

CLS_MENU:       MOV     CH,ROWS                 ;Bottom row.
                XOR     CL,CL                   ;Column zero.
                MOV     DH,CH
                MOV     DL,2CH                  ;To column 44.

CLEAR_WINDOW:   PUSH    BX                      ;Preserve BX.
                MOV     BH,NORMAL_ATTRIB        ;Normal attribute.
                MOV     AX,600H                 ;Scroll active page.
                INT     10H
                POP     BX                      ;Restore BX.
                RET

;-------------------;
; DOS print string. ;
;-------------------;

PRINT_STRING    PROC    NEAR
                MOV     AH,9
                INT     21H
                RET

PRINT_STRING    ENDP

;--------------------------------------------------------;
; Buffered keyboard input and file buffers at end of code. ;
;--------------------------------------------------------;

EVEN

FILESPEC        EQU     $
FILE1_BUFFER1   EQU     FILESPEC + 2 * (SPEC_LENGTH + 2)
FILE1_BUFFER2   EQU     FILE1_BUFFER1 + TEN_K
FILE2_BUFFER1   EQU     FILE1_BUFFER2 + TEN_K
FILE2_BUFFER2   EQU     FILE2_BUFFER1 + TEN_K

_TEXT           ENDS
                END     START
```

ends.

next 9 bytes must also match, so the 'n' in 'an' is compared with the 'l' in 'original'. No good. So COMPARE returns to the point where it received its false alarm and starts again, comparing the 'a' in 'an' with the 'I' in 'original'. COMPARE thus continues to try to match up the 'an original' string until it syncs up; or it reaches a maximum of 400 bytes from the anchor position of FILE2; or it reaches the end of file; whichever comes first. In this example, the end of file is reached with the compare of the 'a' with the period of FILE2 without success in syncing up. (Actually,

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```
100 REM - BASIC PROGRAM TO CREATE COMPARE.COM
110 CLS: PRINT "Creating COMPARE.COM ": OPEN "COMPARE.COM " AS #1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM#=0
130 FOR I = 1 TO 154: LINESUM#=0: LOCATE 2,3: PRINT "Countdown: ";154 - I;
140  FOR J = 1 TO 16 : READ BYTE$: CHECKSUM#=CHECKSUM#+VAL("&H"+BYTE$)
150   LINESUM#=LINESUM#+VAL("&H"+BYTE$)
160   IF (BYTE < 256) THEN LSET A$=CHR$(VAL("&H"+BYTE$))
170   PUT #1: NEXT J
180  READ LINETOT$: LINECHECK# = VAL("&H" + LINETOT$)
190  IF LINECHECK# = LINESUM# THEN GOTO 210
200  LOCATE 4,2: PRINT "Error in line #"  ;240 + 10 * I
210 NEXT I
220 CLOSE: LOCATE 6,2: IF CHECKSUM# <> 254690 THEN GOTO 240
230 PRINT "COMPARE.COM  created successfully": SYSTEM
240 PRINT "COMPARE.COM  is not valid!": SYSTEM
250   DATA E9, 0, 2, D, 20, 20, 20, D, A, 43, 4F, 4D, 50, 41, 52, 45, 376
260   DATA 20, 31, 2E, 30, 20, 20, 43, 29, 20, 31, 39, 38, 38, 20, 5A, 69, 340
270   DATA 66, 66, 20, 43, 6F, 6D, 6D, 75, 6E, 69, 63, 61, 74, 69, 6F, 6E, 642
280   DATA 73, 20, 43, 6F, 2E, D, A, 50, 43, 20, 4D, 61, 67, 61, 7A, 69, 496
290   DATA 6E, 65, 20, FE, 20, 4D, 69, 63, 68, 61, 65, 6C, 20, 4A, 2E, 20, 57C
300   DATA 4D, 65, 66, 66, 6F, 72, 64, D, A, D, A, 53, 79, 6E, 74, 61, 508
310   DATA 78, 3A, 20, 20, 43, 4F, 4D, 50, 41, 52, 45, 20, 66, 69, 6C, 65, 4B9
320   DATA 73, 78, 65, 63, 20, 66, 69, 6C, 65, 73, 70, 65, 63, 5B, 2F, 42, 5E2
330   DATA 5D, 5B, 2F, 57, 5D, D, A, 2F, 42, 20, 3D, 20, 42, 69, 6E, 61, 41A
340   DATA 72, 79, 20, 20, 20, 2F, 57, 20, 3D, 20, 57, 6F, 72, 64, 53, 74, 4B1
350   DATA 61, 72, 24, 1A, 0, 0, 0, B0, 0, 0, 18, 7, 70, FF, 0, 1, 350
360   DATA 0, 0, 3A, 33, 3A, 83, 0, 0, 0, 0, 0, 0, 0, 0, 3A, 5B, 1BF
370   DATA 3A, AB, 0, 8, 0, 0, 0, 0, 0, 0, 0, 0, 8, 0, 0, 58, 135
380   DATA 0, 58, 0, 3A, 33, 3A, 83, 0, 0, 0, 0, 0, 0, 0, 0, 0, 17A
390   DATA 0, 0, 0, 0, 0, 0, 8, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
400   DATA 0, 0, 0, 0, 8, 0, 0, 98, A, E8, A, 0, 0, 0, 0, 52, 1E6
410   DATA 65, 71, 75, 69, 72, 65, 73, 20, 36, 34, 4B, 20, 66, 72, 65, 65, 595
420   DATA 20, 52, 41, 4D, 24, 55, 6E, 73, 75, 70, 70, 6F, 72, 74, 65, 64, 5CD
430   DATA 20, 76, 69, 64, 65, 6F, 20, 6D, 6F, 64, 65, 24, 43, 4F, 4D, 45, 544
440   DATA 58, 45, 36, 2, 51, 2, D, A, A, 45, 6E, 74, 65, 72, 20, 66, 3CD
450   DATA 69, 72, 73, 74, 20, 66, 69, 6C, 65, 20, 6E, 61, 6D, 65, D, A, 55A
460   DATA 24, D, A, A, 45, 6E, 74, 65, 72, 20, 73, 65, 63, 6F, 6E, 64, 4DF
470   DATA 20, 66, 69, 6C, 65, 20, 6E, 61, 6D, 65, D, A, 24, D, A, 46, 419
480   DATA 69, 6C, 65, 20, 6E, 6F, 74, 20, 66, 6F, 75, 6E, 64, 24, 50, 72, 5CD
490   DATA 65, 73, 73, 20, 61, 6E, 79, 20, 6B, 65, 79, 20, 66, 6F, 72, 20, 5A3
500   DATA 6E, 65, 78, 74, 20, 63, 6F, 6D, 70, 61, 72, 65, 20, 20, 20, 45, 56B
510   DATA 73, 63, 20, 74, 6F, 20, 45, 78, 69, 74, 0, 57, 6F, 72, 6B, 69, 59F
520   DATA 6E, 67, 0, 46, 69, 6C, 65, 73, 20, 73, 69, 67, 6E, 69, 66, 69, 5D1
530   DATA 63, 61, 6E, 74, 6C, 79, 20, 64, 69, 66, 66, 65, 72, 65, 6E, 74, 662
540   DATA 0, 46, 69, 6C, 65, 73, 20, 61, 72, 65, 20, 65, 66, 66, 65, 63, 564
550   DATA 74, 69, 76, 65, 6C, 79, 20, 69, 64, 65, 6E, 74, 69, 63, 61, 6C, 66A
560   DATA 0, 43, 6F, 6D, 70, 61, 72, 65, 20, 63, 6F, 6D, 70, 6C, 65, 74, 5DB
570   DATA 65, 64, 0, FC, BB, 0, 10, B4, 4A, CD, 21, BA, FF, 1, 73, 3, 6AC
580   DATA E9, 12, 1, BE, 81, 0, AC, 3C, D, 74, 20, 3C, 2F, 75, F7, C6, 669
590   DATA 44, FF, 0, AC, 3C, D, 74, 1B, C6, 44, FF, 0, 24, 5F, 3C, 57, 5E6
600   DATA 75, 5, C6, 6, AD, 1, 7F, 3C, 42, 75, DB, C7, 6, EB, 1, 10, 60A
610   DATA 0, EB, D3, BE, 81, 0, 33, ED, AC, 3C, 20, 77, 4, 3C, D, 75, 65E
620   DATA F7, 4E, 8B, FE, 8B, D6, AC, 3C, 20, 77, FB, C6, 44, FF, 0, 56, 908
630   DATA 50, E8, 18, 5, 73, 3, E8, 81, 6, 58, 5E, 89, BE, F7, 1, 83, 6B2
640   DATA C5, 2, 83, FD, 2, 77, 9, 3C, D, 75, CD, E8, 6C, 6, EB, EB, 784
650   DATA BD, 2, 0, 8B, B6, F7, 1, AC, 3C, 0, 74, E, 3C, 61, 72, F7, 668
660   DATA 3C, 7A, 77, F3, 80, 64, FF, 5F, EB, ED, B3, ED, 2, 73, E4, BD, 9C0
670   DATA 2, 0, 8B, B6, F7, 1, AC, 3C, 8, 74, 1D, 3C, 2E, 75, F7, BB, 645
680   DATA 2, 0, BF, 2C, 2, 56, 57, B9, 3, 0, F3, A6, 5F, 5E, 74, F, 531
690   DATA 83, C7, 3, 4B, 75, EF, EB, DE, 83, ED, 2, 73, D5, EB, 6, C7, 937
700   DATA 6, EB, 1, 10, 0, A1, B2, 1, A3, E1, 1, A1, B4, 1, A3, E9, 6BD
710   DATA 1, E8, D2, 4, E8, 8A, 5, E8, 59, 0, 73, 26, E8, 8B, 6, 8B, 714
720   DATA 3E, ED, 1, 3, 3E, A8, 1, 8A, 3E, AB, 1, 80, 3E, B0, 1, 1, 4FA
730   DATA 74, 8, BE, D1, 2, 83, EF, 1E, EB, 22, BE, F1, 2, 83, EF, 10, 7DD
740   DATA EB, 1A, E8, C6, 5, E8, 2E, 6, E8, 1E, 6, 80, FC, 1, 75, C7, 799
750   DATA E8, 57, 6, EB, A, E8, 68, 6, B0, 1, EB, 13, E8, 4, 6, 8A, 6BB
760   DATA 36, AA, 1, FE, CE, 32, D2, 32, FF, B4, 2, CD, 10, 32, C0, B4, 81B
770   DATA 4C, CD, 21, E8, 34, 6, BE, AB, 2, 8B, 3E, ED, 1, 83, C7, 48, 718
780   DATA 8A, 3E, AB, 1, 80, CF, 80, E8, D9, 5, A1, A8, 1, D1, E0, 8B, 08F
790   DATA F8, D1, E7, 89, 3E, C2, 1, 8A, 16, CE, 1, FE, C2, F6, E2, 3, 944
800   DATA F8, 89, 3E, C4, 1, BD, 2, 0, 8B, 86, CF, 1, 89, 86, C6, 1, 6FA
810   DATA 8B, 86, D3, 1, 89, 86, B6, 1, A0, CE, 1, 32, E4, 89, 86, CA, 809
820   DATA 1, 83, ED, 2, 73, E2, BF, DB, 1, A1, E1, 1, B9, 4, 8, F3, 796
830   DATA AB, A1, E9, 1, B9, 4, 0, F3, AB, C6, 6, B1, 1, 0, C6, 6, 6DB
840   DATA AF, 1, 0, 8B, 36, B6, 1, 8B, 3E, B8, 1, E8, 2, 3, E8, 2B, 5AA
850   DATA 3, 73, 7, E8, 36, 3, 73, 7, F9, C3, E8, 2F, 3, 73, 9, F6, 660
860   DATA 6, B1, 1, 7, 74, 9, EB, 5E, 80, 3E, B1, 1, 7, 74, 57, 8A, 551
870   DATA 3E, AB, 1, E8, 6, 3, 72, 43, E8, 11, 3, 72, 3E, 8A, 4, 8A, 554
880   DATA 25, A6, 74, 28, 83, 3E, EB, 1, 10, 74, 30, 3C, A, 74, 19, 3C, 4D7
890   DATA D, 74, 10, 80, FC, A, 74, 19, 80, FC, D, 75, 1E, 3C, 20, 74, 590
900   DATA B, EB, E, 80, FC, 20, 74, 4, 33, ED, EB, A, 33, ED, E8, 17, 74C
910   DATA 0, BD, 2, 0, 8A, C4, E8, F, 0, EB, 88, C6, 6, B0, 1, 1, 5F5
920   DATA E0, 7C, 1, E9, 7D, FF, F8, C3, 58, 51, 56, 57, 8B, 8E, C6, 1, 8B3
930   DATA 83, 3E, EB, 1, 18, 74, 5, E8, 76, 8, EB, 3, E8, B6, 0, FF, 71F
940   DATA 86, B6, 1, E3, 6, 89, 8E, C6, 1, EB, 60, A1, EB, 1, 89, 86, 7EB
950   DATA C6, 1, 3D, 18, 0, 74, 1B, B, ED, 75, 5, E8, 7E, 2, EB, 3, 56B
960   DATA E8, 89, 2, 72, D, 8B, BE, B6, 1, 80, 3D, D, 75, 4, FF, 86, 6BA
970   DATA B6, 1, 88, 3E, AF, 1, 1, 75, 10, 83, BE, CA, 1, 0, 74, 2B, 55E
980   DATA FF, 8E, CA, 1, 75, B, 8B, CD, 88, C1, 2, 8, E, B1, 1, EB, 726
990   DATA 1A, F6, 6, B1, 1, 1, 75, 13, E8, C6, 2, 8B, F7, 83, C6, 2, 6CE
1000  DATA B9, 3, 0, F3, A5, 0B, 86, B6, 1, 89, 5, 5F, 5E, 59, 58, C3, 6DB
1010  DATA 3C, D, 74, 21, 3C, 9, 74, E, 3C, A, 74, 30, 51, B9, 1, 0, 3A2
1020  DATA E8, 14, 0, 59, 49, C3, 51, 49, 83, E1, 7, 41, 51, E8, 5, 0, 5E5
1030  DATA 58, 59, 2B, C8, C3, B0, 20, 88, 3E, AF, 1, 1, 75, 14, 83, BE, 670
1040  DATA CA, 1, 0, 74, D, 8B, BE, C2, 1, E8, 57, 3, E2, FB, 89, BE, 7BE
1050  DATA C2, 1, 33, C9, C3, 80, 3E, AF, 1, 1, 75, 7, 83, 8E, CA, 1, 679
1060  DATA 0, 75, 2, 49, C3, 51, 50, 51, 8B, BE, C2, 1, 83, F9, 10, 75, 682
1070  DATA 3B, 58, 53, 8B, 86, B6, 1, 2B, 86, B2, 1, 3, 86, F3, 1, 50, 5D7
1080  DATA 8B, 86, EF, 1, 73, 3, 5, 0, 10, 0A, 3E, AB, 1, B9, 1, 0, 4BA
1090  DATA 06, E8, E8, 4F, 0, 86, E8, E8, 4A, 0, B, C9, 74, 9, B8, 3A, 778
1100  DATA E8, 0, 3, 58, 49, EB, E9, 83, C7, 4, 5B, 58, E8, 35, 0, B0, 72E
1110  DATA 20, 59, 83, F9, 9, 75, 2, B0, 2D, 53, 8A, 3E, AB, 1, E8, E2, 6E3
1120  DATA 2, 5B, 89, BE, C2, 1, D1, E1, D1, E1, 3, F9, 83, C7, 1E, 58, 887
1130  DATA E8, D0, 2, 59, 49, 75, C, A1, A8, 1, 2D, 3B, 0, D1, E0, 1, 641
1140  DATA 86, C2, 1, C3, 51, B9, 4, 2, D2, C0, 50, 24, F, 4, 30, 3C, 5A1
1150  DATA 39, 7E, 2, 4, 7, E8, AB, 2, 58, FE, CD, 75, EB, 59, C3, 80, 778
1160  DATA 3E, AF, 1, 1, 74, 32, C6, 6, AF, 1, 1, E8, 9C, 3, BD, 2, 558
1170  DATA 0, A1, EB, 1, 89, 86, C6, 1, 8B, 8E, B6, 1, E8, A2, 1, 8B, 749
1180  DATA 5, 89, 86, B6, 1, 88, B6, B6, 1, 3B, F1, 73, 6, AC, E8, 57, 753
1190  DATA FE, EB, F2, 83, ED, 2, 73, D9, 8B, 1E, B6, 1, B9, 90, 1, 51, 894
1200  DATA 8B, 16, B8, 1, B9, 90, 1, 51, B9, A, 0, 8B, F3, 8B, FA, E8, 7A3
1210  DATA EA, 0, 72, 3F, E8, F5, 0, 72, 37, 8A, 4, 8A, 25, A6, 74, 28, 6A0
1220  DATA 83, 3E, EB, 1, 10, 74, 2C, 3C, A, 74, 1A, 3C, D, 74, 11, 80, 47F
1230  DATA FC, A, 74, 9, 80, FC, D, 75, 1A, 3C, 20, 74, D2, 4E, EB, CF, 745
1240  DATA 80, FC, 20, 74, CA, 4F, EB, C7, 3C, 20, 74, C3, E2, C1, EB, 2D, 929
1250  DATA 59, EB, 4, 42, 59, E2, B0, 43, 59, E2, A4, 56, 57, BE, B3, 2, 7B7
1260  DATA 8B, 3E, ED, 1, A1, A8, 1, D1, E0, 2D, 3A, 0, 3, F8, 53, 52, 6B9
1270  DATA 8A, 3E, AB, 1, E0, CC, 2, 5A, 5B, 5F, 5E, EB, 2, 59, 59, EB, 723
1280  DATA 7A, 0, 73, 4, 8B, 1E, BA, 1, E8, 01, 0, 73, 4, 8B, 16, BC, 592
1290  DATA 1, 89, 1E, D7, 1, 89, 16, D9, 1, 8A, 3E, AC, 1, BD, 2, 0, 52D
1300  DATA 8B, B6, B6, 1, 3B, B6, D7, 1, 74, D, 83, BE, CA, 1, 0, 74, 6C2
1310  DATA 6, AC, E8, 83, FD, EB, E9, 83, ED, 2, 73, E4, E8, 11, 0, BD, 97D
1320  DATA 2, 8, BB, 86, D7, 1, 83, 86, B6, 1, 83, ED, 2, 73, F3, C3, 74C
1330  DATA F6, 6, B1, 1, 6, 74, 24, F6, 6, B1, 1, 1, 75, 1D, 80, E, 51B
1340  DATA B1, 1, 1, BD, 2, 0, 0B, 86, B6, 1, 89, 86, D3, 1, 8B, 86, 62E
1350  DATA C6, 1, 89, 86, CF, 1, 83, ED, 2, 73, EB, C3, 33, ED, 3B, B6, 84A
1360  DATA BA, 1, 72, 79, 3B, B6, BE, 1, 72, 75, EB, F, BD, 2, 0, 3B, 631
1370  DATA BE, BA, 1, 72, 68, 3B, BE, BE, 1, 72, 64, 50, 53, 51, 52, 56, 67D
1380  DATA 57, 8B, B6, B2, 1, 8B, FE, 81, EF, 0, 28, B9, 0, 14, F3, A5, 7D1
1390  DATA E8, 68, 0, 81, AE, D3, 1, 8, 28, 81, AE, D7, 1, 0, 28, 81, 62B
1400  DATA AE, B6, 1, 0, 28, 81, 86, F3, 1, 0, 28, 73, 6, 81, 86, EF, 61F
1410  DATA 1, 0, 10, E8, 2B, 8, B9, 4, 0, 81, 2D, 0, 28, 47, 47, E2, 427
1420  DATA F8, 5F, 5E, 5A, 59, 5B, 58, B, ED, 74, A, 81, EF, 0, 28, 81, 6AA
1430  DATA EA, 0, 28, EB, B, 81, EE, 0, 28, 81, EB, 0, 28, F8, C3, F9, 7E4
1440  DATA C3, 8B, FD, D1, E7, D1, E7, 81, C7, DB, 1, C3, B8, 0, 3D, CD, A64
1450  DATA 21, 72, 7, 09, 86, FB, 1, E8, 1, 0, C3, 8B, 9E, FB, 1, 8B, 701
1460  DATA 96, B2, 1, 8B, F2, B9, 0, 28, B4, 3F, CD, 21, 72, 17, 3, D0, 6E4
1470  DATA 89, 96, BA, 1, 8B, C0, E3, C, A0, AD, 1, 3C, FF, 74, 5, 20, 73E
1480  DATA 4, 46, E2, FB, F8, C3, 6, B8, 0, 5, CD, 10, 88, 40, 0, 8E, 708
1490  DATA C0, 26, A0, 49, 0, 3C, 7, 74, A, 3C, 3, 76, 6, BA, 15, 2, 41C
1500  DATA E9, 52, FB, B4, 12, B3, 10, CD, 10, 88, FB, 10, 74, 15, 26, F6, 7CC
1510  DATA 6, 87, 0, 8, 75, D, 32, FF, B8, 30, 11, 6, CD, 10, 7, 88, 4B3
1520  DATA 16, AA, 1, 26, A0, 4A, 0, 32, E4, 8B, D0, 8B, 1E, EB, 1, 83, 65A
1530  DATA FB, 10, 75, 6, 8B, D3, 3C, 28, 74, C3, 89, 16, EB, 1, 89, 16, 6A9
1540  DATA CF, 1, 89, 16, D1, 1, A3, A8, 1, D1, E0, 8A, 16, AA, 1, F6, 77F
1550  DATA E2, A3, ED, 1, 80, EA, 4, D0, EA, 88, 16, CE, 1, 26, A1, 63, 832
1560  DATA 0, 5, 6, 0, A3, A4, 1, 3D, BA, 3, 74, 15, 81, 6, A6, 1, 404
1570  DATA 0, 8, B4, 8, CD, 10, 88, 26, AB, 1, 80, F4, 77, 88, 26, AC, 640
1580  DATA 1, 7, C3, 6, 8B, 16, A6, 1, 8E, C2, 8B, 16, A4, 1, 8A, D8, 611
1590  DATA EC, D0, D8, 72, FB, FA, EC, D0, D8, 73, FB, 8B, C3, AB, FB, 7, BF8
1600  DATA C3, E8, D8, 0, 8A, 36, AA, 1, FE, C6, 32, D2, 32, FF, B4, 2, 89D
1610  DATA CD, 10, 33, FF, BE, 9, 1, 8A, 3E, AB, 1, E8, A5, 0, 8B, 3E, 6A1
1620  DATA A8, 1, D1, E7, 83, EF, 40, 46, E8, 98, 0, BD, 0, 0, 8B, E, 72F
1630  DATA A8, 1, 57, B0, CD, E8, AB, FF, E2, FB, 5F, 83, FD, 2, 77, 2A, 96E
1640  DATA 57, 83, C7, A, B8, B5, E8, 9A, FF, 8B, B6, F7, 1, E8, 73, 0, 925
1650  DATA B0, C6, E8, 8E, FF, 5F, A1, A8, 1, D1, E0, 8A, 16, CE, 1, FE, 9B2
1660  DATA C2, F6, E2, 3, F8, 83, C5, 2, EB, C4, C3, BE, 7E, 2, 8B, 3E, 958
1670  DATA ED, 1, 8A, 3E, AB, 1, E8, 4A, 0, C3, 80, 3E, AE, 1, 1, 74, 639
1680  DATA B, C6, 6, AE, 1, 1, BA, 3, 1, E8, 94, 0, 8B, 96, 32, 2, 516
1690  DATA E8, 8D, 0, 8B, BE, F7, 1, 8B, D7, 83, EA, 2, 8B, DA, C6, 7, 8B9
1700  DATA 50, B4, A, CD, 21, 57, B0, D, AE, 75, FD, C6, 45, FF, 0, 5F, 799
1710  DATA 8B, D7, E8, 57, FE, 73, 8, BA, 6D, 2, E8, 63, 0, EB, CD, C3, 909
1720  DATA E8, 20, FF, AC, 3C, 28, 73, F8, C3, B4, 0, CD, 16, C3, B4, 1, 84C
1730  DATA CD, 16, C3, E8, F3, FF, E8, F5, FF, 75, F8, C3, 33, C9, 8B, 16, B29
1740  DATA A8, 1, FE, CA, 8A, 36, AA, 1, EB, 2A, B9, 0, 2, 8B, 16, A8, 6F5
1750  DATA 1, FE, CA, 8A, 36, CE, 1, FE, C6, E8, 18, 0, 2, 2E, CE, 1, 71B
1760  DATA FE, C5, 2, 36, CE, 1, FE, C6, EB, A, 8A, 2E, AA, 1, 32, C9, 7E1
1770  DATA 8A, F5, B2, 2C, 53, 8A, 3E, AB, 1, B8, 0, 6, CD, 10, 5B, C3, 6DD
1780  DATA B4, 9, CD, 21, C3, 90, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2FE
```

COMPARE.BAS A BASIC program that will create COMPARE.COM automatically

in a text file the period would usually be followed by a terminating Ctrl-Z. The results would be the same.)

The program doesn't give up at this point, however. It returns to the anchor positions of both files and increments to a new starting position in FILE1. This time it tries to match the string 'n original t'. The first bytes compared are 'n' in 'an' of FILE1 with the anchor 'n' in 'not' of FILE2. COMPARE gets excited again, though we already know it's all for naught, since the search will once again reach the end of FILE2 without syncing up.

Proceeding in this manner, COMPARE inches along FILE1 until the 'o' in 'original' of FILE1 becomes the new starting position. This time, though starting again with the FILE2 anchor point (the 'n' in 'not'), COMPARE quickly succeeds in matching the 10-byte (sans space) 'original th' string.

Once COMPARE is successfully synchronised, the text from the anchor position to the start of the string match is displayed in inverse video. In this example, the 'an' string of the first file and the 'not the' string in the second are highlighted. The highlighted difference can be as little as a 1-byte insertion up to the 400-byte maximum reach of both files if no match is found. In the latter case, COMPARE displays the additional message, 'Files significantly different'. Even then the program does not give up, and commences a new round of searching until the window is filled.

At this point you can choose either to continue searching, by pressing any key except Esc, or to quit, by hitting Esc. It's still quite probable that a match can be found with additional searches if the difference in the files is not a lopsided insertion, deletion, or block move.

The reason a successive string is required before we are declared back in sync, is to prevent false matches on embedded words such as the 'the' in 'thesis'. Spaces are not counted in the string matches to avoid premature matches in indentations or tab positions that are delimited by actual spaces. (This is one of my two promised reasons why the compares are done a byte at a time, using the CMPSB instruction instead of the string compare instruction,

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```
COMPARE 1.0 (C) 1988 Ziff Communications Co.              ▪ Michael J. Mefford
════╡SAMPLE1╞═══════════════════════════════════════════════════════════════
This is a test file.
Notice that COMPARE is not
confused by word wrap.
This line is the original sample.
A line has be inserted in the original.
The last line is the same in both examples.→

════╡SAMPLE2╞═══════════════════════════════════════════════════════════════
This is a test file.
Notice that COMPARE is not confused by
word wrap.
This line is not the original sample.
The last line is the same in both examples.→

C>_                         Compare completed
```

Fig 1 The COMPARE screen display defaults to text format. The differences are highlighted in reverse video

```
COMPARE 1.0 (C) 1988 Ziff Communications Co.              ▪ Michael J. Mefford
════╡SAMPLE1╞═══════════════════════════════════════════════════════════════
0000:0000  54 68 69 73 20 69 73 20-61 20 74 65 73 74 20 66  This is a test f
0000:0010  69 6C 65 2E 0D 0A 4E 6F-74 69 63 65 20 74 68 61  ile.♪◙Notice tha
0000:0020  74 20 43 4F 4D 50 41 52-45 20 69 73 20 6E 6F 74  t COMPARE is not
0000:0030  0D 0A 63 6F 6E 66 75 73-65 64 20 62 79 20 77 6F  ♪◙confused by wo
0000:0040  72 64 20 77 72 61 70 2E-0D 0A 54 68 69 73 20 6C  rd wrap.♪◙This l
0000:0050  69 6E 65 20 69 73 20 74-68 65 20 6F 72 69 67 69  ine is the origi
0000:0060  6E 61 6C 20 73 61 6D 70-6C 65 2E 0D 0A 41 20 6C  nal sample.♪◙A l
0000:0070  69 6E 65 20 68 61 73 20-62 65 20 69 6E 73 65 72  ine has be inser
0000:0080  74 65 64 20 69 6E 20 74-68 65 20 6F 72 69 67 69  ted in the origi
0000:0090  6E 61 6C 2E 0D 0A 54 68-65 20 6C 61 73 74 20 6C  nal.♪◙The last l
════╡SAMPLE2╞═══════════════════════════════════════════════════════════════
0000:0000  54 68 69 73 20 69 73 20-61 20 74 65 73 74 20 66  This is a test f
0000:0010  69 6C 65 2E 0D 0A 4E 6F-74 69 63 65 20 74 68 61  ile.♪◙Notice tha
0000:0020  74 20 43 4F 4D 50 41 52-45 20 69 73 20 6E 6F 74  t COMPARE is not
0000:0030  20 63 6F 6E 66 75 73 65-64 20 62 79 0D 0A 77 6F   confused by♪◙wo
0000:0040  72 64 20 77 72 61 70 2E-0D 0A 54 68 69 73 20 6C  rd wrap.♪◙This l
0000:0050  69 6E 65 20 69 73 20 6E-6F 74 20 74 68 65 20 6F  ine is not the o
0000:0060  72 69 67 69 6E 61 6C 20-73 61 6D 70 6C 65 2E 0D  riginal sample.♪
0000:0070  0A 54 68 65 20 6C 61 73-74 20 6C 69 6E 65 20 69  ◙The last line i
0000:0080  73 20 74 68 65 20 73 61-6D 65 20 69 6E 20 62 6F  s the same in bo
0000:0090  74 68 20 65 78 61 6D 70-6C 65 73 2E 1A           th examples.→

C>_                         Compare completed
```

Fig 2 COMPARE can be forced to display in the hexadecimal format with the /B option. Note that the segment offset starts at absolute zero

REP CMPSB.) The large number of spaces between the instruction field and comments in the assembly listings provides an example of a situation in which spaces would otherwise confuse COMPARE.

As you can see, COMPARE's algorithm can comprise a considerable number of compares. This could test your patience with long working times on files that are significantly different. To minimise the working time, however, I made the SYNCHRONISE procedure in the assembly code as tight as possible, utilising all the registers to hold values instead of going out to RAM.

Word-wrap considerations

Compare makes special provisions for word-wrap paragraph reformation that results from insertions, deletions, or just plain changing the margins. Word processors deal with word-wrap in ASCII files in one of two ways. The subtle difference between the two is whether a word-delimiting space is saved at the end of a line or is just inferred by the carriage return/linefeed combination. See sentences 1 and 2 of Fig 4. When displayed, these sentences look the same; the space at the end of a line is invisible since there is nothing to its right to make it show up. The actual files, however, will be differentiated by the space character. Since the sentences read the same, it is not desirable to bring attention to the space as a difference.

COMPARE applies a number of rules to avoid confusing word-wrap with a mismatch. When 2 bytes mismatch, if one is a linefeed, the linefeed is skipped and the following byte is compared with the current byte in the other file. If one of the mismatched bytes is a carriage return, the corresponding byte is checked to see if it is a space character. If so, they are considered a pair and the next 2 bytes are compared. Otherwise, the carriage return is skipped (the same as with linefeeds), and the next byte is checked with the current position in the opposite file. (This is the second reason that compares are done a byte at a time.) As this may seem a bit complex, let's step through it, using the first two sentences in Fig 4.

The first mismatch will be the carriage return and the space character after the word 'but'. Following the above rule, these are considered a pair, so we go on to the next bytes in both sentences. Here we find a mismatch between the linefeed of the first sentence and the carriage return of the second. We ignore linefeeds, so we skip it and hold our position at the carriage return in the second sentence (it's not checked at this point). Next, we compare the 'h' in 'have' in the first sentence with the carriage return. This time since a carriage return is not mismatched with a space, the carriage return is skipped while still holding the 'h' position in the first sentence. We now are at the linefeed, which we ignore. That then brings us to the 'h' in both sentences — a match, and we haven't missed a beat. The same algorithm also keeps things on track when sentences wrap at different words, as occurs in the third sentence in Fig 4. In fact, it will work with any combination of the three

```
FILE1
-----
This is an original thesis.

FILE2
-----
This is not the original thesis.
```

Fig 3 The article text explains how COMPARE proceeds when it discovers the alien words 'an' in FILE1 and 'not the' in FILE2 in these two short file examples

sentences in the example, though I'll leave it up to you to work through it in detail.

In a binary comparison the carriage return and linefeed are given no special treatment. COMPARE has no way of knowing if a 13 or 10 actually represents a carriage return or linefeed character. A 13 could be: an OR AX immediate instruction (binary coded as character 13); a short jump or near call of 13 bytes; a part of a variable; or a carriage return. A linefeed could similarly be misconstrued. Therefore, unmatched carriage return-linefeeds are highlighted, as you see in the hexadecimal dump of Fig 2. This contrasts with their treatment in the text example in Fig 1.

Modifying compare

You may have wondered how I arrived at the requirement of 10 consecutive matching bytes to get back in sync. What I did was to use my PARSE program (Programming/Utilities, *APC* Magazine, January 27, 1987) to examine some of my documents and find an average number of characters per word. I then added a fudge factor for occasional big words and rounded it off to an even number — 10. The 400-byte value came entirely from my imagination. You may wish to change both the sequence (10) and the reach (400) values to suit your intuition. Decrease the reach if you find that COMPARE thinks too long — increase it if your files have major changes and COMPARE fails to sync up. Likewise, you can modify the sensitivity by increasing or decreasing the number of consecutive bytes required for a match.

To experiment with the synchronisation algorithm, enter the following:

```
DEBUG COMPARE.COM
E 6ED cd ab
E 6F5 cd ab
E 6F9 gh ef
W
Q
```

where *abcd* is the number of bytes (in hex) that COMPARE will reach out to find a match before it gives up, and *efgh* is the number of bytes (excluding spaces) required for COMPARE to register a legitimate match. COMPARE defaults to *abcd* equal to 0190h (400 decimal) and *efgh* equal to 000Ah (10 decimal). Be sure to enter both bytes in each entry and make both of the reach parameters (*abcd*) the same to keep the synchronisation search symmetrical.

Base pointer

If you examine the assembly listing, you will notice that the BP (base pointer) is used extensively as an index register to each of the display windows. COMPARE's window variables are words and are stored in sequence. The base pointer is then given a value of 0 or 2 to access the appropriate variable. For example, the second window position can be retrieved with the two instructions

```
MOV BP,2
MOV AX, WINDOW_POS[BP]
```

The second instruction will compile to

```
MOV AX,[BP+xxxx]
```

where xxxx equals the displacement of the first WINDOW_POS variable. By adding the BP's value of 2 to the displacement, we can easily address the second window's position. Normally the base pointer is used in conjunction with the stack segment to access the stack instead of the data segment. Since we are dealing with .COM files here and the segments are all the same (as long as we don't change them), it is perfectly permissible to use the BP in this manner. There are just not enough orthogonal registers available in the Intel 80 series microprocessors otherwise. You have to inform the assembler that you wish the BP to be referenced as if the stack segment and data segment were the same. This is accomplished with an

```
ASSUME SS:_TEXT
```

```
These sentences are effectively the same in context but<cr><lf>
have word wrap to the next line in different places.

These sentences are effectively the same in context but <cr><lf>
have word wrap to the next line in different places.

These sentences are effectively the same in context<cr><lf>
but have word wrap to the next line in different places.
```

Fig 4 The first two sentences are identical except for the additional space character at the end of the line. The third sentence is the same except that the line break is at a different word

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directive. If you don't. the assembler will use its default assumptions and compile the above instructions as

```
MOVE AX,DS:[BP+xxxx]
```

The result is that an extra byte is added in the form of an unneeded segment override.

Buffered keyboard input

One other routine deserves comment. COMPARE uses the DOS Buffered Keyboard Input function call 0Ah to get filename information from the user. if this were not supplied on the command line. To implement this call, point DS:DX to a buffer with the first byte specifying the maximum number of characters the buffer can hold. On return. the second byte of the buffer will have the actual number of characters entered. followed by the input from the user. The character count excludes the terminating carriage return. which is always the last character.

This is a dandy little call that requires few instructions to achieve a line input editor complete with display output and cursor — courtesy of DOS and the BIOS. The editor control is not fancy: it doesn't utilise the familiar edit keys. Ins. Del. or any of the cursor-controlling arrow keys. The exception is the Left Arrow. which acts like the Backspace key. erasing the character left.

You can live without those editing features in a simple input prompt. and you'd probably see function 0Ah used by many programs but for one annoying quirk: its implementation of the Esc keypress.

Esc should always act as a rip cord. taking you back to where you were or cancelling the current entry. However. chances are that the user's intention in hitting Esc was simply to quit COMPARE. Instead. he finds himself locked in until he hits Enter after typing in a correct filename. The only way to quit buffer input (and thus COMPARE) at this particular point is to use the Ctrl-C or Ctrl-Break.

The trade-off in code space saved by using this call is well worth it in a short utility like COMPARE. for the need to quit the program in the middle of entering the filenames is rare.

COMPARE won't get used as often as DR, but when the need arises. it's wonderful to know that you can review and approve the editing changes in a manuscript so fast that you won't even have to delay your dinner. Enjoy the leisure it creates.

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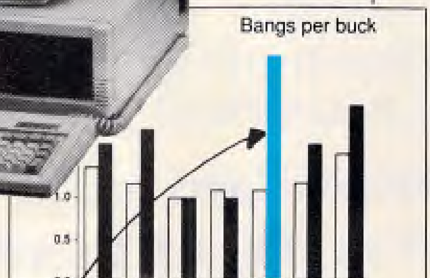

Bangs per buck — just one way of comparing the relative merits of these seven ultra cheap clones. The lighter shading denotes price (in thousands of dollars) and the darker shading a performance index. See Table 3 for more details. (Machines in order from left to right are ... Rod Irving, MicroDOS, Commodore, Uni-x, ...nics and Techn...

Processor.

NEC. The Uni-x contains a NEC V20, manufactured by Sony.

... Thus a V20 running at 4.77MHz will outrun an 8088 running at the same clock speed.

... machines examined provided a standard PC clock rate of 4.77MHz as a minimum, although the Uni-x delivered higher than standard performance even on this clock rate by virtue of the V20. The Atlantis and ... machines ...

Performance.

... The Uni-x is fastest overall, providing a 50 per cent boost over the Technology Interface due to the V20.

Display.

... delivered with a nice INTRA tilt/swivel amber screen. ...

Cost Effectiveness.

As you might expect, the do-it-yourself Uni-x comes up trumps with its low cost and relatively high performance.

Specifics.

very sens... place ...
The Uni-x features a delightfully small motherboard. It has employed a VLSI component to replace the Intel 8253 timer, 8255 PPI, 8237 DMA controller and several other components. This reduced the component count and a simplified motherboard serves to reduce costs.

. . . see for yourself in the full Report in the October '87 issue, or ring us for a copy.

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PC power problems

I use a PC with a 20Mbyte hard disk installed. During the course of my work session, I often have to leave the machine for a period of time. What length of time would you recommend as the point when turning a hard disk PC off is better than leaving it on? I realise that turning the power on creates wear, but so does the continuous rotation of the disk. If I plan to return in one hour, would it be better to leave it on or to turn it off and power-on again when I return?
L Herr

The answer to this question is an unequivocal 'it depends'. I've always believed that the current surge and electronic shock caused by the power on/off cycle does more harm to computer components than continuous operation. Keep in mind that the power on/off cycle shocks all components, not just the hard disk.

Memory boards, CPUs, and displays are all subject to wear. A hard disk, while spinning, is simply running an electrical motor. I can't ever remember one failing because the motor or spindle failed.

When I leave the office, I turn off the peripherals (monitor, printer, etc) but leave the PC system unit in my office on continuously. The main reason is convenience. To be able to use my office PC while at home, it must be turned on and connected to a modem. And should the computer break, the company would, of course, pick up the repair bill.

At home, however, I take a different tack. When I need my machine, I turn it on. When I don't, I turn if off. During dinner breaks, which last about an hour, I'll leave the machine on, just blanking the display screen. If I'm going to be away longer than that, or maybe not return at all, I'll shut the computer off.

In each case, however, if I'm not using it, I park the hard disk heads. This is probably the simplest and most important thing you can do to protect your computer while you're away. If the power fails, or you turn it off, the head will land safely away from your data — RH.

```
N NUMLKOFF.COM
A 100
POP DS
AND BY [417],DF
INT 20

RCX
8
W
Q
```

Fig 1 Type these instructions into DEBUG to create the file NUMLKOFF.COM. Be sure to include the blank line after the INT 20

Mixing processors

I recently purchased an Intel 8087 numeric coprocessor for my PC. Before I installed it, I called Intel to check if it were safe to use the 8087 with the NEC V20 I was currently using. Alas, Intel said it was a bad idea and that I should dig out my old 8088 for use with the 8087. Why won't the V20 work safely with the 8087?
A Dekom

Not having been party to your conversation with Intel, it's hard to speculate as to why its staff said the V20 was incompatible with the 8087. Perhaps it's somewhat like calling IBM and asking if you can put a Compaq disk drive in your PC — I have a feeling IBM would also say it was a bad idea. As for working with the 8087 maths coprocessor, the V20 should present no problems. I have run this particular combination for several years in my PC with no ill effects of any kind. The real question about the NEC chip is, why didn't Intel think of it first?

Originally popularised as a fast replacement for the 8088, the NEC V20 is actually much more. First, the chip uses CMOS (Complementary Metal-Oxide-Semiconductor) construction. This allows it to run cooler and draw less power than the standard TTL (Transistor-Transistor Logic) 8088 — a feature especially important to manufacturers and users of laptop computers. Less power consumption means smaller, lighter computers that can run longer on a single battery charge.

But while lower power use is important to laptop users, the V20 holds significant advantages for desktop users as well. For example, one of the slower operations on the 8088 is calculating the effective address (EA). Whenever data is moved to or from memory, the correct place in memory must be determined. Often this involves using segment register maths and implied indexing. The 8088 performs this calculation by executing many small steps (microcode instructions) internally. This takes time. In contrast, the EA calculation in the V20 is performed rapidly in hardware. This is one reason PCs with a V20 installed return such a high number using The Norton Utilities' SI test.

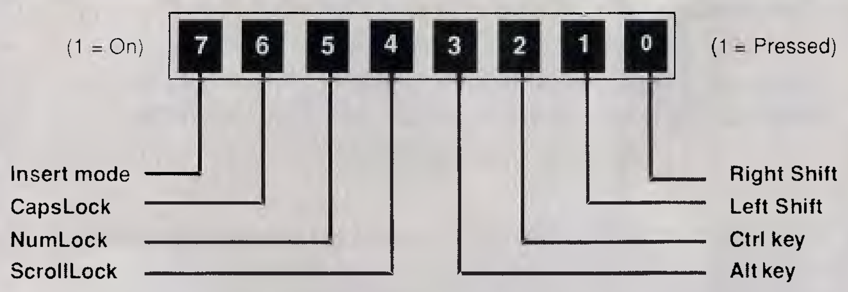
Besides adding the EA hardware, two major improvements were made to the machine instructions. In addition to executing the 8088 opcodes, the V20 will directly execute all the 80286 real-mode opcodes. Therefore, compilers and assemblers that offer the option can be set to compile for the 80286 and still execute on the V20. Note that protected-mode code (like OS/2) is not supported.

The second improvement isn't widely known or used in the IBM PC world. The V20 can be switched into 8080 compatibility mode. Thus, with the proper setup software, PCs equipped with a V20 can directly execute programs written for the older 8080 CP/M computers — RH.

Unlocking NumLock

Perhaps the simple question I have has been answered before. My IBM PC AT boots up with the NumLock on. If I forget to turn it off before going into some of my applications, like APL, which change the key assignments, I'm stuck! What can I add to my AUTOEXEC.BAT file to turn NumLock off at the start?
H Weingartner

Shift status byte encoding



The shift status byte, located at 0:417h in the BIOS data area, reflects the current status of the keyboard toggle states and the positions of certain shift keys.

After we got used to the original PC and AT keyboards, on which the number pad defaulted to the cursor keys, IBM did the dirty on us once again when it made NumLock default to on. Fortunately, there is a clean, simple fix for the problem. Fig 1 shows a program you assemble with DEBUG to create NUMLKOFF.COM. Running the program will set NumLock off regardless of its present state.

The status of the shift indicators is kept at 0000:0417h, a byte in the BIOS data area in low memory. Each bit in this byte reflects a piece of information about the shift state of the machine at that instant. The contents of the byte are labelled with their meanings in the diagram 'Shift status byte encoding'.

NUMLKOFF shows how simple a program can be under DOS. The entire thing can be created in about 15 seconds. (The OS/2 version is still compiling!) The POP DS instruction loads the DS register with a zero that was placed on the stack by DOS.

NUMLKOFF then simply forces bit 5 to zero by masking it with the value DFh (11011111 binary). The INT 20 instruction terminates the program and returns you to the DOS prompt — RH.

Structured function returns

The Jensen and Wirth Pascal User Manual specifies that a function result must be scalar, subrange, or pointer type. Turbo Pascal extends this specification by allowing strings. But you can't create a function that will return an array, a record, or any other structured type. However, with some minor trickery you can come very close.

The program in Fig 2 shows a function that returns the complex product of two complex numbers. The trick here is that it returns that product as a string. With TP4's typecasting facility, it's a snap to refer to that string as the RECORD type it really is. Note that you have to add a dummy length byte at the start of the structure and set it to an appropriate value. With this minor addition, you can program almost exactly as if your function returned a complex result directly.

You can do this trick with almost any structured type. Just add the length byte to the structure and make sure the string type occupies the same number of bytes. Have your function calculate the desired result and typecast it to a string. Then the program line that calls the function typecasts it back to the structured type. That's it! — NR.

Fast EGA output

The demo program EGA_GRPH.COM, written solely in Turbo Pascal, Version 3.0, (see Fig 3), has full colour support for the EGA. It puts pixels to the screen 3.1 times as fast as MetaWINDOWS and 3.5 times as fast as the standard Turbo Pascal Plot procedure (which won't work on the EGA in 640 by 350 resolution). You can use EGA_GRAPHICS alone or with the monochrome graphics primitives (Draw a line, Circle, and ScreenDump for hard copy), also in Turbo Pascal.

The speed comes from using arrays to avoid repetitive calculations and from writing directly to the video memory and the EGA registers. Also, with just one statement you can both initialise an address register port and write to a data register port, because the 8088 can output two bytes in one operation. For example, in the Init_Graphics procedure the statement 'PortW[$03CE] := $1803' is equivalent to 'Port[$03CE] := $03' and 'Port[$03CF] := $18' but is twice as fast. Comments in the source code explain the ports and their data.

After writing to the EGA registers, the 8 by 14 font is wiped out. Before you use the standard Turbo Pascal WriteLn and Write statements you must reload it. The procedure WriteAgain accomplishes the font reload and lets you change the text background and foreground colours.

V Mansfield

```
{$R-,S+,I+,D+,T-,F-,V+,B-,N-,L+ }
{$M 16384,0,655360 }
PROGRAM ComplexDemo;
TYPE
  Complex = RECORD
              L : byte;     {dummy length byte}
              R, I : Real; {real and imaginary parts}
            END;
  CompStr = STRING[12];
VAR
  X          : Compstr;
  C1, C2, C3 : Complex;
  N          : Byte;
FUNCTION ComplexMul(A,B : Complex) : CompStr;
VAR Temp : Complex;
BEGIN
  Temp.L := 12; {set the dummy length byte}
  Temp.R := A.R*B.R - A.I*B.I;
  Temp.I := A.R*B.I + A.I*B.R;
  ComplexMul := CompStr(Temp); {typecast}
END;

BEGIN
  C3 := Complex(X);
  WriteLn('Enter 1st complex number, real part first.  E.g. "2.5 5.0"');
  Write(':'); ReadLn(C1.R, C1.I);
  WriteLn('Enter 2nd complex number, real part first.  E.g. "2.5 5.0"');
  Write(':'); ReadLn(C2.R, C2.I);
  Compstr(C3) := ComplexMul(C1,C2);{typecast}
  WriteLn('Their product is ',C3.R:1:11,' + ',C3.I:1:11,'i');
END.
```

Fig 2 Demonstrating a way to simulate structured function results in Turbo Pascal

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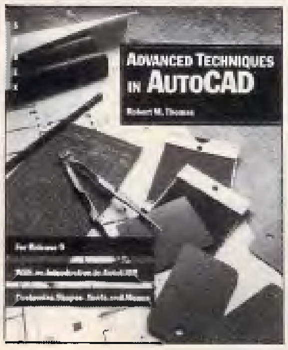

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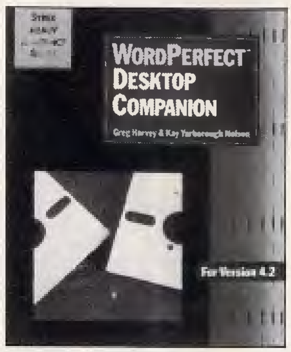

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I like the trick of calculating the offsets for X and Y values once and putting them into an array. If you're going to plot a lot of pixels, the time saving is immense! — NR.

Partial print screens

When I'm debugging a program or working on a spreadsheet, I often need to use the DOS Shift-PrtSc function to print out just a few lines of code or some current figures. More often than not, this results in a large amount of wasted paper.

To solve this problem, I wrote PRNBYLIN.COM, created by the PRNBYLIN.ASM assembler listing in Fig 4 or the Basic PRNBYLIN.BAS program in Fig 5. This TSR program takes over control of the DOS print screen function.

Now I can select the exact lines I want to print without having to print the entire screen. When in the 80-column mode, you can move the selection bar by using the Plus and Minus keys on the number pad and mark your position by pressing Enter. The program uses DOS's normal print screen function when not in the 80-column mode.

R Powell

```
PROGRAM EGA_GRAPHICS;{ primitives for fast color graphics in TURBO PASCAL. }

TYPE
  RegPack = RECORD
              AX, BX, CX, DX, BP, SI, DI, DS, ES, Flags : Integer
            END;
VAR
  RegPak : RegPack;
  { Next 4 arrays avoid repetitive calculations }
  Xaddr : ARRAY[0..639] OF Byte;
  Yaddr : ARRAY[0..349] OF Integer;
  Point : ARRAY[0..639] OF Byte;
  HiPoint : ARRAY[0..649] OF Integer;
  I, J, Color, Left : Integer;
  dummy : Char;

  PROCEDURE Init_graphics(BackGround : Integer);
    {Sets up graphics hardware and arrays to avoid repetitive calculations.}
  VAR
    indx : Integer;
  BEGIN
    PortW[$03CE] := $1803;    { Use XOR for writing to graphics memory
                                $1603 for OR. }
    { For Color machines let RegPak.AX:= $0010, Mono = $000F }
    RegPak.AX := $0010;
    Intr($10, RegPak);
    FOR indx := 0 TO 349 DO Yaddr[indx] := 27920-80*indx;
    { Subtracting from 27920 makes origin at the lower left corner. }
    FOR indx := 0 TO 639 DO Xaddr[indx] := indx DIV 8;
    FOR indx := 0 TO 639 DO
      BEGIN
        Point[indx] := $80 SHR(indx MOD 8);
        HiPoint[indx] := Swap(Point[indx])+8;
      END;
    GraphBackground(BackGround); { Standard TUBRO works fine here }
  END;

  PROCEDURE Plot(x, y : Integer);
  VAR
```

continued . . .

Fig 3 The EGA_GRAPHICS program demonstrates fast point-plotting on the EGA

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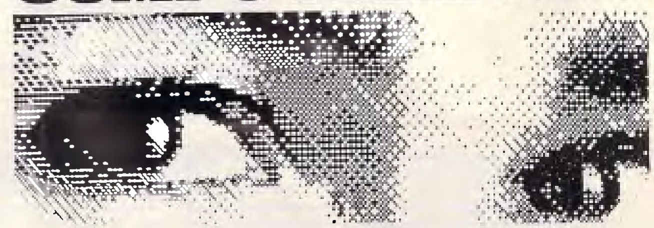

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This terrific little program also lets you Escape out of an accidental Shift-PrtSc by simply hitting Esc. And you can hit Esc if you realise you marked the wrong area and want to start again. It works from inside lots of different programs and gives you the kind of real flexibility DOS doesn't when you're printing — PS.

A hostile environment

I am having a problem with COMSPEC on my computer system. I use a dual-floppy PC with no hard disk, and several programs that I use look to drive A: when they need to reload COMMAND.COM. Removing the application disk and replacing it with the DOS disk is annoying. I thought I'd solve the problem by creating a small RAM drive to use as drive C:, copying COMMAND.COM onto it, and setting the COMSPEC variable to reflect the change. Much to my chagrin, it did no good! Listing the environment by entering the SET command with no arguments showed COMSPEC=A:\ and COMSPEC=C:\ entries! I have tried to erase the first by entering SET COMSPEC=, but cannot get rid of the COMSPEC pointing to A:. What gives?
R Poliakoff

Unfortunately, Mr Poliakoff's letter did not include a printout of the environment or a disk copy of his AUTOEXEC.BAT file, so I was unable to examine the exact entries haunting his environment. The SET command can be tricky. There are a few things about the environment and the SET command that bear explaining.

The format for the SET command is

```
SET [var]=[string]
```

When you press the Enter key at the end of this command, DOS scans the command line from left to right to parse out the var and string arguments.

The var variable is defined as the entire string of characters that begins with the first non-white-space character following the SET command and ends with the character immediately preceding the equals symbol (=). All alphabetic characters are capitalised, but otherwise no changes are made. Thus, the following two strings are not *equivalent*

```
SET COMSPEC=A:\
SET COMSPEC =A:\
```

In the first case, var is 'COMSPEC'. But in the second, var is 'COMSPEC ', where the trailing space is included as

```
    total, junk : Integer;
  BEGIN
    total := Xaddr[x]+Yaddr[y];   { Find sequential address }
    PortW[$03CE] := HiPoint[x];   { Protect bits in mask }
    Junk := Mem[$A000:Total];     { Latch bit planes by reading }
    Mem[$A000:total] := point[x]; { Light up pixel }
  END;

  PROCEDURE PixelColor(Color : Integer);
  BEGIN
    PortW[$03CE] := $FF01;    { Enable set/reset }
    PortW[$03CE] := Swap(Color); { Set color of Pixel}
  END;

  PROCEDURE WriteAgain(BackGround, ForeGround : Integer);
    { Reloads 8x14 font }
  BEGIN
    RegPak.AX := $1101;
    RegPak.BX := $0002;
    Intr($10, RegPak);
    { Set new background and foreground colors }
    GraphBackground(BackGround);
    TextColor(ForeGround);
  END;

BEGIN
  Init_Graphics(Green); Left := 0;
  FOR Color := Black TO White DO
    BEGIN
      PixelColor(Color);
      FOR I := 1 TO 20 DO
        BEGIN
          Left := Left+1;
          FOR J := 0 TO 30 DO Plot(Left, J);
        END;
    END;
  WriteAgain(Green, White);
  Write('After color graphics calls you must ');
  WriteLn('reload font with Procedure WriteAgain.');
  WriteLn('Otherwise standard Write and WriteLn does not work.');
  WriteLn;
  WriteLn('Strike any key to do color graphics again.'); Read(Kbd, dummy);
  WriteLn;
  FOR J := 1 TO 30 DO
    BEGIN
      PixelColor(Random(16));
      FOR I := 0 TO 349 DO Plot(J+I, I);
      PixelColor(Random(16));
      FOR I := 0 To 349 DO Plot(Abs(380-I-J), I);
    END;
  WriteAgain(Blue, Yellow);
  WriteLn('Reload font again with WriteAgain before WriteLn.'); WriteLn;
  WriteLn('Strike any key to exit.');
  Read(Kbd, dummy);
  TextMode(C80);
END.
```

ends

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```
;PRNBYLIN.ASM      Russell W. Powell
;PRNBYLIN.ASM is a memory resident program that allows you
;to print one or more lines when using <Shft>-<PrtSc>.
;
;Assemble and link with MASM, then create .COM file using
;EXE2BIN

;set up installation of TSR
CSEG            SEGMENT
                ASSUME  CS:CSEG,DS:CSEG,ES:CSEG
                ORG     0100H
START:          JMP     INIT
IRUPT           DW      0
IRPT1           DW      0
CURPOS          DW      0

MAIN:           PUSH    DX                          ;save registers
                PUSH    AX
                PUSH    BX
                PUSH    CX
                PUSH    DS
                PUSHF
                PUSH    CS
                POP     DS
                MOV     AX,0050H                    ;check if PrtSc is
                MOV     ES,AX                       ;active
                CMP     BYTE PTR ES:[0000H],01
                JZ      ENDM
                MOV     BYTE PTR ES:[0000H],01      ;make PrtSc active
                MOV     AH,0FH
                INT     10H
                CMP     AL,3                        ;check for 80-col mode
                JLE     SAVECUR
ENDM:           POPF                                ;return to BIOS PrtSc
                POP     DS
                POP     CX
                POP     BX
                POP     AX
                POP     DX
                JMP     FAR [IRUPT]
SAVECUR:        MOV     AH,3                        ;save cursor position
                INT     10H
                MOV     CURPOS,DX
                XOR     CX,CX
                MOV     DX,CX
                MOV     AH,2
                INT     10H
                CALL    ATTR                        ;show selection bar
GETKEY:         XOR     AH,AH                       ;get key
                INT     16H
                CMP     AH,1CH                      ;test for <CR>
                JE      SELECT
                CMP     AH,4AH                      ;test for <+>
                JE      PGUP
                CMP     AH,01                       ;test for <ESC>
                JE      END10                       ;quit
                CMP     AH,4EH                      ;test for <->
                JNE     GETKEY
PGDN:           CMP     CL,24                       ;move bar down
                JE      GETKEY
                CMP     CH,CL
                JNZ     PGD1
                CALL    ATTR
                INC     CH
PGD1:           INC     CL
                CALL    ATTR
                JMP     GETKEY
SELECT:         CMP     CH,CL                       ;get line positions
                JNZ     PRINT                       ;and print
                CMP     CL,24
                JE      PRINT
                INC     CL
                CALL    ATTR
                JMP     GETKEY
PGUP:           CMP     CL,0                        ;move bar up
                JZ      GETKEY
                CALL    ATTR
                CMP     CH,CL
                JNZ     PGU1
                DEC     CH
                DEC     CL
                JMP     PGU2
PGU1:           DEC     CL
                CMP     CL,CH
                JNZ     GETKEY
                INC     CL
PGU2:           CALL    ATTR
                JMP     GETKEY
PRINT:          MOV     DH,CH
                SUB     CL,CH                       ;get characters and
                XOR     CH,CH                       ;send to printer
                INC     CX
PRN1:           PUSH    CX
                MOV     CL,DH
                CALL    ATTR

                CALL    PRNT
                INC     CL
                MOV     DH,CL
                POP     CX
                LOOP    PRN1
END1:           MOV     DX,CURPOS                   ;reset cursor and
                MOV     AH,2                        ;return
                INT     10H
                MOV     BYTE PTR ES:[0000H],00H
                POPF
                POP     DS
                POP     CX
                POP     BX
                POP     AX
                POP     DX
                IRET
END10:          CALL    ATTR
                JMP     END1
ATTR:           PUSH    CX                          ;get current
                MOV     DH,CL                       ;attributes and
                XOR     DL,DL                       ;reverse them
                MOV     CX,80
ATR1:           PUSH    CX
                MOV     AH,2
                INT     10H
                MOV     AH,8
                INT     10H
                XOR     AH,7FH
                MOV     BL,AH
                MOV     AH,9
                MOV     CX,1
                INT     10H
                INC     DL
                POP     CX
                LOOP    ATR1
                POP     CX
                RET

PRNT:           PUSH    CX                          ;printer output
                MOV     DH,CL                       ;routine
                XOR     DL,DL
                MOV     CX,80
PTR1:           PUSH    CX
                MOV     AH,2
                INT     10H
                MOV     AH,8
                INT     10H
                PUSH    DX
                XOR     DX,DX
                XOR     AH,AH
                INT     17H
                POP     DX
                INC     DL
                POP     CX
                LOOP    PTR1
                PUSH    DX
                XOR     DX,DX
                MOV     AX,000DH
                INT     17H
                XOR     DX,DX
                MOV     AX,000AH
                INT     17H
                POP     DX
                POP     CX
                RET
INIT:           MOV     AX,3505H                    ;setup TSR
                INT     21H
                MOV     IRUPT,BX                    ;replace old
                MOV     IRPT1,ES                    ;vector with new
                MOV     DX,OFFSET MAIN              ;one
                MOV     AX,2505H
                INT     21H
                MOV     DX,OFFSET INIT
                INT     27H
CSEG            ENDS
                END     START
```

Fig 4 PRNBYLIN.ASM, the assembly language source code for PRNBYLIN.COM, takes control over the DOS print screen function and lets you print as many lines as you want from the screen

part of the variable name.

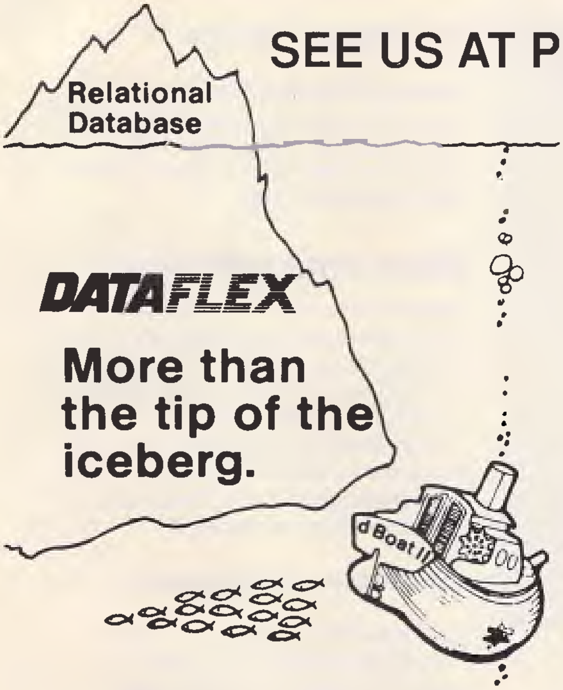
The string *argument is defined as simply the remainder of the command line, that is, all characters entered after the equals symbol, excluding the <ENTER> used to execute the command. Note that unlike* var, *the characters in* string *are not converted to uppercase. Again, unintentional spaces can cause problems for the unwary. An unsophisticated program, for example, expecting to find the string*

COMSPEC=C:

might fail if given

COMSPEC= C:

SEE US AT PC '88 STAND 105



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AMS

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```
100 ' PRNBYLIN.BAS program to create PRNBYLIN.COM -- R. Powell
110 E=5:CLS:PRINT "Checking DATA; please wait..."
120 FOR B=1 TO 21:FOR C=1 TO 16:READ A$:T=T+VAL("&H"+A$):NEXT
130 READ S:IF S<>T THEN PRINT "ERROR IN LINE";B*10+180:END
140 T=0:NEXT:RESTORE:OPEN "PRNBYLIN.COM" AS #1 LEN=1
150 FIELD #1,1 AS D$:FOR B=1 TO 21:FOR C=1 TO 16:READ A$
160 LSET D$=CHR$(VAL("&H"+A$)):PUT #1:IF B=21 AND C=E THEN 180
170 NEXT:READ F$:NEXT
180 CLOSE:PRINT "PRNBYLIN.COM CREATED"
190 DATA E9,28,01,00,00,00,00,00,00,52,50,53,51,1E,9C,0E,800
200 DATA 1F,B8,50,00,8E,C0,26,80,3E,00,00,01,74,0E,26,C6,1224
210 DATA 06,00,00,01,B4,0F,CD,10,3C,03,7E,0A,9D,1F,59,5B,990
220 DATA 58,5A,FF,26,01,01,B4,03,CD,10,89,16,07,01,33,C9,1296
230 DATA 8B,D1,B4,02,CD,10,E8,8E,00,32,E4,CD,16,80,FC,1C,2038
240 DATA 74,24,80,FC,4A,74,2F,80,FC,01,74,76,80,FC,4E,75,1959
250 DATA E8,80,F9,18,74,E3,3A,E9,75,05,E8,6A,00,FE,C5,FE,2432
260 DATA C1,E8,63,00,EB,D3,3A,E9,75,2C,80,F9,18,74,27,FE,2232
270 DATA C1,E8,53,00,EB,C3,80,F9,00,74,BE,E8,49,00,3A,E9,2217
280 DATA 75,07,FE,CD,FE,C9,EB,09,90,FE,C9,3A,CD,75,AA,FE,2685
290 DATA C1,E8,33,00,EB,A3,8A,F5,2A,CD,32,ED,41,51,8A,CE,2281
300 DATA E8,24,00,E8,45,00,FE,C1,8A,F1,59,E2,F0,8B,16,07,2118
310 DATA 01,B4,02,CD,10,26,C6,06,00,00,00,9D,1F,59,5B,58,1102
320 DATA 5A,CF,E8,02,00,EB,E6,51,8A,F1,32,D2,B9,50,00,51,2062
330 DATA B4,02,CD,10,B4,08,CD,10,80,F4,7F,8A,DC,B4,09,B9,2043
340 DATA 01,00,CD,10,FE,C2,59,E2,E6,59,C3,51,8A,F1,32,D2,2219
350 DATA B9,50,00,51,B4,02,CD,10,B4,08,CD,10,52,33,D2,32,1551
360 DATA E4,CD,17,5A,FE,C2,59,E2,EA,52,33,D2,B8,0D,00,CD,2288
370 DATA 17,33,D2,B8,0A,00,CD,17,5A,59,C3,B8,05,35,CD,21,1560
380 DATA 89,1E,03,01,8C,06,05,01,BA,09,01,B8,05,25,CD,21,983
390 DATA BA,2B,02,CD,27,00,00,00,00,00,00,00,00,00,00,00,475
```

Fig 5 When run once in Basic, the Basic program PRNBYLIN.BAS creates PRNBYLIN.COM, which takes control over the DOS print screen function

So, if problems arise using what seem to be identical environment strings, examine the entries at least as closely and literally as DOS does — RH.

Final format forum

Don't throw away those 360k diskettes that you thought you couldn't format in a high-capacity drive. Like the dealer who sold you your AT, I do it all the time. And I'm not winking! Just use the switch provided with the FORMAT command to specify that combination. The syntax is

```
FORMAT A: /4
```

The DOS manual cautions that you may have trouble reading and writing such diskettes in a drive intended for 360k floppies, but mine have all worked well.
D Wilder

In summary, to format a diskette that will have 1.2Mbytes of storage space when using a 1.2Mbyte drive, you must use media rated for high capacity. If you attempt to format 360k diskettes to hold 1.2Mbytes, expect the format program to mark a large number of bytes as unavailable.

To format a diskette rated for 360k to a capacity of 360k using a 1.2Mbyte drive, you must use the /4 option to FORMAT, as Mr Wilder notes.

Because of mechanical differences in the design of the drives, 360k diskettes formatted or written using a 1.2Mbyte drive may subsequently be unreadable in a standard 360k drive — RH.

Verifying with Copy

Is the /V (verify) option for the DOS COPY command equivalent to turning the VERIFY switch ON, or does it involve actual file comparison?
V Alter

The /V parameter, when added to the end of a COPY command, causes DOS to act in the same manner as if the VERIFY ON command had been previously issued. Keep in mind that if VERIFY is turned on with VERIFY ON, it remains on until turned off. Using the /V parameter affects operation only while the COPY command is running.

The /V verify is subject to the same limitations as the VERIFY command. Verifying a file under DOS does not involve a comparison of the original data with the duplicate data; it merely ensures that an attempt to read the duplicate data does not fail.

To convince yourself of this, copy an existing file to the NUL device with the /V switch or VERIFY ON, thus

```
COPY COMMAND.COM NUL /V
```

Since any data sent to NUL is discarded, no copy exists at any time with which to compare the original data. Despite this, the COPY command will report no errors — RH.

Exam time with Word

Teachers who create multiple-choice exams with separate answer sheets can make good use of Microsoft Word's footnote feature to create multiple versions of the tests to prevent copying.

When creating the original exam, Test A, use the Format Footnote command to automatically number the questions. Place the cursor and type

```
<Esc>F(format)F(ootnote)
```

Then enter the answers at the end of the text as 'footnotes', and use the Jump Footnote command to return to the main body of the document.

When you now move the questions around to create Test B (copying and inserting on a copy of Test A), Word will automatically renumber both the questions and the answers, giving you a properly numbered answer sheet to each version of the test.
S Hartman

Also be sure to use a different header on each version of the test, to avoid confusing the two — MS.

Printer help

The PRINTER.TST and PRINTER2.TST files on the WordPerfect Learning disk give you a good deal of information about your printer's capabilities. However, though completely undocumented, WordPerfect also contains very useful summaries of the features available from most printers. This information is contained in a file called PRHELP.EXE, which is on the PRINTER2 disk of WordPerfect 4.2.

To access the file, place the PRINTER2 disk in your disk drive and

```
<Ctrl-F10>             Begin macro definition
FONT2 <CR>             Name it FONT2
<Home><Home><Up>       Go to top of file
<Ctrl-F8>1             Print Format -- pitch/font
<CR>                   Keep the pitch option as it is
2<CR>                  Select font 2
<F7>                   Exit
<Ctrl-F10>             End macro definition
```

Fig 6 A WordPerfect macro for accessing a font

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```
;*-------------------------------------------------------------------*
;*    INFO.COM -- A DIFFERENT PAUSE FOR BATCH JOBS -- by Hal Shearer *
;*-------------------------------------------------------------------*
;*            FORMAT:    INFO [40 CHARACTER MESSAGE]                 *
;*-------------------------------------------------------------------*
CSEG    SEGMENT
        ASSUME  CS:CSEG,DS:CSEG
        ORG     100H
START:  JMP     INIT
STORE   DB      ?
MSG     DB      40 DUP ('.')
BUFFER  DB      'Response needed: PRESS ANY KEY TO ADVANCE'
        DB      40 DUP ('.'),'$'
INIT:
        PUSH    SI                      ;save registers SI
        PUSH    DI                      ;and DI
        MOV     SI,80H                  ;point SI to the text
        CLD                             ;go forward
        CALL    SPACE                   ;parse the spaces
        CMP     BYTE PTR [SI],13        ;is it a carriage control?
        JE      XXX                     ;yes - then jump
        MOV     CX,40                   ;no, place 40 into CX
        LEA     DI,BUFFER               ;point buffer to DI
X:      LODSB                           ;get character from SI to AL
        CMP     AL,13                   ;is it a carriage control char?

        JE      XX                      ;yes, then exit
        STOSB                           ;no, store it in the buffer
        LOOP    X                       ;do process again until CX is 0
XX:     INC     CX                      ;change carriage control to '.'
        MOV     AL,'.'                  ;place a period in AL
REP     STOSB                           ;repeat the store until CX is 0
XXX:    POP     DI                      ;restore registers DI
        POP     SI                      ;and SI
        MOV     AH,1                    ;turn the cursor off
        MOV     CX,0F00H                ;with this address
        INT     10H
WAIT:   HOV     AH,2                    ;place the cursor here
        MOV     DH,24                   ;at row 24
        MOV     DL,19                   ;column 00
        INT     10H

AGAIN:  MOV     STORE,-1                ;set value to -1
INCR:   ADD     STORE,1                 ;increment the value
        MOV     BL,STORE                ;place it into BL
        MOV     BH,0                    ;ready BX to be the index
        MOV     CX,39                   ;going to do this 80 times
        CALL    POS_CURSOR              ;position cursor
LOOP1:  MOV     AL,MSG[BX]              ;put byte from msg area in AL
        MOV     AH,14                   ;set up for teletype print
        INT     10H
        INC     BX                      ;increment the index
        CALL    PAUSE                   ;lets wait awhile
        MOV     AH,1                    ;check for a key depression
        INT     16H
        JZ      SKIP                    ;if not skip it
        JMP     EXIT                    ;if so exit now
SKIP:   LOOP    LOOP1                   ;loop back until CX is zero
        CMP     MSG[BX],'$'             ;is the msg area at the end?


        JE      AGAIN                   ;yes, then go again
        JMP     INCR                    ;go back and start all over
SPACE:  INC     SI                      ;find first char in the text
        CMP     BYTE PTR [SI],32        ;is it a space?
        JZ      SPACE                   ;if so do it again
        RET                             ;return
POS_CURSOR:                             ;position the cursor
        PUSH    BX                      ;save BX register
        MOV     AH,2                    ;set up to move cursor
        MOV     DH,24                   ;start in row 24
        MOV     DL,19                   ;and column 00
        INT     10H
        POP     BX                      ;restore BX
        RET                             ;return
PAUSE:  PUSH    CX                      ;save CX
        MOV     CX,600                  ;loop 300 times for pause
BACK:   LOOP    BACK                    ;loop til CX is zero
        POP     CX                      ;restore CX
        RET                             ;return
EXIT:   CALL    POS_CURSOR              ;prepare to erase the message
        MOV     CX,79
EXIT2:  MOV     AL,' '                  ;place a blank into AL
        MOV     AH,14                   ;prepare to teletype char
        INT     10H
        LOOP    EXIT2                   ;loop til CX is zero
        MOV     AH,1                    ;restore the cursor
        MOV     CH,11                   ;part of cursor in CH
        MOV     CL,12                   ;the rest goes here in CL
        INT     10H
        INT     20H                     ;return to DOS
CSEG    ENDS
        END     START
```

Fig 7 INFO.ASM assembly language code to create INFO.COM

type PRHELP from the DOS prompt. If the file is on your hard disk, change to the appropriate subdirectory or enter the full pathname.

The file is largely self-explanatory, but it includes extensive directions that can be very useful to those who want them. After examining the fonts readily available from your printer, you can write a macro to access each font. Fig 6 provides an example of such a macro.
D Hirsch

Clearly WordPerfect itself has access to detailed information about hundreds of printers. The PRHELP program simply puts this information in a form WordPerfect users can grasp. I imagine I'm not the only one who didn't notice the PRHELP program on the new 4.2 PRINTER2 disk — NR.

PAUSE without pause

I grew tired with what PAUSE DOS provides, so I wrote a flashier version called INFO.COM. You can expand the program to search for specific scan codes or move the message to the middle of the screen. I also provided a way for a 40-character message to be added instead of using DOS's standard message. The syntax is

```
INFO [40 character message]
```

To create INFO.COM, assemble the .ASM code in Fig 7 or run the Basic INFO.BAS program in Fig 8.
H Shearer

OK, if you're used to dull DOS prompts,

```
100 ' Program to create INFO.COM -- by Hal Shearer
110 CLS:PRINT "Checking DATA; please wait..."
120 FOR B=1 TO 18:FOR C=1 TO 16:READ A$:T=T+VAL("&H"+A$):NEXT
130 READ S:IF S<>T THEN PRINT "ERROR IN LINE";B*10+180:END
140 T=0:NEXT:RESTORE
150 OPEN "INFO.COM" AS #1 LEN=1:FIELD #1,1 AS D$
160 FOR B=1 TO 18:FOR C=1 TO 16:READ A$
170 LSET D$=CHR$(VAL("&H"+A$)):PUT #1:NEXT:READ DUMMY$:NEXT
180 CLOSE:PRINT "INFO.COM CREATED"
190 DATA EB,7C,90,00,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,1055
200 DATA 2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,736
210 DATA 2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,52,65,73,70,962
220 DATA 6F,6E,73,65,20,6E,65,65,64,65,64,3A,20,50,52,45,1403
230 DATA 53,53,20,41,4E,59,20,4B,45,59,20,54,4F,20,41,44,1055
240 DATA 56,41,4E,43,45,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,871
250 DATA 2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,736
a260 DATA 2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,2E,24,56,57,807
270 DATA BE,80,00,FC,E8,60,00,80,3C,0D,74,14,B9,28,00,8D,1601
280 DATA 3E,2C,01,AC,3C,0D,74,03,AA,E2,F8,41,B0,2E,F3,AA,1815
290 DATA 5F,5E,B4,01,B9,00,0F,CD,10,B4,02,B6,18,B2,13,CD,1581
300 DATA 10,C6,06,03,01,FF,80,06,03,01,01,8A,1E,03,01,B7,973
310 DATA 00,B9,27,00,E8,27,00,8A,87,04,01,B4,0E,CD,10,43,1255
320 DATA E8,26,00,B4,01,CD,16,74,03,EB,26,90,E2,E9,80,BF,1992
330 DATA 04,01,24,74,CC,EB,CF,46,80,3C,20,74,FA,C3,53,B4,1917
340 DATA 02,B6,18,B2,13,CD,10,5B,C3,51,B9,58,02,E2,FE,59,1837
350 DATA C3,E8,EA,FF,B9,4F,00,B0,20,B4,0E,CD,10,E2,F8,B4,2457
360 DATA 01,B5,0B,B1,0C,CD,10,CD,20,00,00,00,00,00,00,00,840
```

Fig 8 Basic INFO.BAS program to create INFO.COM

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NAME:..
POSITION:......................................
COMPANY:.......................................
ADDRESS:.......................................
....
PHONE:...

APC6/88

type this one in for a real surprise.

It's easy to change the location of the prompt, as Mr Shearer suggests. The addresses for the default row are 1AC and 1F2, and for the default column are 1AE and 1F4 (in each case, change in both places). As delivered, the INFO.COM prompt begins on column 19 of row 24.

The program tries to restore the cursor when it's done, but it has a hard time on an EGA, so use one of Charles Petzold's EGA cursor routines or APC's *COLOUR.COM to put it back when you're done.*

If you don't have COLOUR.COM handy, type in the following script using a pure-ASCII word processor and call it COLOUR.SCR. Then put it and DEBUG.COM (Version 2.0 or later) on your disk and type DEBUG < COLOUR.SCR to create it. It will set your screen to blue text on a white background (attribute hex 71). If you hate this colour, patch the 2-digit hex character at address 113 — the left-hand character sets the background and the right-hand one the foreground. A 4E will produce bright yellow on red. And on CGA monitors, the 03 at address 120 will produce a cyan border.

```
E100 2B C0 1E 50 B8 03 00 CD
E108 10 B8 00 06 B9 00 00 BA
E110 50 20 B7 71 CD 10 B4 02
E118 BA 00 00 B7 00 CD 10 B0
E120 03 BA D9 03 EE CB
N COLOUR.COM

RCX
26
W
Q
```

Turbo Pascal DOS Shell

User-friendly front ends for an operating system are not new, but this one is a good implementation of the not-so-original idea. The program (Fig 9) will not compile under any other version of Turbo Pascal than version 4, which *is* a limitation, but it helps to illustrate the enhanced functions available in this new version of Borland's Pascal.

The program manages to complete a whole series of complicated DOS functions with only one lapse into direct MS-DOS calls (and this is only to turn the cursor off). It behaves in a similar manner to Xtree and the function keys are used as follows:

F1 — Help (not implemented at this stage but very easy to add in if you need it).
F2 — View text file on-screen. Allows a file to be scanned using the PgUp and PgDn keys.
F3 — Change the file attributes of the marked files.
F4 — Change the current disk drive.
F5 — Copy a file.
F6 — Rename a file.
F7 — Make a new directory.
F8 — Delete a file.
F9 — Tag/untag all files in the current directory.
F10 — Quit the program and return to DOS.
SPACE — Tag/untag the selected file.
RETURN — Execute the current file or change to the selected directory. After selecting the command, you will be prompted for a command line. Enter what you usually would but don't include the run filename. For example, to do CHKDSK on drive A:, select the CHKDSK command and enter its command line as 'A:' rather than the more usual 'CHKDSK A:'

All the cursor keys perform their usual functions.

The tagging of files is used to indicate which of the files you want the selected operation to work on.

There are one or two rough edges to this program. For example, if you select the wrong file for execution, it is impossible to stop that file from executing. This can be cured by checking for an ESC key in the COMMAND line menu.

To run the program, type it into the Pascal Editor and compile it into an EXE file, then type the filename to run it. To use it all the time, include the command name as the last line in the DOS file 'AUTOEXEC.BAT'.

J Haughland

```
uses Dos,Printer,Crt;

type
    String20  = String[20];
    String4   = String[4];
    Text80    = String[80];

var
    DirName   : array[1..255] of string[12];
    Tagged    : array[1..255] of boolean;
    IsDir     : array[1..255] of boolean;
    Dir       : SearchRec;
    Time      : DateTime;
    Counter   : Integer;
    A,B       : Integer;

     Choice   : Integer;
     Answer   : String[1];
     InText   : String20;
     FileVar  : File;
     Reply,
       Reply2 : Char;
     Error    : Integer;
     OK       : Boolean;

 procedure WaitKey;        { Wait until a key is pressed }
 begin
   Answer:=ReadKey;
 end;

 procedure cursoroff;      { Turn OFF cursor }
 var reg : Registers;

 begin
 reg.CX:=$2000;
 reg.AX:=$100;
 intr($10,Dos.Registers(reg));
 end;

 procedure cursoron;      { Turn ON cursor }
 var reg : Registers;

 begin
 reg.CX:=$0C0D;
 reg.AX:=$100;
 intr($10,Dos.Registers(reg));
 end;

procedure invers;         { Invers colors }
begin
  textcolor(black); textbackground(white);
end;

procedure normal;         { Normal colors }
begin
  textcolor(white); textbackground(black);
end;

procedure RestoreWindow; { Sets WINDOW to entire screen }
begin
  window(1,1,80,25);
end;

function KeyHit(var Reply, Reply2: char):boolean; { Get Extended keycode }
begin
  Reply2:=' ';
  if keyprossed then
  begin
    KeyHit:=True;
    Roply:=ReadKey;
    if (Reply=#0) and keypressed then
      Reply2:=ReadKoy;
  end
  else KeyHit:=False;
end;

function SelectOption (Option1,Option2:string20;xcor,ycor:integer):integer;

{ Choose between two options with cursor keys or first key }

var  a,b,dummy,choice,bs :integer;
     reply,reply2:char;

begin
  while keypressed do Reply:=ReadKey;

  gotoxy(xcor,ycor);ClrEOL;
  cursoroff;
  choice:=1;

  bs:=0;
```

continued . . .

Fig 9 Turbo Pascal DOS Shell

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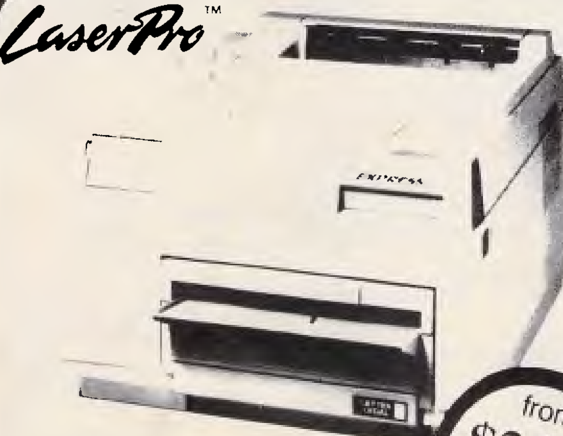

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```
  repeat;
    GotoXY(xcor,ycor);
    if Choice=1 then invers else normal;
    write(Option1);
    normal;
    write('    ');
    if Choice=2 then invers;
    write(Dption2);

    repeat until KeyHit(Reply,Reply2);
    if reply = #27 then bs:=2;
    if reply = #0 then case Reply2 of
                         'K' : Cheice:=Cheice - 1;
                         'M' : Choice:=Choice + 1;
                         'G' : Choice:=1;
                         'O' : Choice:=2;
                         end {case};
    if reply = #13 then bs:=1;
    if upcase(Reply)=copy(Dption1,1,I) then Choice:=1;
    if upcase(Reply)=copy(Option2,1,1) then Choice:=2;
    if Choice(1 then Choice:=2;
    if Choice)2 then Choice:=1;
  until bs)0;
  if bs () 1 then choice:=0;
  cursoron;
  normal;
  SelectOption:=Choice;
end; {SelectOption}

precedure ErrorMsg(Error:integer);  { Give ERROR message on screen }
var x1,y1,x2,y2:byte;
    Msg: string20;

begin
  if errer in [0,18] then exit;
  x1:=lo(WindMin)+1;
  y1:=hi(WindMin)+1;
  x2:=lo(WindMax)+1;
  y2:=hi(WindMax)+1;


  RestoreWindow;
  case error of
  2:  Msg:='FIle not found';
  3:  Msg:='Path not found';
  4:  Msg:='Too many open files';
  5:  Msg:='Access denied';
  6:  Msg:='Invalid file handle';
  8:  Msg:='Not enough memory';
  15: Msg:='Invalid drive';
  16: Msg:='Directory not empty';
  17: Msg:='Cannot move to disk';
  100: Msg:='Read error';
  101: Msg:='Write error'
  else Msg:='Internal Error';
  end {case};


  GotoXY(1,23);
  ClrEol;
  Invers;
  writeIn(^G,' ERROR ',Error,':',Msg,'. (Press any key)');
  Normal;
  WaitKey;
  GotoXY(1,23);
  ClrEol;
  window(x1,y1,x2,y2);
end; {ErrorMsg}



procedure Frame(UpperLeftX, UpperLeftY, LowerRightX, LowerRightY: Integer);
var  I : Integer;

{ Make frame for windowing, etc. }

begin {Frame}
  GotoXY(UpperLeftX, UpperLeftY);
  Write(chr(218));
  for I := (UpperLeftX + I) to (LowerRightX - I) do
  begin
    Write(chr(196));
  end;
  Write(chr(191));
  for I := (UpperLeftY + 1) to (LowerRightY - 1) do
  begin
    GotoXY(UpperLeftX , I);  Write(chr(179));
    GotoXY(LowerRightX, 1);  Write(chr(179));
  end;
  GotoXY(UpperLeftX, LewerRightY);
  Write(chr(192));
  for I := (UpperLeftX + 1) to (LowerRightX - 1) do
   begin
     Write(chr(196));
   end;
  Write(chr(217));
end; {Frame}


Procedure DiskInfo;      { Get information about current drive/directroy }
var Directory: string20;
begin
  RestoreWindow;
  frame(40,16,80,24);
  window(4I,I7,79,23);
  ClrScr;
  GetDir(0,Directory);
  writeln(' Directory: ',Directory);
  writeln;
  writeln(' Disk size:  ',DiskSize(0),' bytes');
  writeln(' Free space: ',DiskFree(0),' bytes');
  writeln;
  write(' ',(DiskFree(0)*I00)/DiskSize(0):0:2,' % free');
  RestoreWindow;
end; {DiskInfo}

Procedure GetDirectory(path:string20; Attr:byte);
begin
  for a:=1 to 255 do
  begin
    DirName[a]:='';
    IsDir[a]:=false;
  end;
  if Attr=0 then Attr:=AnyFile-VolumeID;
  FindFirst(path,Attr,Dir);
  DirName[1]:=Dir.Name;
  A:=2;
  If Dir.Name = '.' then a:=1;
  While DosError = 0 do
  begin
    FindNext(Dir);
    if Dir.Name () '.' then
    begin
      DirName[a]:=Dir.Name;
      if Dir.Attr = Directory then IsDir[a]:=true;
      a:=a+1;
    end;
    if a)255 then a:=255;
  end;
  if a)1 then DirName[a-1]:='';
  DiskInfo;
end; {GetDirectory}


Procedure DisplayInfo(filename:string20); { Dispaly info on a file }
begin
  RestoreWindow;
  {$I- }
  FindFirst(FileName,AnyFile-VolumeID,Dir);
  if DosError () 0 then
  begin
    ErrorMsg(DosError);
    exit;
  end;
  UnpackTime(Dir.Time,Time);
  frame(40,3,80,15);
  window(41,4,79,14);
  ClrScr;
  writeln(' File:      ',Dir.Name);
  writeln;

 If Dir.Attr AND ReadDnly ) 0 then writeln(' Read-Dnly');
 if Dir.Attr AND Hidden ) 0 then writeln(' Hidden');
 if Dir.Attr AND SysFile ) 0 then writeln(' System');


   if Dir.Attr AND Directory ) 0 then writeln(' DIRECTDRY');
   if Dir.Attr AND Archive ) 0 then writeln(' Archive');
   writeln;
   writeln(' Time:      ',Time.Hour,':',Time.Min,':',Time.Sec);
   writeln(' Date:      ',Time.Day,'/',Time.Month,'-',Time.Year);
   if Dir.Attr AND (AnyFile-Directory-VolumeID) ) 0 then
     writeln(' Size:      ',Dir.Size,' bytes');
   RestoreWindow;
   {$I+ }
end; {DisplayInfo}


Procedure DeleteFile(FileName:string20);    { Delete a file }
var ErrorCode:Integer;
    Attr: word;
begin
  {$I- }
  RestoreWindow;
  frame(40,3,80,15);
  window(41,4,79,14);
  ClrScr;
  Assign(FileVar,FileName);
  GetFAttr(FileVar,Attr);
  ErrorCode:=IOResult;
  if ErrorCode ) 0 then
  begin
    ErrorMsg(ErrorCode);
    exit;
  end;

  writeln(' ERASE ',FileName,'?');
  Choice:=SelectOption('Erase','Cancel',2,3);
  if Choice () I then begin RestoreWindow; exit; end;
  if Attr=Directory then RmDir(FileName)
  else
  Erase(FileVar);
  ErrorCode:=IOResult;
  if ErrorCode ) 0 then ErrorMsg(ErrorCode)
  else
  begin
    writeln;
    writeln(' ',FileName,' erased.');
  end;
  {$I+ }
  RestoreWindow;
end; {DeleteFile}


Procedure RenameFile(FileName,NewName:string20);  { Rename a file }
var ErrorCode:Integer;
begin
  {$I- }
  RestoreWindow;
  frame(40,3,80,15);
  window(41,4,79,14);
  ClrScr;
  Assign(FileVar,FileName);
  ErrorCode:=IOResult;
  if ErrorCode ) 0 then
  begin
    ErrorMsg(ErrorCode);
    exit;
  end;

  Rename(FileVar,NewName);
  ErrorCode:=IOResult;
  if ErrorCode ) 0 then ErrorMsg(ErrorCode)
  else
  begin
    writeln(' ',FileName,' renamed');
    writeln(' to ',NewName,'.');
    delay(500);
  end;
  {$I- }
```

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```
  RestoreWindow;
end; { RenameFile }


Procedure ViewFile(FileName:String20);  { View a text file on screen }

var buf       : array[1..1] of char;
    result    : word;
    PrintFile: Text;
    TextLine : String[80];
    Error     : Integer;
    Counter  : Integer;
    PageTop  : array[1..100] of longint;

begin
  RestoreWindow;
  ClrScr;
  frame(1,2,80,22);
  invers;
  gotoxy(10,24);
  write('PgUp / PgDn');
  gotoxy(35,24);
  write(' (*) - Print');
  gotexy(60,24);
  write('ESC - exit');
  {$I- }
  assign(FileVar,FileName);
  reset(FileVar,1);
  Error:=IoResult;
  if Error <> 0 then begin
                       ErrorMsg(Error);
                       RestoreWindow;
                       ClrScr;
                       Exit;
                     end;


  GotoXY(1,1);
  write(' File: ',FileName,'   Size: ',FileSize(FileVar),' bytes.');
  normal;
  window(2,3,79,20);
  ClrScr;
  Counter:=1;
  PageTop[1]:=0;
  repeat
    BlockRead(FileVar,buf,SizeOf(buf),result);
    Error:=IoRosult;
    if Error <> 0 then begin
                         ErrorMsg(Error);
                         RestoreWindow;
                         ClrScr;
                         Exit;
                       end;


for a:=1 to SizeOf(buf) do
begin
  write(buf[a]);
  if buf[a]=#26 then result:=0;
  if (WhereY > 17] or (Result <> SizeOf(Buf)) then
  begin
    repeat
      repeat until KeyHit(Reply,Reply2);
        until (reply2 in ['I','Q']) or (reply in [#27,'*']);
        Counter:=Counter+1;
        if Counter > 255 then Counter:=255;
        PageTop[counter]:=FilePos(FileVar);
        if Reply = '*' then
        begin
          Assign(PrintFile,FileName);
          reset(PrintFile);
          while not EOF(PrintFile) do
          begin
            readln(PrintFile,TextLine);
            writeln(Lst,TextLine);
          end;
          close(PrintFile);
        end;
        if reply in [#27] then result:=0;
        if Reply2 ='I' then
        begin
          Counter:=counter-2;
          if counter<1 then counter:=1;
          seek(FileVar,PageTop[counter]);
        end;
        ClrScr;
      end;
    end;
  until (result=0) or (Result <> SizeOf(buf)) or (reply2 in [#27]);
  {$I+ }
  RestoreWindow;
  close(FileVar);
  ClrScr;
end; {ViewFile}

Procedure Execute(FileName:string20); { EXECUTE (Run) a file }
var Attr: word;
    Path: string20;
    Param:string[80];

begin
  {$I- }
  RestoreWindow;
  Frame(40,3,80,15);
  Window(41,4,79,14);
  ClrScr;
  writeln(' EXECUTE ',FileName);
  writeln;
  if (pos('.EXE',FileName)=0) and (pos('.COM',FileName)=0)
  and (pos('.BAT',FileName)=0) then
  begin
    writeln(' Can execute BAT, EXE or COM');
    writeln(' files only.');
    writeln(' (Press a key)');
    Reply:=ReadKey;
    exit;
  end;
  write('Command line > ');
  readln(InText);
  if pos('.BAT',FileName) > 0 then     { if BAT file then run it with }
  begin                                { COMMAND.COM on root          }
    GetDir(0,path);
    if copy(path,length(path),1) <> '\' then path:=concat(path,'\');
    Param:=Concat(path,FileName,' ',InText);
    FileName:='\COMMAND.COM';
  end
  else Param:=InText;
  if pos('COMMAND',FileName) > 0 then Param:=Concat('/C ',Param);
  RestoreWindow;
  ClrScr;
  writeln('EXECUTE ',FileName,' ',Param);
  Exec(FileName,Param);
  RestoreWindow;
  If DosError <> 0 then begin ErrorMsg(DosError); exit; end;
  {$I+ }
  GotoXY(1,24);
  ClrEOL;
  writeln('Exit code from program: ',DosExitCode);
  ClrEOL;
  invers;
  ClrEOL;
  write('Press any key to return. '):
  normal;
  Reply:=ReadKey;
  RestoreWindow;
  ClrScr;
end;  {Execute}

procedure ChangeFileAttr(FileName:String20);  { Change file attributes }
var
  RO,HI,SF,AR: boolean;
  Error: Integer;
  Attr:word;

  function OnOff(OnOrOff:boolean):string4;
  begin
    if OnOrOff then OnOff:='On  ' else OnOff:='Off ';
  end;

begin
  {$I- }
  assign(FileVar,FileName);
  error:=IoResult;
  if error <> 0 then
  begin
    ErrorMsg(Error);
    exit;
  end;
  RestoreWindow;
  DisplayInfo(FileName);
  frame(1,3,30,20);
  window(2,4,29,19);
  ClrScr;
  GetFAttr(FileVar,Attr);
  RO:=(Attr AND ReadOnly) > 0;


   HI:=(Attr AND Hidden) > 0;
   SF:=(Attr AND SysFile) > 0;
   AR:=(Attr AND Archive) > 0;
   if(Attr AND Directory) > 0 then
   begin
     writeln(' Cannot change a directory');
     writeln('       (Press a key)');
     Reply:=ReadKey;
     RestoreWindow;
     exit;
   end;
   repeat
     gotoXY(1,3);
     HighVideo;
     writeln(' ',FileName);
     writeln;
     writeln(' Change Attributes');
     writeln;
     write(' R');
     LowVideo;
       writeln('ead-Only  ',OnOff(RO));
       HighVideo;
       write(' H');
       LowVideo;
       writeln('idden     ',OnOff(HI));
       HighVideo;
       write(' S');
       LowVideo;
       writeln('ystem     ',OnDff(SF));
       HighVideo;
       write(' A');
       LowVideo;
       writeIn('rchive    ',OnOff(AR));
       writeln;
       writeln;
       HighVideo;
       write(' Q');
       LowVideo;
       writeln('uit');
       Reply:=ReadKey;
       Reply:=Upcase(Reply);
       if Reply = 'R' then RO:=not RO;
       if Reply = 'H' then HI:=not HI;
       if Reply = 'S' then SF:=not SF;
       if Reply = 'A' then AR:=not AR;
   until Reply = 'Q';
   Attr:=0;
   if RD then Attr:=Attr + ReadDnly;
   if HI then Attr:=Attr + Hidden;
   if SF then Attr:=Attr + SysFile;
   if AR then Attr:=Attr + Archive;
   SetFAttr(FileVar,Attr);
   Error:=IOResult;
   if Error <> 0 then ErrorMsg(Error);
   {$I+ }
   ClrScr;
   RestoreWindow;
   HighVideo;
 end; {ChangeFileAttr}
```

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```
Procedure FileCopy(FromName,ToName:string20); { COPY file }
var FromF, ToF : file;
    NumRead, NumWritten: word;
    buf : array [1..2048] of char;


begin
  {$I- }
  RestoreWindow;
  Frame(40,3,80,15);
  Window(41,4,79,14);
  normal;
  ClrScr;
  Writeln;
  Writeln('Copying ',FromName,' => ',ToName);
  Assign(FromF,FromName);
  Reset(FromF,1);
  Assign(ToF,ToName);
  Rewrite(ToF,1);
  Error:=IoResult;
  if Error <> 0 then
  begin
    ErrorMsg(Error);
    Exit;
  end;



  repeat
    BlockRead(FromF,buf,SizeOf(buf),NumRead);
    Blockwrite(ToF,buf,NumRead,NumWritten);
  until (NumRead=0) or (NumWritten <> NumRead);
  Error:=IoResult;
  if Error <> 0 then
  begin
    ErrorMsg(Error);
    Close(FromF);
    Close(ToF);
    exit;
  end;
  writeln(' ',FileSize(FromF),' bytes copied OK.');
  Close(FromF);
  Close(ToF);
  {$I+ }
  Error:=IoResult;
end; {FileCopy}


Procedure ChangeDrive;       { Change DRIVE }
var NewDir:string4;
begin
  RestoreWindow;
  frame(40,16,80,24);
  window(41,17,79,23);
  ClrScr;
  gotoxy(3,3);
  write('New Drive (A-H) ');
  repeat
    reply:=ReadKey;
    reply:=upcase(reply);
  until reply in ['A'..'H',#27];
  if reply = #27 then begin RestoreWindow; exit; end;
  NewDir:=concat(reply,':');
  writeln(NewDir);
  {$I- }
  ChDir(NewDir);
  Error:=IOResult;
  if Error <> 0 then ErrorMsg(Error);
  RestoreWindow;
  DiskInfo;
end; {ChangeDrive}



Procedure ShowDirectory;         { Main PROCEDURE to show directory }
                                 { and get commandskeys.            }

var Present,Previous,PageTop,PageBottom:integer;
    ReScan: boolean;

  Procedure CopyTagged;          { Copy tagged files }
  begin
    a:=0;
    for b:=1 to 255 do if tagged[b] then a:=a+1;
    if a < 1 then
    begin
      gotoXY(1,23);
      invers;
      ClrEOL;
      write(^G,' No files tagged. (Press a key)');
      normal;
      Reply:=ReadKey;
      GotoXY(1,23);
      ClrEOL;
    end
    else
    begin
      RestoreWindow;
      Frame(40,3,80,15);
      Window(41,4,79,14);
      normal;
      ClrScr;
      repeat
        Ok:=true;
        writeln;
        writeln(' Copy ',a,' files to (path):',#13);
        write(' >');
        readln(InText);
        if (pos('*',InText)>0) or (pos('?',InText)>0)
          then begin writeln(' No wildcards allowed.'); Ok:=false; end;
        if pos('.',InText)>0
          then begin writeln(' Path only!'); OK:=false; end;
      until OK;
      If pos('\',InText)=0 then InText:=ConCat(InText,'\');
      if InText = '' then begin; RestoreWindow; exit; end;
      for a:=1 to 255 do
        if tagged[a] then FileCopy(DirName[a],InText+DirName[a]);
      RestoreWindow;
      ClrScr;
    end;
  end; {CopyTagged}


  Procedure DeleteTagged;   { Delete tagged files }
  begin
    a:=0;
    for b:=1 to 255 do if tagged[b] then a:=a+1;
    if a < 1 then
    begin
      RestoreWindow;
      gotoXY(1,23);
      invers;
      ClrEOL;
      write(^G,' No files tagged. (Press a key)');
      normal;
      Reply:=ReadKey;
      GotoXY(1,23);
      ClrEOL;
    end
    else
    begin
      RestoreWindow;
      Frame(40,3,80,15);
      Window(41,4,79,14);
      for a:=1 to 255 do
        if tagged[a] then
        begin
          DeleteFile(DirName[a]);
          tagged[a]:=false;
        end;
      RestoreWindow;
      ClrScr;
    end;
  end; {DeleteTagged}

{ Main part of Procedure ShowDirectory }

begin
  for a:=1 to 255 do
  begin
    DirName[a]:='';
    IsDir[a]:=false;            { Initialize }
    Tagged[a]:=false;
  end;
  Present:=1;
  PageTop:=1;
  ReScan:=True;
  DiskInfo;
  repeat
    if rescan then GetDirectory('*.*',0);
    RestoreWindow;
    gotoXY(1,1);
    invers;
    ClrEOL;
    write('F1-Hlp F2-View F3-ChAtt F4-ChDsk F5-Copy ');
    write('F6-Ren F7-MkDir F8-Del F9-Tag F10-Quit');
    normal;
    DisplayInfo(DirName[Present]);
    frame(1,3,39,24);
    Window(2,4,38,23);
    GotoXY(1,1);
    if Present > PageBottom then
    begin
      PageTop:=Present-16;
      PageBottom:=Present;
    end;


if Present < PageTop then PageTop:=Present;
PageBottom:=PageTop+16;
if PageTop < 1 then PageTop:=1;
if PageBottom > 255 then PageBottom:=255;
for a:=PageTop to PageBottom do
begin
  Normal;
  write('  ');
  if Tagged[a] then HighVideo else LowVideo;     { Display directory }
  if Present=a then Invers;
  write(DirName[a]);
  if IsDir[a] then write(' (DIR)');
  normal;
  writeln('              ');
end;
Reply:=ReadKey;
normal;
ReScan:=false;

case Reply of
  ' ': begin                          { SPACE = TAG / UNTAG }
         if not IsDir[present]then
         begin
           Tagged[present]:=not(Tagged[present]);
           present:=present+1;
         end;
       end;

  #13: begin                          { RETURN = Execute / ChDir }
         if IsDir[present] then
         begin
           if DirName[present] = '..' then ChDir('..') else
           ChDir(Dir.Name);
         end
         else
         Execute(Dir.Name);
         ClrScr;
         GetDirectory('*.*',0);
         for a:=1 to 255 do tagged[a]:=false;
       end;
end {case};
if Reply=#0 then                      { Extended key: Cursor/F-keys }
begin
  Reply:=ReadKey;
  ReScan:=True;
  Previous:=Present;
```

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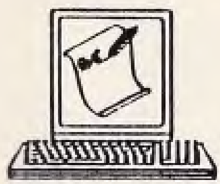

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```
case Reply of
  'H' : present:=present-1;                        { Arrow down }
  'P' : present:=present+1;                        { Arrow up }
  'G' : begin present:=1; ClrScr; end;             { HOME }
  'O' : begin present:=255; ClrScr; end;           { END }
  'I' : begin present:=present-15; ClrScr; end;{ PgUP }
  'Q' : begin present:=present+15; ClrScr; end;{ PgDn }
{ ';' : help; }        { HELP : Make it yourself... }
  '(' : ViewFile(DirName[present]);                              {F2: View }
  '=' : begin ChangeFileAttr(DirName[present]); ClrScr; end;(F3: ChAtt}
  ')' : begin                                                    {F4: ChDisk}
          ChangeDrive;
          for a:=I to 255 do tagged[a]:=false;
          GetDirectory('*.*',0);
        end;
  '?' : begin                                                    {F5: Copy}
          RestoreWindow;
          Frame(40,3,80,15);
          Window(41,4,79,14);
          ClrScr;
          writeln(' COPY: ');
          Choice:=SelectOption('Selected','Tagged',10,1);
          writeln;
          writeln;
          Case Choice of
            I : begin
                  write('Copy to ) ');
                  readln(InText);
                  if InText = '' then
                  begin
                    writeln(' Cannot copy to itself');
                    delay(500),
                    RestoreWindow;
                  end
                  else
                  FileCopy(DirName[present],InText);
                end;
            2 : CopyTagged;
          end; { case Choice }
          RestoreWindow;
        end;

  '@' : begin                                             {F6: Rename }
          RestoreWindow;
          Frame(40,3,80,15);
          Window(41,4,79,14);
          ClrScr;
          writeln(' RENAME: ');
          writeln;
          write(' to: ');
          readln(InText);
          RenameFile(DirName[present],InText);
          RestoreWindow;
        end;
                                                          {F7: KkDir }
  'A' : begin
          RestoreWindow;
          Frame(40,3,80,15);
          Window(41,4,79,14);
          ClrScr;
          write(' Make Directory ) ');
          readln(InText);
          {$I- }
          MkDir(InText);
          error:=IOResult;
          if Error () 0 then ErrorMsg(Error)
          else
            writeln('Directory ',InText,' created.');
          RestoreWindow;
          {$I+ }
        end;
                                                          {F8: Delete }
  'B' . begin
          RestoreWindow;
          Frame(40,3,80,15);

            Window(41,4,79,14);
            ClrScr;
            writeln(' ERASE: ');
            Choice:=SelectOption('Selected','Tagged',10,1);
            Case Choice of
              1 : DeleteFile(DirName[present]);

              2 : DeleteTagged;
            end {case Choice} ;
          RestoreWindow;
          end;

      'C' : for a:=1 to 255 do                           {F9: Tag }
              if DirName[a] () '' then Tagged[a]:=not(Tagged[a]);
      'D' : begin; RestoreWindow; ClrScr; exit; end;    (F10: Quit }
    end {case};
  end;
  if previous () present then Rescan:=false;
  if present ( 1 then present:=I;
  if present ) 255 then present:=255;
  while(DirName[present]='') and (present)1) do present:=present-1;

  until True = False;  { Its no surprise that it will not end here... }
end; { ShowDirectory }

{ MAIN PROGRAM }

begin
  HighVideo;          { Set video and colors to normal }
  Normal;
  CheckBreak:=false; { Can not break program: turn to TRUE for debugging }
  ClrScr;
  ShowDirectory;      { Start main procedure }

end.
```


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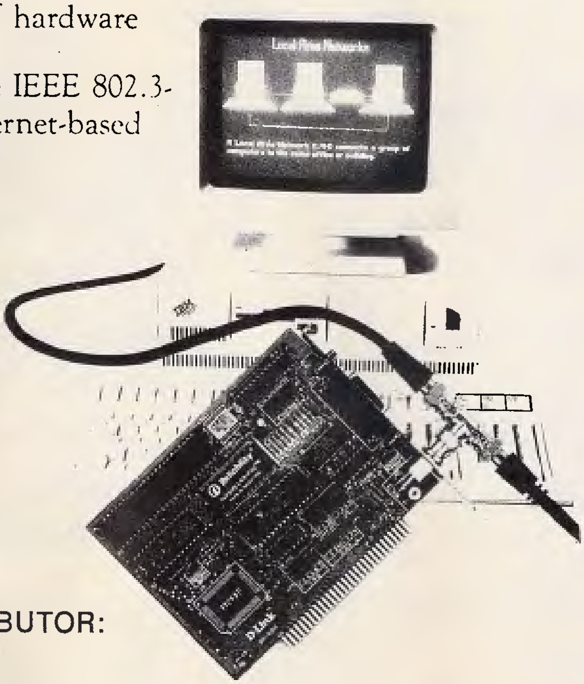

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- The polling rate and release time are switch selectable to accommodate differing installation requirements. Once set for a particular installation, the settings do not need to be altered.
- There is one Status Indicator for each channel to indicating polling and the selected channel.
- All data is handled transparently by PEPsharer so graphics data may be printed without difficulty.
- The input connectors are Centronics sockets to suit the printer end of any parallel printer cable.
- The output connector is a 25pin D type to suit a standard IBM PC printer cable.
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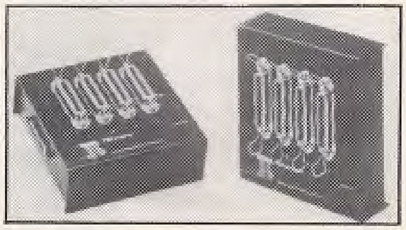

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Atari ST VDU Lifesaver

RESTCRT.ACC is a short program (Fig 10) designed to turn off your VDU after a period of user inactivity. The program was written in C for use on the Atari ST, but could be adapted to run on any computer running the GEM windowing environment.

To be of any use, the program must run alongside GEM applications such as word processors without interfering with them. GEM provides a solution to this in its special Desktop Accessory programs which are always resident in memory and, indeed, are potentially always running!

An accessory differs from other GEM programs in that it is controlled from a loop which is never exited. When the computer is booted with an accessory, that accessory is 'running' until the computer is re-booted.

The management of accessories is handled by the GEM AES (Application Environment System) in such a way that when it is first run, an accessory enters a never-ending loop. It then tells the AES which circumstances must occur before it wishes to continue. The AES suspends execution of the accessory until those circumstances are fulfilled.

This process can be made to give the appearance of multi-tasking, and is often handled by the GEM function 'evnt_multi' which, when used by an accessory in this way, can capture specific menu activity, time delays and messages from other programs. When used in other program structures, evnt_multi allows for the capture of user input, such as keyboard and mouse activity.

In the case of RESTCRT, the circumstances under which the AES passes control back are two-fold. Either the user selects it from the menu to toggle it on or off, or a certain amount of time has elapsed since the accessory was last executed.

The program decides whether the user has stopped using the computer by monitoring the mouse position each time the AES passes control back after a 'time out'. This is done using a cut-down variant of the evnt_multi function, called 'evnt_mouse', which returns the mouse position. If the mouse is found in the same place on two successive checks, the program turns the VDU off.

The checks are performed after a period of time defined by the constant 'LONGTIME'. The value of LONGTIME can be altered to suit your preferences, but I suggest it is in the order of 300,000. This value will blank the screen after approximately five minutes of inactivity. In order to provide a swift method of turning the screen on again, the time value is reduced to that defined in 'SHORTIME' and thus the mouse position is checked rather more frequently.

It is worth noting that these two time values represent how often the accessory is actually run by the AES; and, as such, even when the screen is switched off, the CPU is (almost) uninterrupted and can carry on executing the main GEM application.

The method used to turn the VDU off is simply to set all the colours in the computer's palette to black, having first stored their original values.

Unfortunately, the Atari ST could be described as idiosyncratic in that when it is in high-resolution monochrome mode, the operating system will not allow all 'colours' to be set to the same value: one must be black and one white!

To get round this problem, the program inverts the 'colours' on a monochrome screen every few seconds instead of blacking it out. The frequency of this 'blink' is defined by the constant BLINKCOUNT. The screen blinks at a rate of BLINKCOUNT multiplied by SHORTTIME milliseconds.

To run the program, type in the listing and compile it using an Atari ST C compiler. Name the file with the extension '.ACC' and put it on the boot disk. It can be accessed from the desktop using the DESK menu.

R Howorth

```
#include <osbind.h>           /* Accessory to blank screen after a period of no
#include <ctype.h>            /* mouse movement. Period defined by LONGTIME
#include <gemdefs.h>          /* Mouse must be still for twice LONGTIME to blank
#define  SHORTTIME 200        /* VDU.  Both 'TIME values in milliseconds
#define  LONGTIME 300000
#define  BLINKCOUNT 50        /* -How many SHORTTIMEs per blink
                              /* Program (c) Roger Howorth 1/2/1988
short resting=0;
short activity,blnkf;
int   xrect,yrect,oldxpos,oldypos,res,ltime,htime;
int   rgb|16];
char  susp[]="[0][ VDU Lifesaver|┘ Roger Howorth][ Suspended ]";
char  actv[]="[0][ VDU Lifesaver|┘ Roger Howorth][ Activated ]";

main()
{
   int menuID;                          /* This accessory's menu identifier.
   extern int gl_apid;                  /* The application ID for this Accessory

   appl_init();
   menuID=menu_register(gl_apid,"  Rest CRT");
                                                 /* register as a desk acc.
   res=Getrez();                                 /* get screen resolution
   xrect=640;                                    /* set default screen width
   yrect=400;                                    /* ... and hight
   if (res!=2) yrect=200;                        /* for med. or low res.
   if (res==0) xrect=320;                        /* for low res
   events(menuID);                               /* call event loop routine
                                                 /* and never return!!
}

events(menuID)                                   /* loop processing events.
int menuID;
{
   short rest_tog=1;                             /* Flag to show if user has.
   int event;                                    /* ...'suspended' this program
   int msgbuf[8];
   int ret;
   savecolours();                                /* FIRST save pallette
   time((long)LONGTIME);                         /* set timer
   blnkf=BLINKCOUNT;                             /* and reset blink counter
                                                 /* THEN....
   while(1)                                      /* do until re-boot..
   {
      event=evnt_multi(MU_MESAG | MU_TIMER,               /* wait for either
            0,0,0,                               /* a message or
            0,0,0,0,0,                           /* timer event
            0,0,0,0,0,
            msgbuf,
            ltime,htime,                         /* TIME milliseconds
            &ret,&ret,&ret,&ret,&ret,&ret);


      switch(event)            /* Event has been recieved, but what is it?
      {
      case MU_MESAG  :  if (msgbuf[0]==AC_OPEN)
                        {
                           rest_tog^=1;                 /* toggle my switch
                           if (rest_tog)                /* if activated
                              form_alert(1,actv);
                           else                         /* else if suspended
                           {
                              screenON();               /* restore pallette
                              form_alert(1,susp);
                           }

                        }                               /* in any case ....
                        time((long)LONGTIME);           /* ...re-set timer
                        break;
       case MU_TIMER  : if (rest_tog==0) break;         /* if suspended break
                        findmouse();
                        if (activity==0)
                        {
                           rest();                 /* turn off screen
                           time((long)SHORTTIME);  /* set timer
                        } else                     /* ELSE user activity.
                        {
                           if (resting)
                              screenON();          /* turn on vdu if necessary

                           blnkf=BLIMKCOUNT;       /* reset blink counter
                           time((long)LONGTIME);   /* reset timer
                        }
                        break;
                                                        /* end switch...
      }                                                 /* end while loop..
   }
}

findmouse()                                /* Function to find mouse position
{
   int xpos,ypos,but,key;

evnt_mouse( 0,                                  /* wait for mouse to enter...
            0,0,xrect,yrect,                    /* rectangle defined here
            &xpos,&ypos,&but,&key);             /* as whole screen!
                                                /* -this function doesn't
                                                /* have to wait too long!!
```

continued . . .

Fig 10 Atari ST VDU Lifesaver

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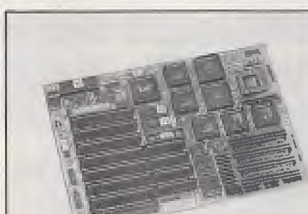
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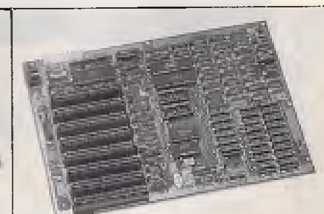
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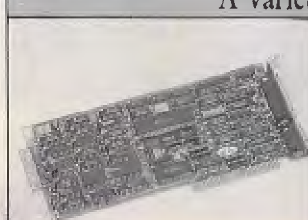
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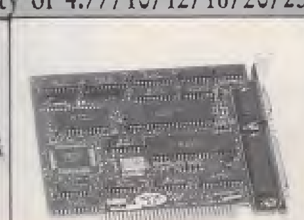
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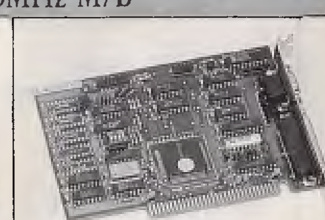
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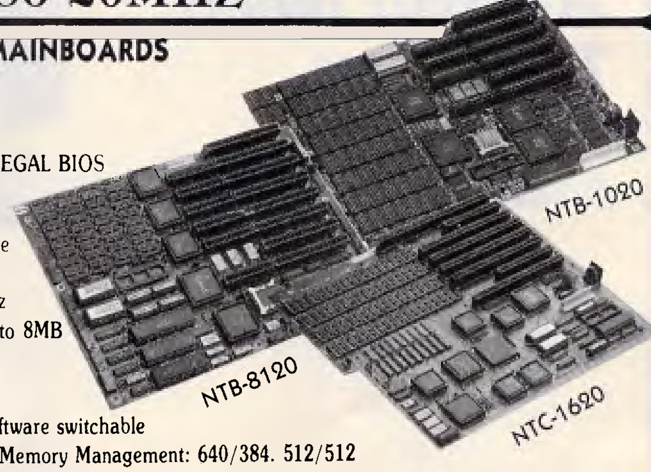

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```
 if ((xpos==oldxpos) && (ypos==oldypos))       /* if mouse hasn't moved..
    activity=0;                                /* set activity FALSE
 else activity=1;                              /* else mouse moved, set TRUE


   oldxpos=xpos;                                  /* save new mouse co-ordinates
   oldypos=ypos;
}

rest()                                   /* Routine to switch VDU off
{                                        /* This routine will blink a high res
                                         /* screen because they can't be turned off

   if (res==2)                           /* If HI RES..
   {
      blnkf++;                           /* increment blink counter and..
                                         /* return if not ready to blink
      if (blnkf < BLINKCOUNT) return(0);

      if (resting) screenON();              /* alse make screen blink
         else screenOFF();
      blnkf=0;                           /* and reset blink-counter


   }  else                               /* ELSE if not hi-res...
                                         /* ....must be colour vdu!
                                         /* so only turn screen off if...
                                         /* it is currently on!  ie don't blink!
   if (!resting) screenOFF();
screenOFF()                                 /* function to 'turn off' screen by
{                                           /* setting all colours to black
   short i;

   savecolours();                                    /* save pallette ...
   for(i=0;i<16;i++) Setcolor(i,0);                  /* set colours to black
   resting=1;                                        /* set (screen) resting flag
}

savecolours()                               /* function to save Atari's 16 colour
{                                           /* pallette into array "rgb"
   short i;
   for(i=0;i<16;i++) rgb[i]=Setcolor(i,-1);
}

scresnON()                                  /* restores scren pallette to that
{                                           /* saved in errey "rgb"
   short i;
   for(i=0;i<16;i++) Setcolor(i,rgb[i]);                /* reset colours in rgb
   resting=0;                                           /* (screen)resting flag
}

time(value)                                 /* Function to place one LONG value
long value;                                 /* into two INT variables:ltime,htime
{
   ltime=value&0x7fff;                                  /* etore low-word time
   htime=value/0x8000;                                  /* and hi-word time
}
```


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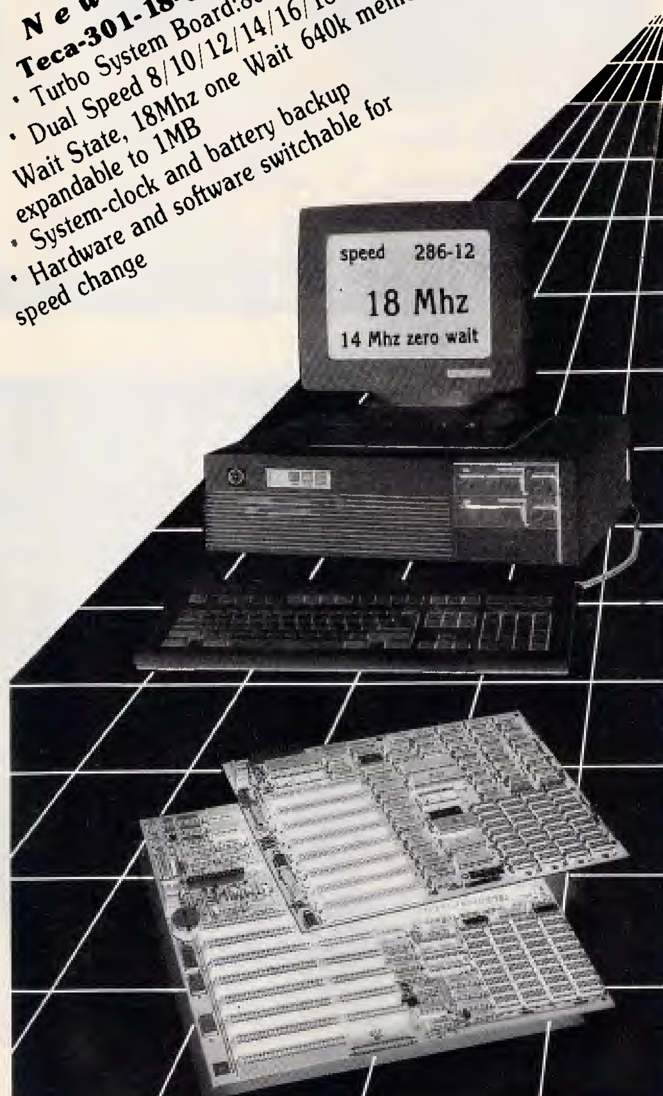

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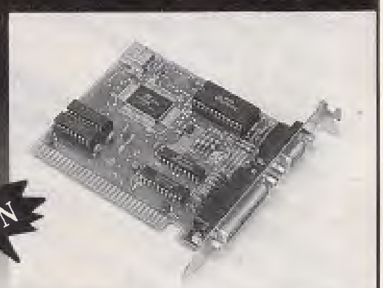

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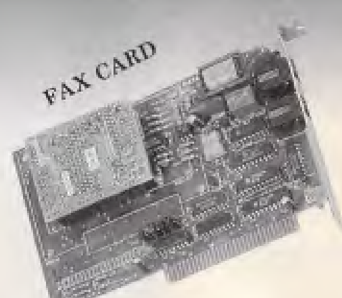

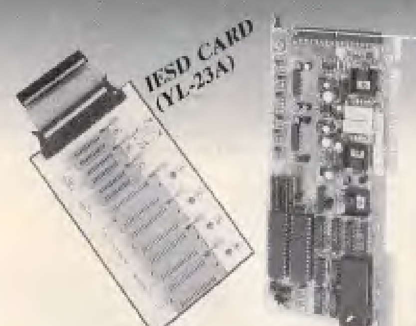

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What's in the SE ROMs?

I have noticed in several articles that the Macintosh SE has 256k ROMS, but how do these ROMs differ from the 128k ROMs in the Macintosh Plus? I have managed to find the hidden 'slideshow', but what besides this (which seems to be a waste of ROM) do the SE ROMs contain?
P Whitelock

The 256k ROMs contain everything the 128k ROMs in the Mac Plus do but with several improved versions of the User Interface, Toolbox, and Operating System Managers; some previously RAM-based Managers moved into ROM and include completely new features. The new Sound Manager makes use of the digital sound chip in the SE. The Menu Manager has been expanded to support hierarchical, scrolling, and pop-up menus. The TextEdit package now supports interline font, size, and style changes. A new Script Manager has been included that supports non-Roman character sets such as Kanji and Arabic. The complete contents of the SE ROM and how to use it are described in 'Inside Macintosh, Volume V', published by Addison-Wesley.

All this adds up to less than 256k, as you've noticed, but it's bigger than 128k, and ROMs don't come in in-between sizes. Although your ROMs may seem under-used now, the extra space just might come in handy if Apple ever does a ROM upgrade. Such 'slop space' sometimes makes the difference between a cheap ROM upgrade and an expensive logic-board upgrade — CE.

Version-number plea of the month

Help! I'm lost in the Mac System maze! I have a 512KE and can't get a straight answer on what the optimum System Tools versions are for my Mac. Apple gave me System Tools with System 3.2 and Finder 5.3 when the ROM upgrade came last week. Someone told me Apple advises against using System 3.2 'on a daily basis' (whatever that means). My friendly Apple dealer says that later versions are too big for my measly 512k RAM. What's a Mac Mother to do?
D Doggett

System Version 3.2, and Finder Version 5.3, are the best versions to use, day in and day out, on your 512KE. If you're using AppleShare, use 3.3 and 5.4. Later versions, such as System 4.0 and Finder 5.5., will stretch the limits of RAM and perhaps deny certain applications the space they need; System 4.1 and Finder 6.0 (with MultiFinder) cramp a 512KE, allowing only the most compact applications (ie, only those written for a 128k Mac) to run — CE.

Is Switcher useful anymore?

Danny Goodman's 'The Complete HyperCard Handbook' discusses using HyperCard with Switcher. Sadly, this information appears to be far out of date. For example, HyperCard cannot live in a 700k partition but requires 782k. Even more significant, the Switcher program (Version 5.1) overhead is 225k, leaving a paltry 17k for any other application on a 1Mbyte machine.

With the advent of MultiFinder, is Switcher obsolete? It seems the one area in which Switcher might still be valuable is in its low overhead on a 1Mbyte Mac.

In the MultiFinder environment, my System and Finder consume a total of 426k. And when I load MacWrite into a 256k partition, the System partition increases by 10k. Of course, if Finder is loaded under Switcher, the difference becomes smaller, but under Switcher there are more compact alternatives to Finder, whereas under MultiFinder, it does not appear to be possible to omit Finder.

Is this essentially correct, or am I missing a vital factor? These numbers indicate that Switcher offers useful combinations that are just not possible on a 1Mbyte Mac under MultiFinder.
V Matzek

You've noticed two things: one, that Switcher has less overhead than MultiFinder, especially because Finder is optional; and two, that with large applications such as HyperCard or PageMaker, it doesn't matter much. Yes, you can run three 128k applications under Switcher whereas you can only run two under MultiFinder, but as the average Macintosh memory size creeps toward 1Mbyte, you'll find fewer applications that can run successfully in a 128k partition anymore, under either Switcher or MultiFinder. So Switcher is still useful for using earlier applications on a 512k or 1Mbyte machine, and MultiFinder is more useful for using newer applications on 1Mbyte machines and up — CE.

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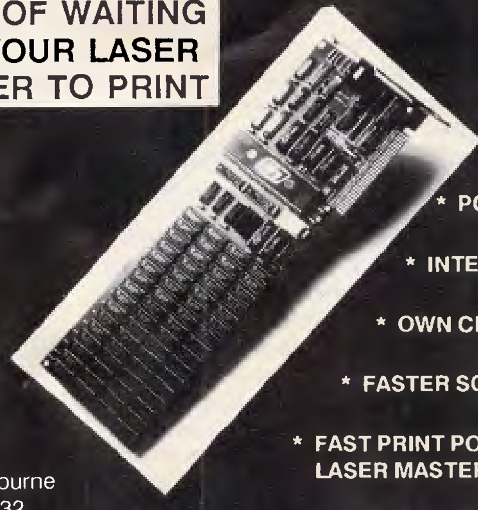

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Zmodem

Steve Withers and Peter Tootill look at the increasingly popular Zmodem communications protocol, now available for a number of microcomputers.

This time last year we compared the efficiencies of the popular file transfer protocols with some of the newer variants. Zmodem came out as one of the best, but at that time it was newly defined and therefore supported by very few systems. It is a well-designed protocol, and deserves the increased popularity it is now enjoying.

One of its biggest advantages is that if a file transfer stops part way through for some reason, it can be continued from the point at which it left off. I had practical experience of this recently when I was downloading a file and twice lost carrier because of poor lines. In each case I was able to redial and resume the transfer from where it stopped. There was no need to start again from the beginning.

Even if your terminal program doesn't support Zmodem, you may still be able to use it. If you have an IBM PC or clone, and your comms software allows you to run another program within the terminal program, take a look at DSZ. DSZ was written by Chuck Forsberg (who devised Zmodem), and is designed especially for use with comms programs that do not have the Zmodem protocol built in. It is distributed as shareware, with a $US25 contribution.

DSZ can be used in a number of ways, but the command syntax can be a little complex. My favourite method is to use a shell program written by Brad Jackson (an Opus sysop in the UK), called DSZT. Although specifically designed for use with a Procomm-like comms program called Telix, it can be used with other programs.

System News

The Codiac Republic is a new addition to the ranks of bulletin boards catering for role playing gamers. To quote sysop Simon Shaw, "the board supports science fiction and fantasy gaming interests with online role-playing games. These include: RuneQuest, AD&D, D&D, Oriental AD&D, Evil AD&D, Traveller 2300, Teenagers From Outer Space, Paranoia, Call of Cthulhu, [and] Robotech".

Thanks to 'Tactics' (a Perth games shop) prizes are offered to successful participants even though no charges are levied on users. Tactics also gives a 10% discount to registered members.

As well as running the Codiac Republic, Simon edits a monthly newsletter called 'Mercenary Strike' which carries news about role playing games generally and the Codiac Republic in particular. In incorporates material from 'Phantasmagoria', the Murdoch University Games Club fanzine.

Larry Lewis, Simon Shaw, and Mark Webster were contributors to this month's news.

New listings

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Airlock Hermitage (02) 600 1384. MV. Greg Glynn. 5.30pm-8am weekdays, 24 hours weekends. V21, V22, V22bis, V23. FidoNet 713/609.

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Eagle One (02) 745 3190. MV. Terry Harvey. V21, V22, V23. Exchange FRP (02) 644 9211. Cameron Martin and Scott Caundle. 7pm-7.30am daily.

Integra TEX (02) 746 1109. P. Kevin Leong. V22. FidoNet 712/703.

Ivory Tower (02) 668 8021. P. Colin Leslie. V22, V22bis.

Pandemonium (02) 411 7642. MV. Mark Farnan. V22.

PC Users Group — IBM Board (02) 724 6813. MV. John Clarke. V21, V22, V23.

PC Users Group — Microcomp Board (02) 540 1842. MV. Bruce Edney. V21, V22. FidoNet 712/505.

Runway (02) 569 5130. MV. Colin Lean. V21, V22, V22bis, V23. FidoNet 712/506.

Ventura Publisher Offline.

BLAZE-dataLINK (047) 36 4825. MV. Lee Enfield. V21, V22, V22bis, V23. FidoNet 713/303 (node 303 and the sysop's name is Lee Enfield).

Triops (063) 62 9715. P. 'Pdisk'. 9pm-6pm daily.

VIC

Amiga Limits (03) 725 2895. MV. 'Captain Kirk'. V21, V22, V23.

L & A (03) 800 3215. MV. Phillip Kelly. V21, V22, V23. FidoNet 631/327.

Labyrinth (03) 318 6562. MV. Stephen Jones. 9pm-9am daily. V21, V23.

MacLink (03) 772 4098. Roger Harris. V21, V22, V23.

Miki's (03) 801 7040. Miklos Bolvary and Emil Zudic. 9pm-9am daily. V22, V22bis, Bell 103, 212. FidoNet 631/326.

Super Dimensional (03) 560 2659. Mulia Marzuki. 9pm-9am daily. V22, V22bis,

Yarra Valley (059) 64 3126. MV. Frank Conner. V21, V22, V23, Bell 103, 212.

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FAR-NOR-64 (070) 54 6892. MV. Ian Pearse. V21, V22, V23, Bell 103, 212.

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Codiac Republic (09) 481 4715. MV. Simon Shaw. 5pm-8am weekdays, 24 hours weekends. V21, V22, V22bis, V23

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Dick Smith Electronics (02) 887 2276. P. Paul Beaver. 24 hours daily. V21, V22.
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Mirage Arcane Offline.
Nightmare (02) 545 1132. Todd Wright. V21, V22, V22bis. V23. FidoNet 712/503.
Omen (02) 498 2495. P. Ted Romer. 4.30pm-9am weekdays, 24 hours weekends. V21, V23.
PC Users Group-Westpac Board (02) 221 5520. MV. Geoff May. V21, V22, V23. Previously known as Sydney PC Users Group.
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RUNX (02)487 2464. MV. Mark Webster. 24 hours daily. V21, V22, V22bis, V23. Also on (02) 487 2533 (2 lines, V21 only); (02) 487 3677 (V22 only); (02) 489 3831 (V22bis only); (02) 487 2788 (V23 only). When offline, recorded system status message on (02) 487 2533. Voice enquires on (02) 487 1299.
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Aces High (03) 878 2918. P. Daryl Harvey. 24 hours daily. V21. V22. V23.
Alpha Centauri (03) 874 3559. M. David and Kim Nugent. V22, V22bis. FidoNet 632/348.
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Brainstorm (03) 758 7086. Rowan Stevens. V21. V22, V22bis, V23. Bell 103, 212. FidoNet 631/322.
Cave 76 (03) 882 9197. 'Avatar'. 6pm-10am daily. V21. V22. V22bis. V23.
Crystal Palace (03) 725 1923. Chris Brunton. V21, V22.
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Melbourne Data Exchange (03) 561 6556. MV. Robert Broomhead. V22, V22bis, V23. FidoNet 633/360.
Melbourne PC Users Group (03) 819 5392. P. Charles Sandercock. FidoNet 631/323. Formerly known as PC User.
Outer Limits (03) 725 6650. MV. 'Captain Kirk'. 5pm-5am weekdays, 24 hours weekends. V21, V22, V23.
Pegasus (03) 725 4948. P. Lee Gordon-Brown. 5pm-9am weekdays, 24 hours weekends. FidoNet 630/309.
Real Connection (03) 288 0331. P. 'Real Article' and 'Deep Image'. 24 hours daily. V21. V22, V23.Sotec (03) 890 8166. MV. Jim Tsorlinis. 5pm-9am weekdays, 24 hours weekends. V22, V22bis, Bell 103, 212.

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Marlin Coast (070) 51 7220. Ray Chalmers. V22, V22bis, Bell 103. Trailblazer. FidoNet 640/501.

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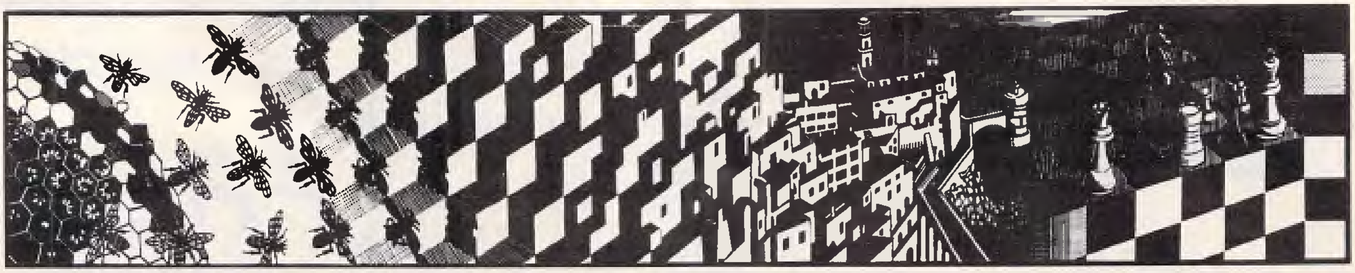


Behave like an adult in the guise of an American cop, or return to your childhood chasing dragons, warlocks, werewolves and witches. Stephen Applebaum bows out of reviewing games with this month's high-class selection.

Jack, the magic dragon-slayer

Title: Black Lamp
Computer: Atari ST
Supplier Imagineering
Format: Disk
Price: $59.00

Oh, for the days of innocence, when adventures were set in fairy-tale lands inhabited by dragons, warlocks, werewolves and witches. As computers become more advanced, so too do the games we play on them. Fairy-tale themes are *passé*; today's gamesters want shadowy realism, with psychopaths and cocaine freaks as the new bogey-men. You only have to look at the likes of Police Quest (also reviewed here), to see that things have changed a great deal since the days of The Hobbit — and not necessarily for the better.

But all is not doom and glcom. Steve Cain and GP Everett, co-authors of Star Trek (which I won't hold against them), have come up with Black Lamp, a delightful fantasy arcade adventure which not only breathes new life into the electronic fairy-tale but also revives the platforms and ladders genre.

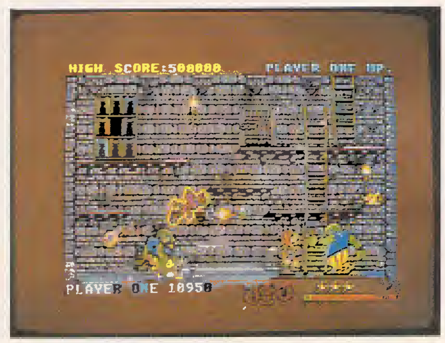
Black Lamp is set in Allegoria, a beautiful kingdom ruled by King Maxim. In recent times Allegoria has been hit by a great blight, which has all but swept aside the general air of happiness which once prevailed across the land. The trouble began when a number of magical lamps, including the eponymous Black Lamp, were stolen from King Maxim's vaults by a group of dragons. Since the theft, Allegoria has been attacked by strange creatures under the influence of an evil force.

You have probably guessed from the outline of the game's rather clichéd scenario, that you play the mug — sorry, brave gallant — who offers his services to deliver Allegoria from perpetual despair. As heroes go, the one in Black

Lamp is unusual — he is a jester named Jolly Jack. Not the sort of person you would expect to take on such a challenge. But then, Jolly Jack has an ulterior motive: for saving Allegoria he expects to be given the hand, and else besides, of the Princess Griselda.

A humble jester Jack may be, but a fool he is not. So before setting off on his quest, he visits his old mate Pratweezle who presents him with a belt that emits bursts of pure magic, and a spell to enable him to defy death a certain number of times.

Jolly Jack has to collect all the stolen lamps and place them in a number of chests situated in various locations around Allegoria. There are, as is always the case, a number of hitches: he is not told where the lamps or the chests are; he is only allowed to carry one lamp at a time; the Black Lamp, of which there is more than one on the higher levels, is guarded by a massive fire-breathing



dragon that must be killed before it will give up its treasure; and, finally, the whole of Allegoria is overrun by hordes of nasty creatures, ranging from slime witches to wasps, which do not take kindly to the thought of being deprived of the lamps.

For the most part, the gameplay involves moving Jack through a number of colourful locations, zapping away at the evil fiends who, with their lightning and fire, threaten to turn him into ash.

When Jack is inside a building, he can move up and down the screen using objects and other projections for foot-holds; while outside, his movement is limited to walking left and right across a scrolling background.

Cain and Evans have allowed players to choose whether they use the ST's mouse, keyboard or joystick as their method of controlling Jack. Of the three, the keyboard is the easiest option as neither of the other two respond quickly enough. Moving Jack in time to dodge the many projectiles constantly thrown at him is a fraught business, which only the response time of the computer's keyboard can handle satisfactorily.

Besides the magic lamps, there is a variety of objects which, when picked up, help Jack in one way or another. Pieces of food, for instance, not only give you more points but also increase Jack's energy; the same goes for different sorts of drinks that just happen to have been left lying around.

The baddies are some of the wickedest creatures to appear in a computer arcade game. There are eleven types, from relatively harmless dragonflies and wasps to the aforementioned dragons. In between these two extremes come slime-spitting witches, lightning-tossing slayers, explosive skull-dropping buzzards, and man-eating werewolves.

Each creature can inflict different degrees of damage on your hero. Likewise, each one earns you a different number of points when hit. This applies not only to shooting the characters, but also the objects they throw at Jack. Obviously, the most points are awarded for killing a dragon. Not only are the dragons the most dangerous of the baddies, but they also have to be hit the most, in specific weak spots, before they will die.

Black Lamp's graphics are similar, though more cartoonish, to those in the brilliant Barbarian from Psygnosis. The backgrounds are all very detailed, although many of the interiors are alike. A lot of time has obviously been spent on creating the game's characters, all of whom are depicted as large, detailed, animated figures. My favourites are the dragons, who look every bit as formidable as the story in the game's manual would have you believe.

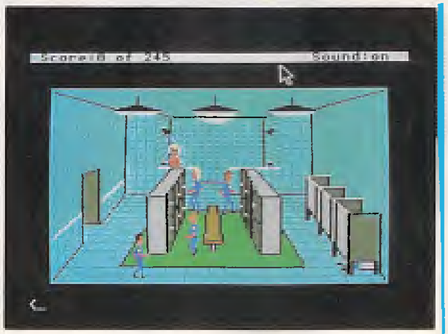
Another nice feature is the musical soundtrack that plays over the action. This can be turned off in favour of simple sound effects, but that would mean missing one of the game's highlights — Fred Gray's jazzed-up version of *Greensleeves*. Black Lamp is an enchanting, fun game. Steve Cain and GP Everett have proved that there is still room in the market-place for good, old-fashioned arcade adventures.

Undercover and out of hand

Title: Police Quest: In Pursuit of the Death Angel
Computer: Atari ST; Amiga
Supplier: Ozisoft
Format: Disk
Price: $69.95

All of a sudden, Sierra, producer of the Black Cauldron and Kings Quest, is writing games aimed at adults. Now, Ozisoft has launched Police Quest, a tale about what it is like to be a policeman in America.

Police Quest comes stamped with a small warning advising 'parental guidance' because the product contains adult material. As far as I can see, this is not to put parents off buying the game for their kids, but to stop women — who may be offended by its sexism — getting



hold of it. Despite Police Quest being about the police, Sierra still manages to include a picture of a semi-naked female called Helen Hots, who, believe it or not, is said to be a resident of Gyrate Court. You almost expect to find Benny Hill credited as scriptwriter, such is the level of the game's humour.

Police Quest is apparently based on a factual account as told by ex-police officer Jim Walls, a man with 15 years of service under his belt. The game is so accurate, that what you experience playing it is as close as you could expect to get to the daily routine of an American cop, short of joining the force . . . or so Sierra would have you believe.

The game is, says a blurb on the box, unlike the 'mindless garbage' made about police on television; programs like *Miami Vice* for example, where even the drunks wear Yves Saint Laurent rags. Indeed, "A police officer's job consists of more than high-speed chases and 'Dirty Harry' shoot-outs." So what is left?, I hear you ask. Well, there is drug traffic, homicide and violence; in other words, the three staple themes of the 'mindless garbage' on television.

Police Quest's action takes place in Lytton, a fictitious town in the grip of a major crime epidemic. Behind the trouble is Death Angel, a racketeer with a finger in every illicit pie; drugs, murder and robbery being his favourite fillings.

A criminal like Death Angel is big-time and way out of your league — at least to begin with. When the game opens, you are a humble uniformed policeman whose daily routine consists of filing reports, booking jay-walkers and spotting stolen cars. You do, however, have dreams of becoming an undercover agent, a move possible only after you have proved your worth as a uniformed officer.

When the game begins, you are in the austere interior of the Lytton police station. As with all of Sierra's 3-D adventures, you don't move around the game environment by typing 'GO NORTH', or whatever, but by controlling an animated figure via, in the case of the ST version reviewed here, the computer's numeric keypad or a joystick.

Using the keypad, you can make your character seemingly walk into and out of the screen, as well as through doors into other locations. The screens depicting each location require a lot of memory space, and, on an Atari ST 512 only one screen can be stored in RAM at a time. Each time you enter a new location, therefore, the computer has to access the game disk in order to load the new screen into memory.

Initially, this hardly interferes with your enjoyment, though it becomes rather tiresome when you have to return to locations for the second time.

Obviously, the quality of the game's graphics has a bearing on whether or not you enjoy this kind of program. Police Quest's graphics are some of the best I have seen in any of Sierra's 3-D adventures — and there have been quite a few. Interior 'shots' are fairly conventional, although now, when you examine something important, you very often get a full-screen close-up.

When you go outside the station and climb into your car, the display changes to an aerial view of a section of Lytton, complete with roads and buildings. Although the car is operated using the same controls as during the interior scenes, driving is difficult, not least because in America they drive on the right-hand side of the road. I crashed several times, which wouldn't have been so bad if it hadn't meant restarting from scratch each time. Saving your current position is essential. You must become familiar with the controls as quickly as possible, because it isn't long before the station radios you to drive to the scene of a motor accident. And so it goes on. Incident follows incident until, finally, you can go undercover in search of the Death Angel.

Overall, Police Quest is an exciting game full of inventive touches and unfortunately, some rather dubious material. Original as it is, though, I'm not sure about this move towards realism: games just get tackier and more sordid. It will be interesting to see what Sierra comes up with as a sequel.

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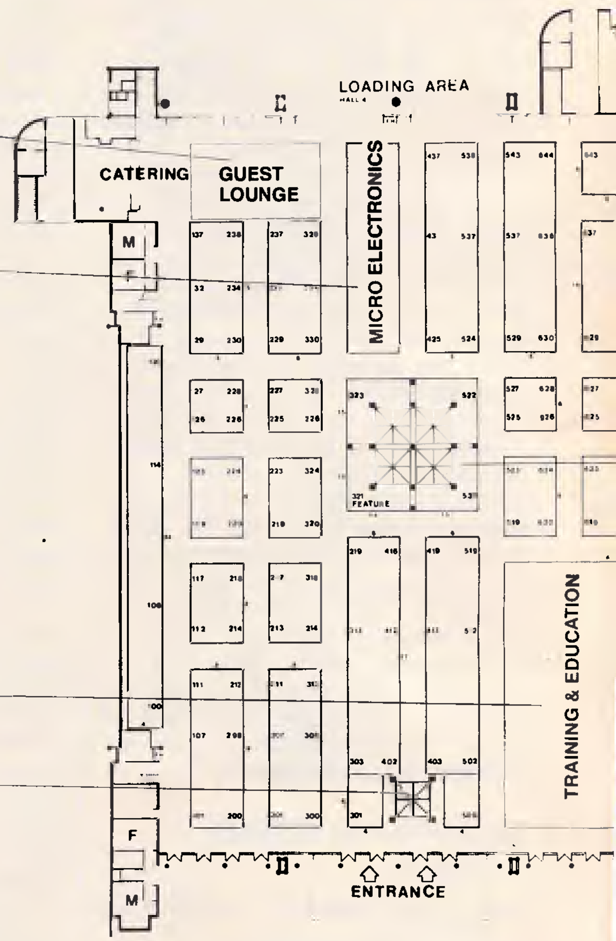

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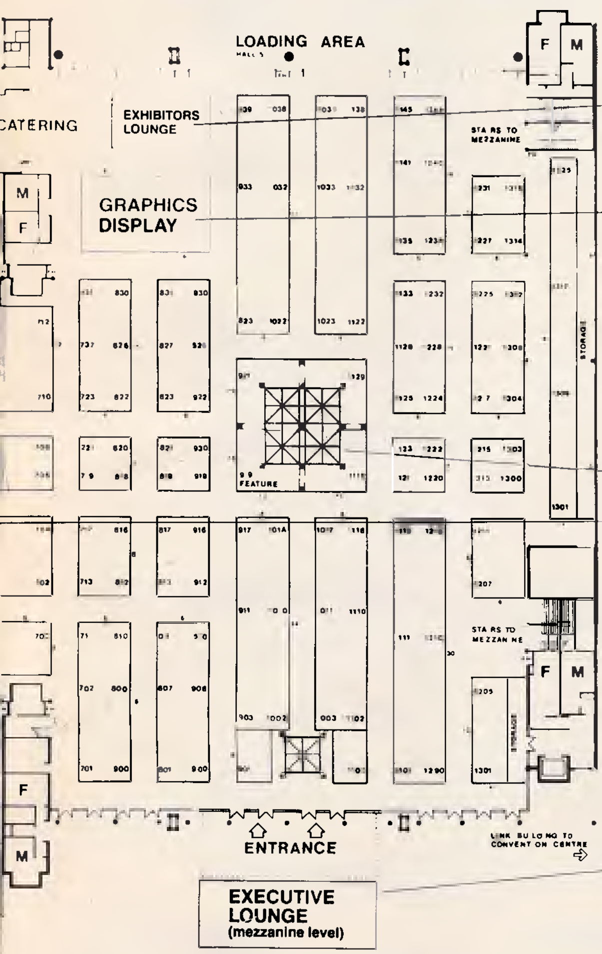

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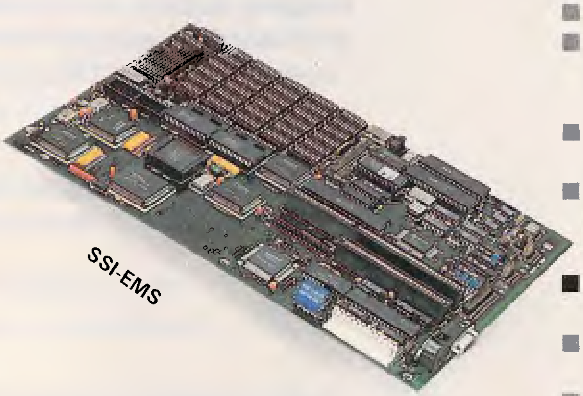

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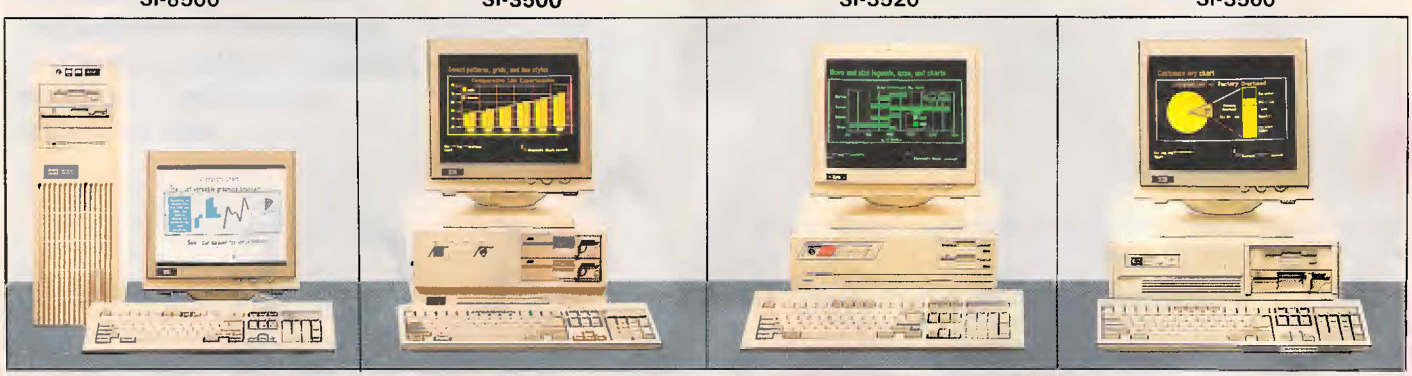

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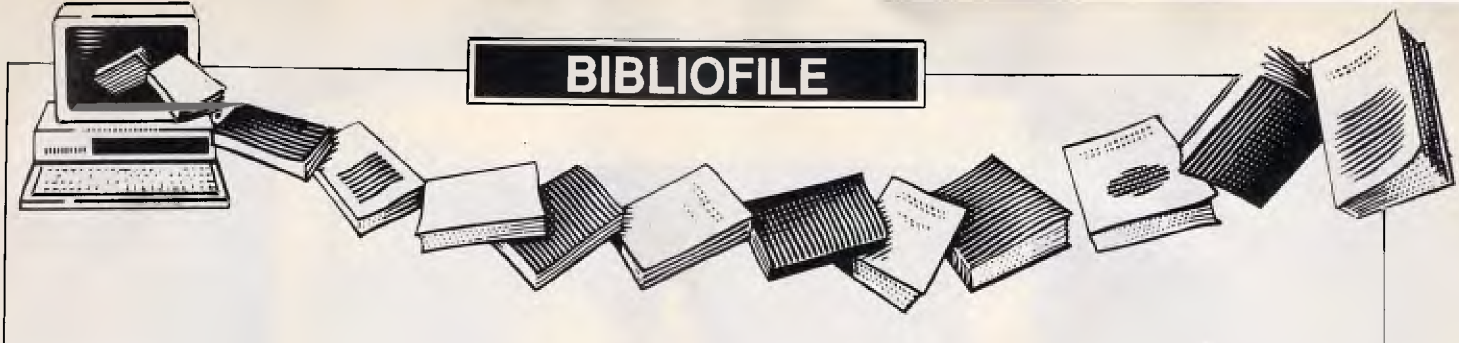
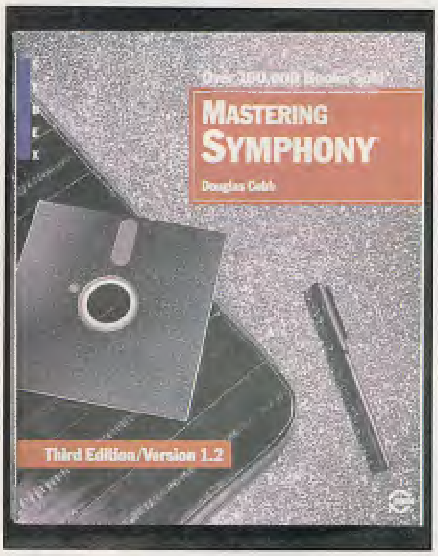


The application of microcomputers for financial planning and alternative spreadsheet manuals, comes under our reviewers' spotlight this month.



Mastering Symphony

Author: Douglas Cobb
Publisher: Methuen
ISBN: 0-89588-470-4
Price: $54.95

This is a megabook to match a megaprogram — my first impression of it was of a cross between hundreds of screenshots and an unedited version of the *Bible*. It contains eight sections, 31 chapters and over 800 pages. The section headings are 'Introduction', 'The Spreadsheet', 'Services', 'Graphics', 'Word Processing', 'Database Management', 'Communications' and 'Advanced Topics'. However, its size has certainly not dampened its popularity. It is now in its third edition and the cover claims that over 100,000 have been sold.

The author, Douglas Cobb, is a highly regarded spreadsheet writer and has provided an excellent combination of tutorial and reference material which can be used by beginners and experienced users alike. For example, the section on Communications, although detailed, contains a primer chapter that explains among other things how a modem works and what the X-on X-off protocol is. As a reference book it is also very comprehensive. Each of the program's many spreadsheet functions, for example, is explained clearly and carefully, using examples where necessary. Throughout the book the author provides helpful, practical details and plenty of tips and advice — features which are sadly lacking in most software manuals. The author also sprinkles the book with useful and interesting background information which makes it easy and pleasant to use — although it wouldn't make light bedtime reading.

Overall, the book is well-organised and illustrated. However, because of its size, I found it easy to get lost in the pages — some additional information at the head of each page (such as section and chapter number), would have been useful. I found the book physically bulky, and would have preferred to see it published as a set of two or three smaller books. Some colour might have been useful to lighten it up and maybe index the page edges for easy reference.

If you need a book on Symphony to complement the software manuals, however, I would strongly advise you to buy this one.

Anthony Meier

Managing your business with Multiplan

Author: Ruth K Witkin
Publisher: Penguin Books
ISBN: 0-914845-94-2
Price: $38.95

I have to confess that I've never used Multiplan and, although I'm no stranger to budget and gross profit analysis, I'd be hard pushed to tell you what 'loan amortization' or 'five-in-one depreciation' analysis means. However, if I needed to work in this field and I were using a spreadsheet for the first time, then on the strength of this book I would certainly use Multiplan.

Geared specifically towards 'the small business user' (I find that an unfortunate phrase, as to me it always conjures up the image of a minute individual), the author presents a very friendly and helpful face to the first time (and the experienced) user of Multiplan.

The heart of the book is really in Part Two where the author devotes individual chapters to setting up 12 financial spreadsheets and illustrates how to adapt them for your business. These spreadsheets range from the aforementioned loan appreciation and five-in-one analysis through price-volume analysis, project cost estimate, cash disbursements, and cash flow analysis. The setting up of each spreadsheet is explained step-by-step and includes formatting cells, printing, using macros for speed and entering formulae.

The remainder of the book deals with obligatory introduction to Multiplan; how to create a general spreadsheet; and how to use Multiplan to the fullest by explaining built-in commands, providing help and advice if your formula won't work, how to use the 'IF' and 'LOOKUP' facilities and lastly, how to make macros work for you.

This book is very readable and is convincing in its praise of Multiplan (version 3) and how easily your own business needs could be matched to any of the presented spreadsheets. It is hard to fault Microsoft publications as they are written to a very high standard — this is certainly true for 'Managing your business with Multiplan.'

Lorna Kyle

Using SuperCalc4

Author: William J Doyle, Jr
Publisher: Jacaranda Wiley
ISBN: 0-471-85992-3
Price: $54.90

I must admit that my heart sank when this book arrived for review: yet another guide for people who can't be bothered to read the manual. Although many pieces of software have documentation

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NAME OF APPLICANT: ____ BIRTHDATE ____

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- ☐ FINANCIAL MANAGER/CONTROLLER
- ☐ MIS/DP MANAGERS
- ☐ PROJECT LEADER/MANAGER
- ☐ ENGINEER/TECHNICAL
- ☐ OPERATION SUPERVISORS/DATABASE ADMINISTRATORS
- ☐ ACCOUNTANT
- ☐ CONSULTANT/ADVISOR
- ☐ EDUCATION/TRAINING
- ☐ SYSTEMS ANALYST/DESIGNER/MANAGER
- ☐ APPLICATIONS PROGRAMMER
- ☐ SYSTEMS PROGRAMMER
- ☐ SALES/MARKETING REPRESENTATIVES
- ☐ STUDENTS
- ☐ COMMUNICATIONS MANAGERS

3. ARE YOU A PERMANENT EMPLOYEE? ☐ CONTRACTOR? ☐

4. DEPARTMENT ____

5. EMPLOYER COMPANY/FIRM NAME ____

6 BUSINESS ADDRESS ____ SUBURB ____
POSTCODE ____ BUSINESS TELEPHONE ____

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SUBURB ____ POSTCODE ____
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7 IF THERE ARE OTHER PEOPLE WHO YOU BELIEVE WOULD BENEFIT FROM RECEIVING PC WEEK, PLEASE SUPPLY THEIR DETAILS.
NAME ____
EMPLOYER NAME/ADDRESS ____
JOB TITLE ____ BUSINESS PHONE NO. ____

8. WHAT IS THE PRINCIPAL ACTIVITY OF YOUR ORGANISATION? (please tick one).
1. ☐ MANUFACTURING (non-EDP)
2. ☐ PUBLISHING/PRINTING
3. ☐ UTILITIES
4. ☐ COMPUTER SUPPLIER
5. ☐ WHOLESALE (non-EDP)
6. ☐ COMPUTER RETAIL (micro)
7. ☐ RETAIL ORDINARY (non-EDP)
8. ☐ TRANSPORT/COMMUNICATION
9. ☐ BANKING/BUILDING SOCIETY/FINANCIER/REAL ESTATE
10. ☐ ACCOUNTING FIRMS
11. ☐ INSURANCE
12. ☐ EDP SERVICE BUREAUS
13. ☐ SYSTEM HOUSES
14. ☐ EDP PACKAGED SOFTWARE
15. ☐ EDP CUSTOM SOFTWARE
16. ☐ CONSULTANTS
17. ☐ OTHER BUSINESS SERVICES
18. ☐ CLUBS/ASSOCIATIONS
19. ☐ GOVERNMENT (National/State)
20. ☐ GOVERNMENT (Local)
21. ☐ EDUCATION/TRAINING
22. ☐ MINING/OIL/AGRICULTURE
23. ☐ HEALTH/PUBLIC
24. ☐ HEALTH/PRIVATE
25. ☐ LEGAL
26. ☐ OTHER
27. ☐ AEROSPACE
28. ☐ COMMUNICATIONS
29. ☐ RESEARCH & DEVELOPMENT
30. ☐ ENGINEERING
31. ☐ MANUFACTURING/EDP

9 NO. OF STAFF EMPLOYED IN DP DEPARTMENT AT THIS LOCATION? ____

10. TOTAL EMPLOYEES IN YOUR COMPANY AT THIS LOCATION? ____

11. WHICH BRACKET BEST FITS YOUR DP DEPT. BUDGET AT THIS LOCATION?
A. ☐ $0 - 99,000
B. ☐ $100 - 499,000
C. ☐ $500 - 999,000
D. ☐ $1M - 2.49M
E. ☐ $2.5M - 4.9M
F. ☐ $5M+

12. WHAT TYPE OF EQUIPMENT DOES YOUR COMPANY USE?

	MAKE	QUANTITY
A. ☐ MAINFRAME (show principal make)		
B. ☐ MINI COMPUTERS		
C. ☐ PERSONAL COMPUTERS		
D. ☐ LAN (LOCAL AREA NETWORKS)		
E. ☐ PC-NETWORK		
F. ☐ INTELLIGENT TERMINALS		
G. ☐ WORD PROCESSORS		
H. ☐ PACKAGED SOFTWARE		
J. ☐ MAINFRAME NETWORK		
K. ☐ MINI COMPUTER NETWORK		
L. ☐ WAN (WIDE AREA NETWORK)		

13. ARE YOU A VOLUME BUYER* OF PCs AND PC EQUIPMENT (*Defined as purchasing over 4 PCs per annum)?
☐ YES PLEASE INDICATE QUANTITY BELOW EACH MODEL
☐ NO PLEASE INDICATE QUANTITY YOU PLAN TO PURCHASE

MANUFACTURERS NAME/ NAME/MODEL	CURRENTLY OWNED QUANTITY	PLAN TO PURCHASE		
		0-12 months quantity	13-24 months quantity	25-36 months quantity
A. IBM PC & PC XT				
B IBM AT				
C. PS/2 – MODEL 30 (8086)				
D PS/2 – MODEL 50, 60 (80286)				
E. PS/2 – MODEL 80 (80386)				
F LAPTOPS (IBM OR COMPATIBLE)				
G. IBM (MODELS NOT LISTED ABOVE)				
H IBM COMPATIBLES/CLONES				
J MACINTOSH				

14. THE PERSONAL (MICRO) COMPUTERS PURCHASED BY MY COMPANY ARE FOR:
A. ☐ INTERNAL USE B. ☐ RESALE C. ☐ OTHER (PLEASE SPECIFY)

15. IF YOU ARE A COMPUTER CONSULTANT, HOW MANY IBM OR COMPATIBLE PCs DO YOUR CLIENTS PURCHASE THROUGH YOUR RECOMMENDATIONS PER YEAR? ____

16. IF YOU ARE A COMPUTER SUPPLIER/RETAILER HOW MANY IBM OR COMPATIBLE PCs DO YOU SELL PER YEAR? ____

17. HOW ARE PERSONAL COMPUTERS, PERIPHERALS AND SOFTWARE NORMALLY OBTAINED FOR THIS LOCATION?

	COMPUTERS	PERIPHERALS	S/W
1. DIRECT FROM MANUF./MANUF. REP	☐	☐	☐
2. RETAIL COMPUTER STORE	☐	☐	☐
3. SYSTEMS HOUSE/OEM	☐	☐	☐
4. MAIL ORDER HOUSE	☐	☐	☐
5. COMPUTER WHOLESALE/DEALER	☐	☐	☐
6. IN-HOUSE	☐	☐	☐
7. OTHER	☐	☐	☐
8. CONSULTANT	☐	☐	☐

18. WHAT IS THE COMMUNICATIONS CAPABILITY FOR WHICH THESE PCs ARE USED.
A. ☐ COMMUNICATE WITH REMOTE TIME SHARING DATABASE
B. ☐ COMMUNICATE WITH INTERNAL MAINFRAME OR MINI COMPUTERS
C. ☐ USED IN LOCAL AREA NETWORK
D. ☐ DOWN LOAD DATA FROM MAINFRAME OR REMOTE SERVICE
E. ☐ VOICE/DATA
F ☐ OTHER (please specify)

19. WHAT APPLICATIONS ARE THESE PCs USED FOR:
(Tick all that apply)
A. ☐ ACCOUNTING
B. ☐ COMMUNICATIONS
C. ☐ DATABASE MANAGEMENT
D. ☐ DATA INPUT/ANALYSIS
E. ☐ EDUCATION
F. ☐ ELECTRONIC MAIL
G. ☐ DESKTOP PUBLISHING
H. ☐ FINANCIAL/PLANNERS/SPREADSHEETS
J. ☐ GRAPHIC DESIGN
K. ☐ PERSONAL TIME MANAGEMENT
L. ☐ PORTFOLIO MANAGEMENT
M. ☐ PROGRAMMING
N. ☐ PROJECT MANAGEMENT
P. ☐ PROCESS CONTROL
Q. ☐ SCIENTIFIC OR ENGINEERING APPLICATIONS
R. ☐ STATISTICAL ANALYSIS
S. ☐ TAX CALCULATION OR PLANNING
T. ☐ WORD PROCESSING
U. ☐ OTHER

20 DO YOU ACQUIRE/SPECIFY OR RECOMMEND ANY OF THE PRODUCTS OR SERVICES BELOW?
☐ YES ☐ NO

1. COMPUTERS
A. ☐ MAINFRAMES
B. ☐ MINI COMPUTERS
C. ☐ PERSONAL COMPUTERS

2. CONNECTIVITY
A. ☐ LOCAL AREA NETWORKS
B. ☐ MICRO/MINI/MAINFRAME LINKS
C. ☐ MODEMS
D. ☐ COMMUNICATIONS PORT
E. ☐ COMMUNICATIONS SOFTWARE
F. ☐ TERMINAL EMULATORS
G. ☐ VOICE/DATA

3. PERIPHERAL EQUIPMENT
A. ☐ LASER PRINTER
B. ☐ LETTER QUALITY PRINTER
C. ☐ DOT MATRIX PRINTER
D. ☐ GRAPHICS PRINTER
E. ☐ HIGH SPEED PRINTER
F. ☐ COLOUR MONITOR
G. ☐ MONOCHROME DISPLAYS
H. ☐ HARD DISKS
J. ☐ TAPE BACKUP SYSTEMS
K. ☐ PLOTTERS/CHARTING DEVICES
L ☐ SCANNERS

4. ADD-ON BOARDS
A. ☐ MEMORY BOARDS
B. ☐ GRAPHICS BOARDS
C. ☐ CPU COMPATIBILITY CARDS

5. SOFTWARE PACKAGES
A. ☐ ACCOUNTING
B. ☐ ORDER ENTRY/INVENTORY
C. ☐ PAYROLL
D. ☐ TIME BILLING
E. ☐ FINANCIAL/PLANNERS/SPREADSHEETS
. ☐ PROJECT MANAGERS
G. ☐ WORD PROCESSORS
H. ☐ COMPILERS
J. ☐ DATABASE MANAGERS
K. ☐ PROGRAM DEVELOPERS/GENERATOR TOOLS
L ☐ GRAPHICS
M. ☐ DESKTOP PUBLISHING
N. ☐ UTILITIES
P. ☐ CAD/CAM

6. OUTSIDE SERVICES
A. ☐ MAINTENANCE
B. ☐ EDUCATION/TRAINING
C. ☐ SOFTWARE/SYSTEMS DESIGN
D. ☐ REMOTE COMPUTING
E. ☐ DATABASE SERVICES
F ☐ OTHER

7. OTHER
A. ☐ DISKETTES
B. ☐ STOCK PAPER
C. ☐ FORMS AND OTHER CONSUMABLES
D. ☐ FURNITURE

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PC WEEK
THE NATIONAL NEWSPAPER OF IBM STANDARD MICROCOMPUTING.

that appears to have been written by chimpanzees to be read by PhDs, SuperCalc4 users are fortunate in having a reasonable manual to work from. So why do books like this come onto the market?

Having said that, William Doyle has produced a good, comprehensive introduction to SuperCalc 4 (Release 1.1), a spreadsheet in the mould of Lotus 1-2-3 and VisiCalc.

He covers its features in the order that a beginner would be likely to need them, starting with moving around and data entry, working up through data manipulation, I/O, built-in functions and graphics, and onto advanced capabilities such as macros and creating turnkey systems.

The book is written in an easy, tutorial style and explains the spreadsheet's facilities well. There are copious examples and exercises (with answers) throughout, each chapter building on the examples of its predecessor — a good incentive to work through and understand the system. It is sufficiently thorough and well-organised, so advanced users could use it for reference purposes.

William Doyle has written an excellent introduction to SuperCalc4 which I would recommend to anyone who needs to learn how to use this spreadsheet and no longer has a manual.

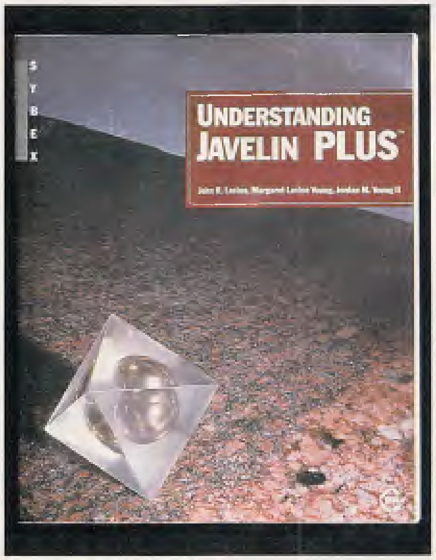
Nicolas North

Understanding Javelin Plus

Authors: John R Levine, Margaret Levine Young, Jordan M Young II
Publisher: Methuen
ISBN: 0-89588-358-9
Price: $49.95

The main author of this book, John Levine, is a software engineer and one of the creators of Javelin itself. (I wonder whether the program name was obtained from an anagram of his own name?) He certainly knows his subject and it shows in the book. It is not a replacement for the software manuals, which are excellent themselves, but a very useful addition.

The book's emphasis is on how to design and build models using Javelin Plus, making full use of the program's features and facilities. The book has a practical bias and should ideally be used sitting in front of a machine running the program. The chapters take you through the design and creation of numerous models which are used to explain and illustrate Javelin's capabilities. The models cover a wide range of real-life applications such as business planning and mail list management.



All aspects of model building are covered — there is a chapter that covers dealing with errors and diagnosing problems. There is a very useful section on good modelling practices like planning ahead and designing 'from the top down'; and a section on good macro practices, like making your macros robust and readable.

Javelin Plus is a powerful and complex program that needs a book like this to help users see its full potential. The book covers both Javelin and Javelin Plus. The text is notably impersonal — factual and 'to the point' — but it is compensated for by being well-illustrated with diagrams, screenshots and tables. There are also handy notes scattered throughout the book for Lotus 1-2-3 users.

'Understanding Javelin Plus' is a good buy if you want to learn more about modelling than the Javelin manuals can teach you. By covering a large range of example models in depth, the book condenses a considerable amount of knowledge and experience into its pages.

Anthony Meier

1-2-3 The Complete Reference

Author: Mary Campbell
ISBN: 0-07-881005-1
Publisher: McGraw-Hill
Price: $47.95

Lotus 1-2-3 is one of the success stories of the decade. Most micro users have used or seen it. My initial reaction to this book, therefore, was 'What else is there to say?'

The answer of course, is in the title. This is 'the authoritative desktop companion of every Lotus 1-2-3 user'. New users may wish to start at page 1 and work through almost 900 pages of information, while more experienced users may dip and dive about as they wish. Mary Campbell has performed a first-class feat in collating everything you ever wanted to know about 1-2-3, but were too afraid to ask.

The book is divided into three main sections: Part One covers the worksheet and associated commands; Part Two deals with database and graphics commands; while Part Three 'expands the basic 1-2-3 features with the power of macros and add-on products'. No need to gnash your teeth either if you're sitting there with version 1A, which was superseded in the latter half of 1986 by version 2, as both versions are fully covered. I'd recommend that you update to version 2 though, with its 'greater memory capabilities, more sophisticated analytical techniques, new built-in calculating abilities, and an expanded macro command language' — otherwise you might find yourself excluded from the next office party.

The trouble with large softback volumes, and I mean *large*, is that the spine has a habit of breaking away from the contents after only a couple of uses. It would also have been nice if the production costs had run to a hint of colour and some kind of finger index; that aside, the author has made best use

of the monochrome available by boxing off important points and interspersing the text with large, clear screen layouts. Copious worked examples are given to illustrate commands, and I was especially pleased to see good descriptions given to mathematical functions such as COS, TAN and EXP. These are so often glossed over.

I'm sure every 1-2-3 user could find shelf space for this book. Take it from me, you won't need to buy any other.

Lorna Kyle

END

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NUMBERS

Mike Mudge explains the concept of difference tables.

Many readers will already be familiar with the concept of difference tables. These tables arise in any introduction to numerical methods or, more simply, in the process of interpolation — central to the use of tabulated function values (now, alas, frequently replaced with a consequent lack of understanding, by the use of the pocket calculator!).

Suppose that $y = f(x)$ is tabulated at equal increments, h, in the independent variable x; these x-values being denoted by x_0, $x_1 = x_0 + h \ldots x_n = x_{n-1} + h = x_0 + nh$ and the corresponding y-values by $y_n = f(x_n)$.

The first forward differences, dy, of y are defined by $dy_n = y_{n+1} - y_n$.

The second forward differences, d^2y, of y are similarly defined by $d^2y_n = d(dy_n)$.

This apparently elaborate algebraic notation is readily clarified by the following example. Suppose $y = x^3 + 1$ with $x_0 = 2$ and $h = 3$: the difference table begins as shown in Fig 1.

Clearly, the second differences of n^2 are constant and equal to 2.

Question Do there exist non-consecutive integers $x_0, x_1, x_2, \ldots$ such that the second differences of their squares are constant? Specifically, can that constant be equal to 2?

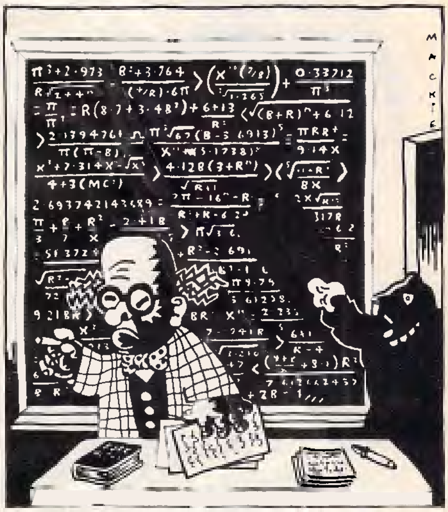
Answer Yes! For example (6, 23, 32, 39) see Fig 3.

Duncan Buell, of the Supercomputing Research Center, has recently (1987) completely characterised such sequences of length 4 but states that the existence of such sequences of length 5 (and above) is still an open question.

He poses an intermediate step, which he calls problem B; seeking a sequence of five integers $n_0^2\ n_1^2\ n_2^2$ N, n_4 where n_0, n_1, n_2 are not consecutive such that their second differences are constant, say, c, and specifically with c = 2.

Problems

(i) Construct a computer program to input function values and print out, correctly formatted, the associated difference table up to the n^{th} differences.



(ii) Search for sequences of four squares such as (6, 23, 32, 39) and (39, 70, 91, 108) whose squares have second constant differences.

(iii) Extend (ii) to sequences of five integers in the pattern of Buell above.

(iv) Attempt to resolve Buell's open question regarding sequences of five squares.

x	$y = x^3 + 1$	dy	d^2y	d^3y
2	9			
		126 − 9 = 117		162
5	126		270	
		513 − 126 = 387		162
8	513		432	
		1332 − 513 = 819		162
11	1332		594	
		2745 − 1332 = 1413		162
14	2745		756	
		4914 − 2745 = 2169		
17	4914			

Fig 1

n	$y = n^2$	dy	d^2y
1	1		
		3	
2	4		2
		5	
3	9		2
		7	
4	16		2
		9	
5	25		2
		11	
6	36		

Fig 2 The difference table for n^2

1	n_i	$y = n_i^2$	dy	d^2y
0	6	36		
			493	
1	23	529		2
			495	
2	32	1024		2
			497	
3	39	1521		

Fig 3

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NUMBERS

(v) Given that the n^{th} difference of a table of n^{th} powers is constant (see d^3y for $y = x^3 + 1$ above), investigate sequences of non-consecutive integers whose cubes have constant third differences, and so on, through fourth and fifth powers.

Readers are invited to send their attempts at some or all of the above problems to Mike Mudge, c/- *APC*, 124 Castlereagh Street, Sydney 2000, to arrive by 15 July, 1988. It would be appreciated if such submissions contained a brief description of the program and a summary of the results obtained in a form suitable for publication in *APC*.

These submissions will be judged using subjective criteria, and a prize will be awarded by *APC* to the 'best contribution' received by the closing date.

Please note that submissions can only be returned if a suitable stamped, self-addressed envelope is provided.

Review: December

This problem produced a variety of responses, the largest powerful number seen being 467 9307774, degree 10, base 10. The geometrical interpretation hinted at in the article may well be a figment of the author's imagination — no-one made significant progress along these lines!

The very worthy prizewinner is Brian Stuart. Brian searches for powerful numbers for all number bases from 3 to 99 to all possible degrees, with a restartable algorithm. By 24 January, 1988 he had reached $3x10^6$ for all bases and 10^8 for some; with a target of 2^{31} 'at some 11 million per hour'.

Among the many interesting results were: (a) 19 5 16 base 24 (=11080 decimal) is powerful of degree 3 and the only powerful number base 24 less than $119x10^6$; and (b) no powerful numbers found to base 90.

END

Mike Mudge *welcomes correspondence on any subject within the areas of number theory and other computational mathematics. Particularly welcome are suggestions, either general or specific, for future Numbers articles; all letters will be answered in due course.*

Isolated readers can be put in contact with others sharing the same interests. However, greater efficiency regarding published problems should result from contacting the prizewinner.

LAZING AROUND

Brainteasers courtesy of JJ Clessa.

Quickie

77/77 = 1
(7/7) + (7/7) = 2
(7+7+7)/7 = 3

Can you continue and arrange four 7s together with any standard mathematical symbols to be equal to 4, 5, 6 . . . up to 20? (By the way, if anyone can get the value 26, please let me know).

Prize puzzle

My bank account number contains the following eight digits (not in this order, I hasten to add)

1 3 3 3 4 6 8 8

It makes me wonder just how many different integers could be made using some, or all, of these digits. Further, if all these integers were sorted into ascending order, what would be the integer in the 5000th position?

Two answers please — the total number of integers, plus the one in 5000th position.

Answers on postcards or backs of envelopes only, to reach the *APC* office no later than 30 June, 1988.

Send your entries to: Lazing Around June, *APC*, 124 Castlereagh Street, Sydney 2000.

March prize puzzle

Not too difficult this month, although computer program running times to obtain solutions varied from nine hours on a BBC 'B' computer, to one hour by hand (and we call this progress?)

The problem wasn't difficult to solve by hand, and the required solution is

4 8 2		6 1 4
1 5 7	which rotates to	3 5 8
6 3 9		9 7 2

The winning card came from S A Collie, PO Box 1111, Mount Gambier, SA, 5209.

To all other entrants — keep trying!

END

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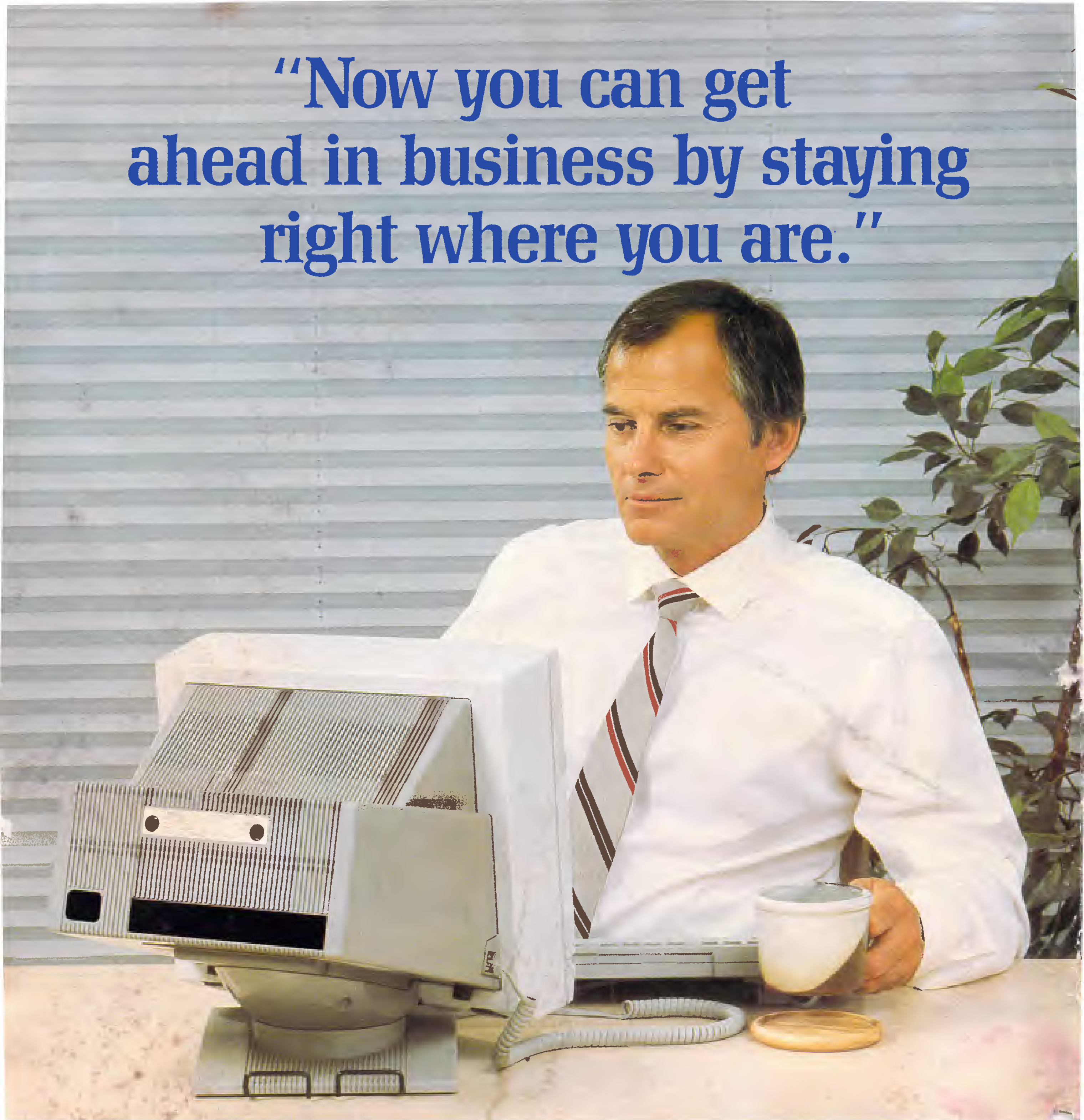

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