Australian Personal Computer

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APC CONTENTS

Volume 8, Number 5, May 1987

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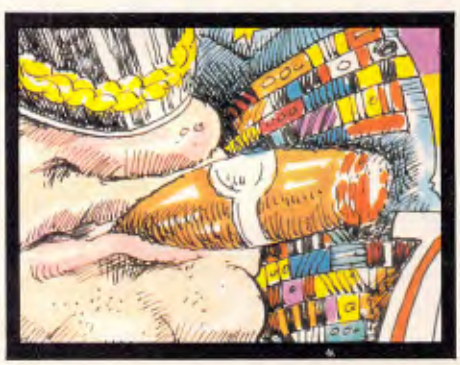

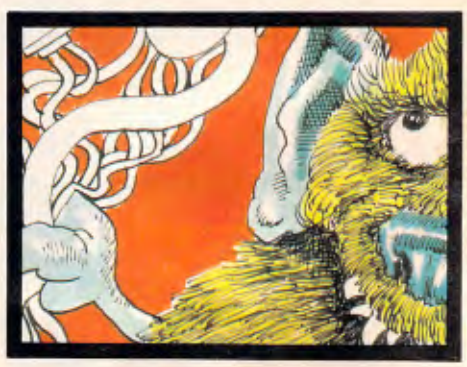

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We've made a few changes to APC this month. This is the result of the culmination of arrangements we have established with two leading US computer magazine publishers. From this issue, APC is plugged directly into the US computer scene and will endeavour to further enhance its reputation for bringing readers product news first.

The changes include the demise of 'The West Coast' column, although Tim Bajarin is still with us: his writings will be included in a much expanded 'Newsprint'. 'What's New' will also be accommodated in this revamped news column to provide a more analytical approach to the reporting of product announcements. 'Banks' Statement' is renamed to 'Braindump', APC's new regular opinion column which will permit a variety of authors. 'SubSet' is gone, replaced with a greater number of in-depth productivity articles (vis. 'Instant Directory Access' on page 113 of this issue). If you feel inclined, write to us with your thoughts on these changes . . . we'd be interested in your opinion.

FEATURES

BENCHTESTS & REVIEWS

TWENTY YEARS AFTER WE MADE PC NUMBER ONE, WE MADE THE NUMBER ONE PC.

In 1965 Olivetti made the programma 101.

The first computer in the world small enough to fit neatly on top of a desk.

So, not being people to mince words, we called it a "desktop PC".

Since that auspicious beginning, Olivetti desktop PCs have grown to become giants in their field. And, only last year, we scored another first.

Olivetti M24.

The Olivetti M24 was awarded the coveted "World Class Award" by PC World Magazine.

But these aren't our only claims to fame.

All Olivetti PCs are famous in their own right.

There's the M28. Olivetti's flagship AT level PC.

Based on 80286 architecture, this PC is expandable up to 70 megabytes.

Olivetti M28.

Which means it can be small enough, or big enough, to suit any needs.

Our M24SP is a special performance PC able to clock up speeds other comparable computers can only envy at a price that puts them all to shame.

Then there's the M19. Our entry model PC, which can function either as a network workstation or stand alone. Whichever suits your business.

Of course, all our PCs are outstanding performers. Built with Olivetti's experience and reputation for style and graphic resolution.

Olivetti M24SP.

Each one is fully industry compatible and designed to handle new generation software.

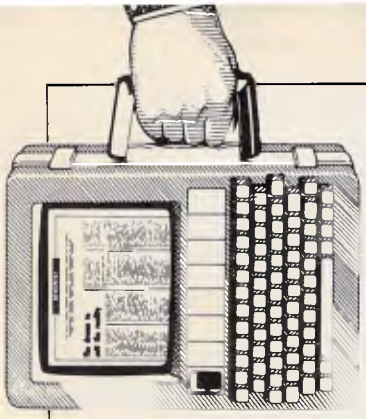
And all are backed by Australia's largest computer service network.

So when you buy from the Olivetti range of PCs you can be sure your personal computer will be performing for a long long time to come.

Olivetti M19.

Because when Olivetti makes a first, we make sure it will last.

olivetti



NEWSPRINT

The poisonous side of data processing and the real meaning of personal computers — as always, news from Guy Kewney and associates covers a lot of ground.

Dark thoughts from above

"Guy", said a colleague in the aeroplane on our way back from the Hanover Fair, "could you do me a favour?"

"Of course, what?"

"Could you stop standing on my foot?"

I hadn't known. Naturally, I apologised, explained, hoped no serious damage was done, and (most important) got off his foot.

Computing is the sort of business where such thoughtfulness is natural. Computing harms no-one. It provides services which the world absolutely couldn't manage without, and computing people are dedicated to sympathy — trying to understand their fellow humans, and to provide what they need to help them. And if there are some people who feel that computer games are wicked, well, it's probably a healthy sign — a sign of lively debate amongst intelligent philanthropists.

It would be nuts to start looking for ways in which computers are harmful.

Compared with driving cars, for example, computers don't generate fumes. Compared with building freeways, they don't destroy homes. They use trivial amounts of electricity. And they sit on desks, for years, generating almost undetectable radiation. With all this going for computers, well, why look for trouble? Obviously, you can't make omelettes without breaking eggs, and there must be some drawbacks . . .

The interesting thing about all this self-satisfying drivel, is that we don't know what

PC'87 — The Ninth APC Show

Victorian readers can thank IBM for its timely release of its PS/2 range with that system's first public showing to be at Melbourne's Ninth *Australian Personal Computer* Show. And John Button can also thank IBM for substantiating his statement that "The Ninth *APC* Show, held in conjunction with associated exhibitions, Office Technology 87 and Communications 87, represents the most complete picture of microcomputing technology ever staged in Australia." So don't miss PC87 at the Royal Exhibition Building in June.

There'll be a lot more in the way of new products offering than IBM's PS/2 . . . and that may include a number of other IBM products announced in the US recently but which are presently subject to the old 'we don't speculate on future product announcements' line from IBM. This includes IBM's first desktop publishing system, covered elsewhere in Newsprint.

What we definitely can say will be on display includes:

- A fax machine from Sharp small enough to fit into a briefcase.
- Olivetti's own range of integrated software, Olisoft, which includes word processor, spreadsheet, database and graphics module.
- A budget-priced computer aided design package from the people who produced the market-leading AutoCAD software. It is capable of associated dimensioning, automatic scaling and text selectable layers and linetypes — and it is compatible with AutoCAD.
- A number of 80386-based machines including one from Kaypro which has the distinction of a pedigree Intel-built motherboard.
- Not a product exactly, but Management Technology Education is conducting a series of courses on each business day of the Show. Topics include 'Communications, PCs and Office Technology', 'How to select a PC for your business' and 'Trends in technology and applications'.

See you there!

Please note that this year the organiser, Australian Exhibition Services, has made a few changes to the Show.

A special registration desk has been provided for DP professionals to speed up their entry to the exhibitions. DPs will also be provided with a pass allowing entry to the DP lounge provided.

Another change affects children under sixteen years of age who will only be admitted if accompanied by an adult.

With desktop publishing being all the rage, there's been a number of innovations in associated hardware. One is the A4 screen; prior to the era of DTP, larger than normal screens tended to be of the 19in variety and were used in computer aided design applications. But the strange shape of the screen shown above is what is needed for DTP — with the ability to show an entire A4 (ie, magazine) page at a time. It looks lovely, doesn't it? It also costs a bundle at around $3500 — still, APC is considering purchasing a couple for its DTP system used to produce the magazine.

Super High Resolution Colour plus unrivalled *NEC* power for less than $5000

We are delighted to announce the new NEC Powermate 80286 machines are available from Telecomputing PCS.

NEC is renowned for the clarity of its monitors.

A new standard of desktop Personal Computer, the NEC Powermate is fully IBM compatible and is based on the Intel 80286 Processor running at 8MHz, combined with the Phoenix Bios and a 20MB, 40MS Hard Disc.

We are offering the following systems at special introductory prices.

POWERMATE - PACKAGE I Under $5000

• 640K RAM • 1.2MB Floppy Drive • Fast 20MB Drive • Advanced Graphics Card (EGA) • Keyboard • Advanced Graphics Multisync Monitor 640 x 350 Pixels (compatible with PGA, EGA) • The Multisync feature makes it possible to upgrade Boards or Software without purchasing a new monitor.

POWERMATE - PACKAGE II Under $6500

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the drawbacks are. We use nickel-cadmium batteries. How do you extract cadmium? What pollution does a nickel mine cause? I don't know — I've never been to a nickel mine .

Then there's the semiconductor process. Galium arsenide . . . a strange compound of arsenic. Poisonous, a heavy metal. I wonder where they get galium. Do you know? And the various photo-sensitive chemicals used to make chips — I seem to vaguely recall that several Silicon Valley companies turned out to have poisoned the wells for years, with the waste products.

Wonder where those wastes are going now?

And the plastics industry, without which we'd have no disks, no circuit boards, no cheap cases, produces some of the most persistently toxic chemicals known. Who disposes of those? And how much? Do you know?

And then take the whole business of buying and selling computers. I travel thousands of miles, by air, each year. I encourage others to do the same, and so do a lot of other computer industry people.

In 50 years' time, most of us will be ancestors — grandparents, probably. It's quite probable that by then, the world will be in a pitiful state.

You want scare pictures? OK, imagine pesticides which no longer kill insects (immune) but have built up in the soil, and are poisoning us. Imagine a plague affecting wheat, making bread a luxury item, rice a food for the rich. Imagine a human race infected by bacteria, all immune to antibiotics. Imagine a climate changed so that Australian cities are mostly under sea-water, but the rest is desert.

All these things you will find, if you check, are not just vague possibilities, but strong probabilities. It's just a question of how long.

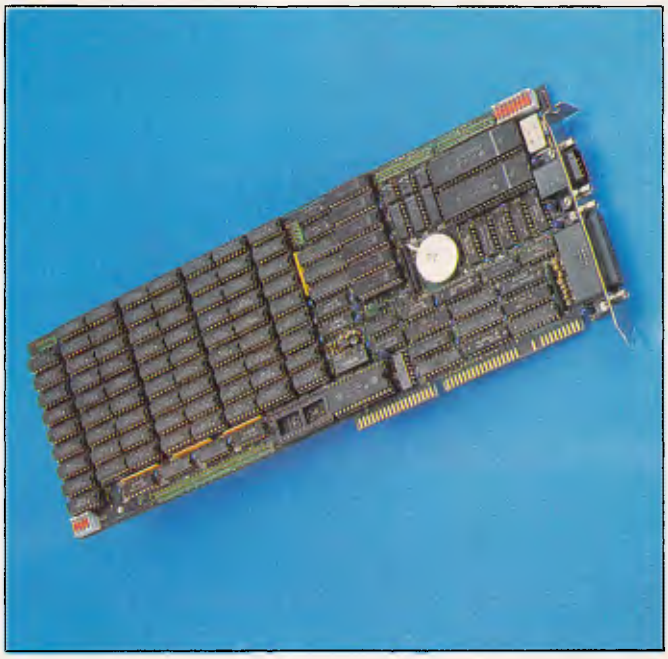
Will our grandchildren say: "Oh, my grandparents were in the computer business in the '80s. It wasn't their fault." Or will they keep quiet about how the family used to earn its living? Perhaps you have a theory about this — but have you done any research?

The trouble is that this planet of ours doesn't speak, it doesn't say; 'Could you get off my foot?' You have to look, very carefully, to make sure you aren't causing permanent damage.

But of course, that's no business of mine, is it? I should get on with my job — describing hardware, software and industry gossip — and stop bothering our readers with irrelevant ecological politics.

Right?

Guy Kewney



The Hyperam AT 16-bit memory expansion board comes as standard with 512k of RAM, but can be expanded to 2Mbytes. It is designed to the Lotus/Intel/Microsoft expanded memory specification and, best of all, it's Australian designed and manufactured. It sells for $1341. Details on (02) 819 7222.

Measuring IBM's impact

Hopefully, our exclusive coverage of IBM's fastest announcements in the Benchtest and here in Newsprint contains all the information you need. Here are a few pointers to measure that data by.

First, acceptance must be measurable.

People will tell you that IBM automatically sets a standard which others follow.

This is false. IBM set a standard in mainframe computing by introducing the 360 range, because nobody else could do it. Nobody else could offer a whole range of machines which obeyed the same instruction set — ran the same programs.

IBM set a standard in micros because micros were new, and dangerous, and rebellious. IBM made micros respectable. It can't do that twice.

Second, time for acceptance must be measured.

Measure this by comparing IBM with Apple. IBM and Apple have a very comparable status in the micro industry today.

It took Apple three years to establish the Macintosh standard. The Macintosh was a startling improvement on existing technology, and was backed by all the big producers of software, and was taken up by buyers at a rate far, far greater than the IBM PC was, when it appeared.

Guy Kewney

RAMming home the point

Well, OK, this month's little anecdote about Gem: I installed the RAM disk on my Gem Desktop on the PC 1512. There is a program to set it up, called NVR — non-volatile RAM — and then you tell Gem that you have it, and tell it to save this new drive to the standard Desktop.

Next time I ran Gem, guess what? No RAM disk. I installed it again as drive D: and got a little message from Gem: "Your path name is too long!"

What happened? Well, as part of the automation of the process of running your PC, Amstrad has decided that if you are running Gem, you won't want to lose valuable memory to RAM disks, and so the Gem start-up process automatically zaps any RAM disk you have set up.

So drive d: doesn't exist. So the Gem process of installing it decides that d: must be one parameter too many in the command it is creating for DOS. So it gives you that strange message.

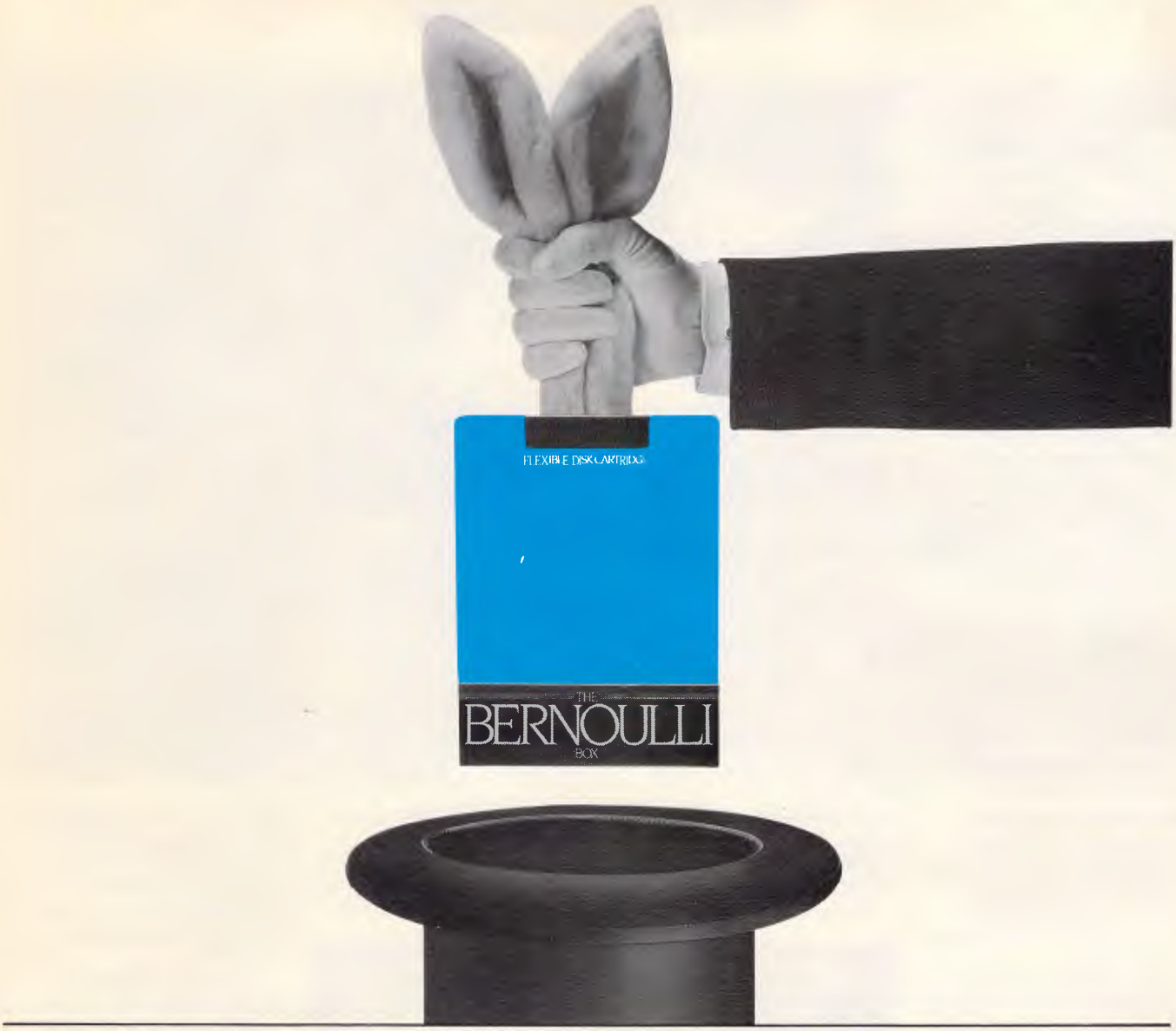
Funny, I'm almost sure I remember Digital Research telling me I was being crudely malicious, for suggesting that Gem placed heavy demands on memory. I wonder why Amstrad thought it necessary to claw back memory from RAM disk?

And what chance for those Amstrad users who want to run Gem XM, which relies on a RAM disk for its program swapping?

Guy Kewney

Making an impression

The much admired



Multiply your information storage with the Great Bernoulli Trick.

The Bernoulli Box PC Mass Storage sub-system gives you infinite data storage capacity. You simply keep adding Bernoulli disk cartridges. There's absolutely no limit to the on-hand storage.

When you run out of conventional hard disk storage and must purchase another (say, 40 megabytes capacity) there will probably be a time when that will overflow as well.

But if your purchase is a 20 + 20 Bernoulli Box, you can keep adding further storage in 20 megabyte units indefinitely by simply buying more disk cartridges – with the added advantage of a very, very low marginal cost.

And Bernoulli is as fast as the fastest conventional hard disk! Outstanding flexibility, too: the rugged Bernoulli Box cartridges travel well – through the mail or by courier. And they're conveniently modular so you can keep each client or project on a separate cartridge for easy reference.

Get the Bernoulli Box advantage. Phone Sourceware or your dealer now.

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SO 29 FPC

There are people who want a portable computer that is lighter than 5kg, and people who want a portable computer that will take IBM expansion cards. Those are the only ones who won't be interested in the new MultiSpeed machine from NEC.

First, it's fast. The chip inside is two steps up on the standard 8088 used in the original PC. It's the 16-bit bus version, which from Intel would be the 8086 and it uses the NEC version, the V30, which is considerably faster in its on-chip operations.

On top of that, the clock speed is 9.54 MHz, exactly twice the PC's 4.77 Mz.

Taken all together, NEC can claim that it runs nearly five times faster than the standard machine, so it is around AT speed.

Next, the display is good. It's not as good as the Zenith 181 — nothing is — but as standard supertwist LCDs go, it's pretty clear. And it can be replaced, at the office, with a standard colour monitor.

The keyboard is standard PC layout, the only difference being the position of the cursor pad above the qwerty keys, rather than on the right of them. Bitter experience has taught me that portables with some of the qwerty keys doubling as numeric keys are just not right, and just don't run a lot of software correctly.

Priced at $3373 it is not the cheapest in Australia, but should be below Zenith's 181, and the new Olivetti M15 when they are released. It's also faster than the other two.

Finally, NEC has come up with a dream of a scheme for getting data on and off those 3.5in diskettes. You plug the MultiSpeed into your standard PC, as an external disk drive. The PC then uses the MultiSpeed's diskettes as if they were its own.

And it has a handle.

To compete, Zenith will release a Mk II of the 181, with a built-in 10 or 20Mbyte hard disk. This one will have a handle.

Guy Kewney

Megahaus desktop publishing package, First Impression, is now a sister product to Open Access, the integrated software system.

Publisher SPI has bought the company.

I saw a demo of First Impression at Hanover Fair. Its two most startling features were: first, it looked exactly like an Apple Macintosh; and second, it barely worked.

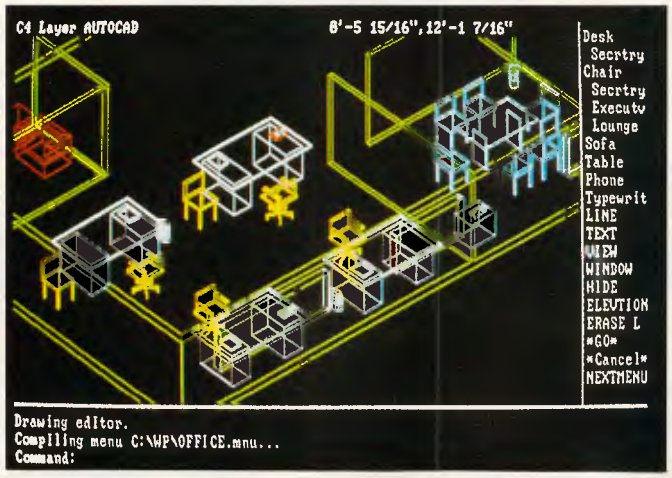
The problem has been that people keep changing the design spec, to the point where it now risks being dangerously late. Critics who have played with it have praised it — one described it as 'the only true WYSIWYG' desktop publisher, and singled it out for its excellent abilities to revise long documents on the page.

To me, it looks like an invitation for a lawsuit from Apple. It even uses Apple's 'Chicago' typeface for the pull-down menu bar — but SPI executives say they don't expect litigation, because they aren't competing with Apple.

Surprisingly, the windows and mouse operations are entirely proprietary, using neither GEM nor Windows environments.

Megahaus executive Keith Swanson said that one consideration delaying the launch was how to cope with font generation for new machines. "We will probably use Gem as our graphics interface for new machines." he said, "but the decision has still to be finalised. The other option is to write new screen drivers for each machine."

Price of the program is projected between $1500 and $3000, but it will only appear in beta-test versions in July, and might not hit the open market this year.

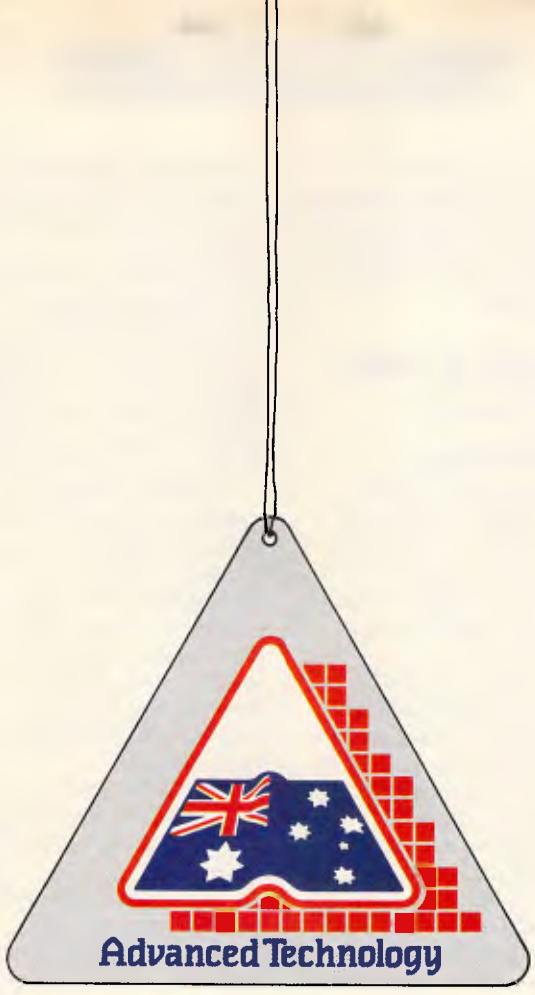


According to Hercules, AutoCAD takes advantage of its InColor card's 16 colour display capabilities. The card offers compatibiltiy with programs adhering to its Graphics Card and Graphics Card Plus standard, has RamFont capability and offers a maximum resolution of 720 by 348 pixels

Watching for Steve Job's NExt move

Now that Apple has released its colour workstation computer, the Mac II, industry observers are straining their ears to pick up information about Steve Jobs and his NExt computer. When Jobs left Apple, he took with him one of the engineers who was in charge of developing the Mac II.

In fact, the hiring of this individual caused Jobs to be fired and eventually Apple sued him to keep him from competing with it in the future.



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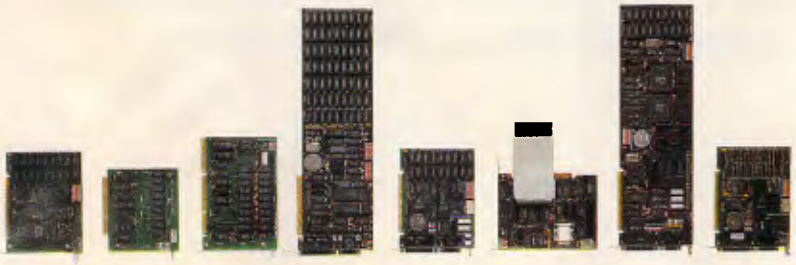

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*Hypertec featured in the first four places in no less than three hardware categories in the 1986 PC World Class Awards.

R2557/F.P./Little

Although they have settled this suit out of court and Jobs has guaranteed not to compete directly with Apple for two years, many are watching closely the development of his computer, which he aims to sell at the high end of the education market.

What makes it even more interesting is that Apple's new Mac II is also an excellent machine for this market.

Speculation is running high that his machine will have better graphics, more power and, since he knows the Mac and its operating system, some even think he has found a way to get his machine to run Mac programs, without violating Apple's ROM copyrights.

Sources close to NExt believe that he will use the Motorola 68020 as the main processor, but also say he will use the Inmos Transputer chip, as well as its 'paintbox chip' to handle the multi-tasking and extra graphics features he demands. Sources claim the machine is to be announced in September and shipping is to begin early in 1988.

Tim Bajarin

Getting a head start with technology

I bought a Texas Instruments 99/4A computer for my son when he was only three, and he learned his numbers and ABC on this machine before he even went to school.

He is nine now, and although he has classes on computing at his elementary school, he works as a 'computer tutor' helping other kids learn to use PCs. I know that this sounds like a proud father boasting about his son, and he did have an advantage since I have nine computers at home he can use if he wishes, but this example really underscores the fact that children can and do use computers even at early ages.

To help the kids in your life get a head start, take a good look at a package from Broderbund called Welcome Aboard. This is an exceptional learning tool that uses the Muppets to teach children all about computer literacy.

Captain Kermit the Frog teaches you about steering the ship. He does this by showing you the ship's navigation system. He teaches the child how to program this computer's steering mechanism by teaching him Slowgo, a programming language similar to Logo.

Fozzie Bear teaches children about databases by helping them develop a joke library.

In Miss Piggy's Salon de Beaute, they learn the basics of paint and draw programs with computer-aided design in mind.

Scooter is in charge of the communications room. He walks them through the principles of word processing and electronic mail.

The program comes with a Muppet Guide to computerese that helps them understand all the terms related to computing.

It is one of the most creative educational packages I have run across. A version is just about to be released for the new Apple IIGS. It is already available for the Commodore 64 and original Apple II series. This program should be shipped with each home computer.

A new colouring booking from Electronic Arts teaches users about modern technology while painting electronic images. This is a simple, colour-by-number system that contains prepared images representing various scientific categories such as the body, the universe,

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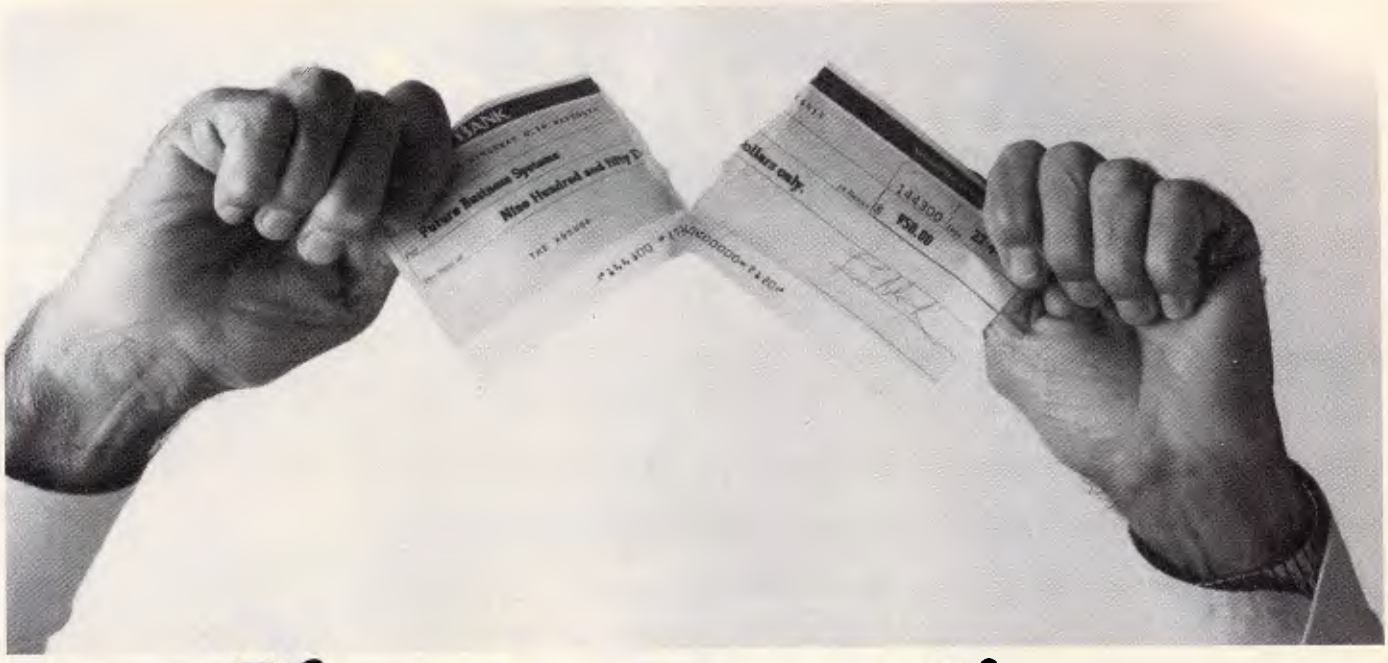

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lasers, computers, genetics, interstellar communication, and more. As these images are coloured, either with the user's personal choice of colour or with guidelines from the computer, visual changes will occur to help the user understand and learn more about the technological topic being portrayed. Available for the Atari and Amiga computers for around $US19.95 it is a great gift for families who have students especially interested in science.

Tim Bajarin

Oracle database now on PCs

Without waiting for a new multi-tasking operating system Oracle has announced three PC programs that let users build minicomputer and mainframe-class database applications that surpass the 640k RAM barrier of current versions of DOS.

Oracle's Australian Managing Director, Steve Clark, said it was the company's intention to provide "identical functionality to mini and mainframe systems on a PC or PC network". He also said it was "the first database we know of to take advantage of the protected mode on PC/ATs and '386 machines".

The programs incorporate proprietary technology and include hooks to Oracle's SQL*Star distributed-database environment, allowing the PC to share data stored on other PCs, minicomputers and mainframes as if the data resided on a single PC. The three products are Professional Oracle, a $2950 stand-alone PC database that breaks the 640k limit of DOS 3.X; Networkstation Oracle, a $1600 program that gives the PC access to Oracle and IBM DB2 databases residing on host computers; and LANserver Oracle, a $5750 multi-user database server for local area networks. According to Oracle this package is designed to decrease network traffic by allowing distributed storage of data.

The Professional and Network station Oracle will be available by June and the LANserver by the fourth quarter.

For more information, call Steve Clark at Oracle on (02) 959 5080

Ashton-Tate moves quickly with SQL

Ashton-Tate, stung by IBM's April 2 announcement that it would enter the database arena, has quickly moved to remain competitive in the market it has largly dominated for the past five years.

Last month, the database leader hired Dr Henry Wong, an expert in Structured Query Language (SQL), the database programming language developed by IBM.

Dr Wong will join the company as senior scientist, working to incorporate SQL into a future version of dBase, Ashton-Tate's cornerstone product. Dr Wong is an associate professor of computer science at the University of California and co-operated in the first development efforts at IBM of SQL.

Ashton-Tate last week also purchased SQL programming tools from Wordtech, an independent database programming developer. Dr Wong has also reportedly been associated with Wordtech.

Financial analysts agreed that Ashton-Tate needed to make a swift statement of direction and of SQL compatibility in the wake of the announcement that IBM would incorporate an SQL database system in its future proprietary operating system known as OS/2 Extended Edition.

William Shattuck, a software analyst at the US investment banking firm Montgomery Securities, said both the technology acquisition from Wordtech and the hiring of Dr. Wong were not a snap reaction to the IBM announcement.

"Ashton-Tate has long said that they would conform to the SQL standard," he said.

WP for the Mac, Atari, Amiga

WordPerfect expects to begin beta testing WordPerfect for the Apple Mac in April, and will begin shipping it in June, according to market researcher Dataquest.

The Macintosh word-processing software will be 100 per cent file-compatible with WordPerfect 4.2 on all of the machines it supports including IBM PCs and compatibles, Data General minicomputers and Digital Equipment's VAX minicomputers, said Roger Bell, manager of Apple marketing at WordPerfect.

Users of the Macintosh version can simply send their files via modem to an IBM PC, where they can be accessed by the DOS version of WordPerfect.

The new Mac version supports macros, pop-up menus, submenus and on-screen columns.

At the West Coast Computer Fair held in San Francisco, March 26 to 29, the company demonstrated versions of its best selling word processor for the Macintosh, Atari ST and Commodore Amiga. WordPerfect expects to ship the Atari and Commodore versions in June.

Comms guide

Business people who fear they're being left behind in the computer stakes are offered assistance in a newly-published booklet from Touche Ross titled *The Executive's Guide to Business Computer Communications.*

Copies are available free from Touche Ross offices in capital cities.

Ring-a-ring-a . . .

There is currently a rash of suits alleging copyright infringement in the US. It all centres around a recent precedent upholding the copyright of a software author not only to a program's source code but to the 'look and feel' of the software.

Lotus has taken action against Paperback Software and Mosaic Software for their 1-2-3 clones and is rumoured to be about to take action against Ontio Software for a similar 'offence'. The interesting thing is that the founders of Ontio are Julian and Richard Lang and Tracy Licklider who just happen to collectively make up the majority of shareholders at a firm called SAPC.

SAPC is a descendant of Software Arts (producer of the VisiCalc spreadsheet program for the Apple II). SAPC is also taking legal action on the 'look and feel' issue — against Lotus! The firm argues that Lotus 1-2-3 infringes VisiCalc's copyright by copying ". . . the total concept look and feel of VisiCalc."

Lotus has responded to the charges, saying the principals behind it were acting with ulterior motives — to foil its attempt to eradicate Lotus 1-2-3 clones, specifically the clone from Ontio which is said to have an anticipated price tag of $45.

Also on the 'look and feel' issue: producers of the popular Xtalk communications program won an injunction against SoftKlone, producers of the Xtalk work-and look-alike program, Mirror.

SoftKlone replied quickly with an altered version which resembled Xtalk less closely.

Edwin Huang, manager of the IBM software division of Imagineering (Mirror's Australian distributor) said that existing stock had been returned to SoftKlone and that the new version of Mirror was "one to two months away".

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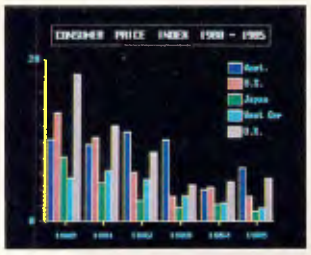

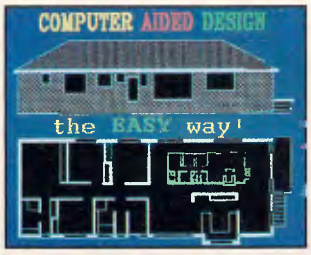

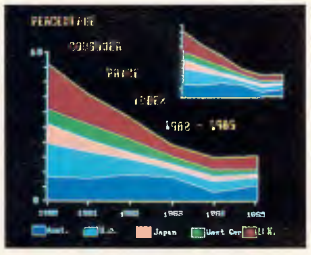

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OS/2: step 1 in IBM universal link

Looking at Operating System/2 (OS/2) as the next operating system for PCs doesn't tell the whole story, according to IBM officials.

OS/2 represents the first manifestation of the firm's goal to make all of its diverse computers talk to one another. Systems Applications Architecture (SAA) is the name of the plan to get IBM and its customers to that goal.

It may sound like the ultimate in corporate computing, but this functionality will not be here tomorrow; nor will it be here next month. The first version of this master plan is slated for shipment later in the year, and IBM officials and others familiar with SAA's development have said it may be years before users see full scale implementation. Nonetheless, IBM asserts that SAA is its software blueprint for years to come.

SAA is "a software-based approach to presenting all members of the various product families to the user in a consistent fashion," explained Lee Reiswig, systems manager for the communications and data-management division of IBM's Entry Systems Division in the US.

OS/2 makes good on IBM's promise to break the 640k memory barrier and provide users with the ability to run multiple programs at the same time.

The Standard Version of OS/2 includes a Presentation Manager that will provide users with a consistent graphics interface. IBM aims to have this interface duplicated on PCs and all other IBM systems; this aspect of SAA is called Common User Access.

SAA also includes a Common Programming Interface and a Common Communications Interface, which allow developers to write applications that can be ported to other IBM machines in a different family.

These two features of SAA will only be completely supported in the extended version of IBM's Operating System/2. The two modules built into the extended version to support SAA are the Database Manager and the Communications Manager.

The Database Manager is a complete relational database management system based on IBM's mainframe Database 2 (DB2) and Structured Query Language/Data System (SQL/DS) database management systems. It will include both a standard SQL command-driven user interface and a menu-driven prompted interface for inexperienced SQL users.

The Communications Manager portion of OS/2 extended version will provide PCs with communications to virtually every connectivity option supported by IBM, including the Token-Ring and PC Networks, Synchronous Data Link Control (SDLC), asynchronous communication and X25 networks.

Both the Communications Manager and the Database Manager are being developed internally by IBM and will not be offered by Microsoft in its MS-OS/2 version of the operating system. This does not preclude other compatible makers from including equivalent functions in their products, according to Dan Barovich, manager of operating systems and languages at IBM's Entry Systems Division.

"We have laid out our directions because that is what our customers have asked for, and to that extent we have also published our interfaces to the rest of the industry," he said.

IBM's new operating systems

IBM PC-DOS 3.3
An interim solution until Operating System/2 is available. DOS 3.3 provides a single-tasking operating environment for the Personal System/2 and existing IBM PCs.
Price: $274
Availability: Immediate

IBM Operating System/2 (three versions)

Standard Edition Version 1.0
A platform for future application growth. Version 1.0 supports 16Mbytes of memory and multitasking.
Price: $706
Availability: First quarter of 1988

Standard Edition Version 1.1
Includes all of the functions of version 1.0, plus a graphics-based presentation manager and windowing capabilities.
Price: $706
Availability: To be announced in the fourth quarter

Extended Edition
Combines the enhanced functions of Standard Edition version 1.1 with IBM communications support and database management.
Price: $1711
Availability: To be announced in December

IBM products spawn a host of new terms

IBM has often seemed inscrutable, even to those who follow the firm's movements closely. Last month's new product announcements, however, underscored one of the central sources of the difficulty in understanding the computer giant: Big Blue speaks a different language from the rest of the microcomputer world. So here are 11 new and old IBM-minted words or phrases, followed by their English-language equivalents, which *APC* decided are sufficiently important for understanding the new products, or unusual enough to warrant attention.

Personal System: PC
Micro Channel (TM): 16- or 32- bits bus available on PS/2 models 50, 60 and 80. More powerful and faster than PC line bus
Planar board: Motherboard
Hard File: Hard-disk drive. This has nothing to do with program or data files,as far as is known. (An IBM official approached last week didn't know what this meant.)
Intergrated swivel base: A monitor stand
Pel: Dot on a screen (a.k.a. pixel, or picture element)
VGA (Video Graphics Array): A graphics processor heir to CGA and EGA, it provides resolution up to 640 by 480 pixels (a.k.a. pels) with 16 colours, or 320 by 200 lines
SAA (Systems Applications Architecture): IBM's proposed intersystem software architecture, intended to let developers write software that will run on all families of IBM computers
Executive Quality Print: Letter-quality print
Pointing device: Mouse
OS/2: Heir to DOS. There was not an

Fatal complications

MultiMate Advantage 3.6, a word processor from Ashton-Tate, can be a lethal weapon when it comes to IBM DisplayWrite 4.0 files, according to several corporate users.

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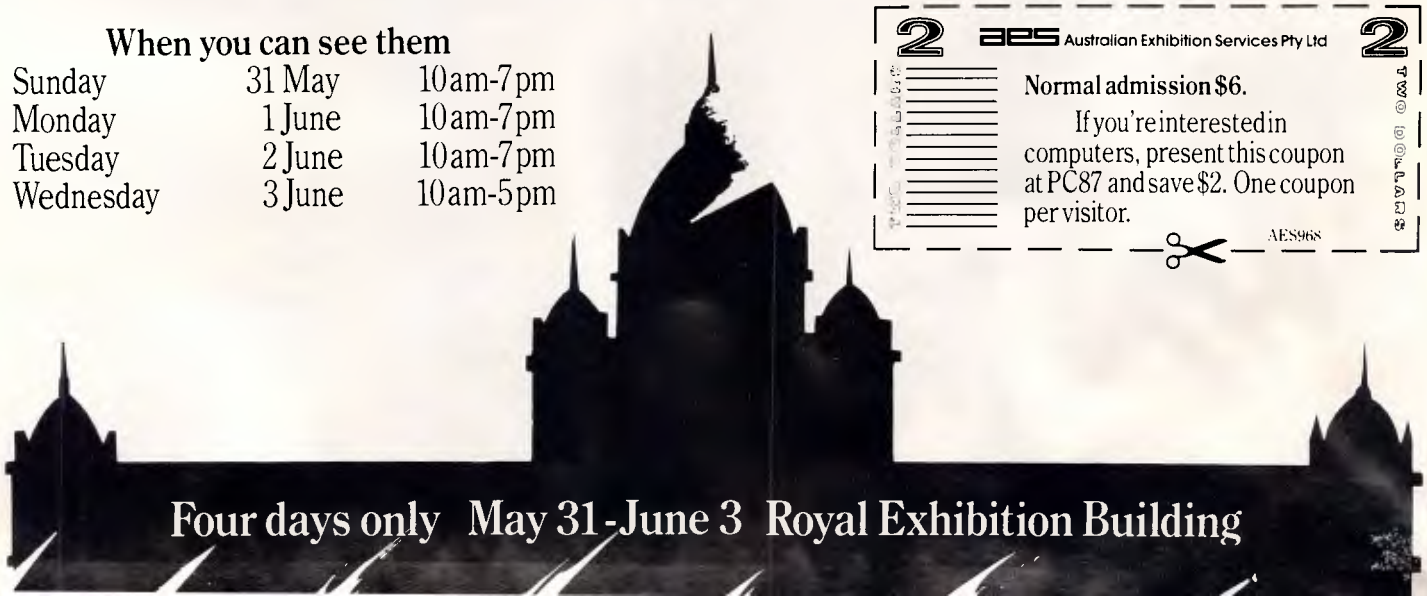

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Because the two programs share the same default extension — .doc — users who accidently pull up DisplayWrite files in MultiMate will either kill their DisplayWrite file or hang up their system.

Ashton-Tate has confirmed the problem and is working on it. However, no correction is scheduled in the soon-to-be-released version of MultiMate.

"It means that we have to write some type of indicator within the file structure, so that when MultiMate goes to pull up anything but a MultiMate document, it will produce an error message," said a company spokesperson.

Ashton-Tate officials said MultiMate will load any file with a .doc extension. However, the problem occurs only when DisplayWrite 4.0 files are involved. DisplayWrite 4.0, which began shipping this spring, adopted the .doc extension, whereas version 3.0's default extension was .txt.

According to an MIS manager at a large oil company, when a user brings up a DisplayWrite file under MultiMate, the document summary screen becomes mangled. If the user then tries to proceed by pressing the F10 key, the machine locks. If the user hits the ESC key, MultiMate erases the DisplayWrite file.

Conversely, DisplayWrite 4.0 will not allow users to open MultiMate files, even if they have a .doc extension.

Trapeze adds link to 1-2-3

Data Tailor is adding the ability to read DOS .WKS files to Trapeze, the firm's free-form spreadsheet program for the Macintosh.

Support of the DOS. WKS file format will provide Trapeze users with the ability to import files from Lotus 1-2-3 and spreadsheets created using Microsoft's Excel, said Andrew Wulf, Data Tailor's president.

With large numbers of Macintoshes connected to PCs via local area networks, the ability to import data files created using spreadsheet programs that generate .WKS data files is increasingly important, Mr. Wulf said. "Many of our users, particularly those among corporations, have told us that this is a 'must have' option."

The ability to support DOS .WKS files will be provided in release 1.1 of Trapeze, scheduled to be shipped in May.

Other additions to Trapeze include new charting functions and support of colour within the spreadsheet when the program is used on Apple's Macintosh II.

With the expected commercial availability of DOS coprocessor cards for the Apple Macintosh SE and Macintosh II PCs, more Macintosh developers are expected to provide users with the ability to import DOS files into their Macintosh applications, said Paul Cubbage, a software analyst with DataQuest.

But Macintosh developers, particularly those who market spreadsheets, could be skating on thin ice when it comes to importing .WKS files as well as formulae, Mr. Cubbage said.

"It's one thing to read in .WKS data files, and another to read in formulae as well as data and then manipulate data using Lotus commands. Lotus could argue [in subsequent 'look and feel' suits] that the use of symbols like @ is a method of artistic expression," the analyst speculated.

For more information call Imagineering on (02) 697 8666.

Multitasking releases

PC and Personal Systems users won't have to wait for the new OS/2 operating system to do multitasking. IBM last week introduced a software program and a new version of its XMA expanded memory board that give all IBM PC users these capabilities.

The software, called the 3270 Workstation Program, extends IBM DOS 3.3 functions to provide the same capabilities for the Personal System/2 computers as a 3270 PC would: support for up to four host sessions, and for up to six DOS applications and two notepad sessions, all of which func-

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tion simultaneously. The OS/2 operating system will have multitasking capabilities as well.

The XMA card, a superset of the Lotus/Intel/Microsoft Extended-Memory Specification, lets the user break the 640k DOS barrier and access up to 3Mbytes of system memory. Previously, the XMA board only worked in the 3270.

One version of the card, available in the fourth quarter of this year, will work with the Personal System/2 Model 30, and the existing AT, XT, XT-286 and 3270 PC family. A second version, the $2251 80286 Expanded Memory Adaptor, is designed for the new Personal System/2 Models 50 and 60 80286-based PCs. Sources expect it to be available by the first quarter of next year.

Users will be able to select from two versions of IBM's 3270 Workstation Program which was previously known as the Control Program for the 3270 PC. Version 1.0 supports selected models of the IBM PC XT, PC/AT, 3270 PC, 3270 PC/AT, and most models of the Personal System computers. It should be available around June for Models 30, 50 and 60-041, 60-071, 80-041 and 80-071 with a retail price of $1077.

Version 1.1 adds two enhancements to version 1.0. It supports the most powerful Personal System, Model 80-111, and provides the functions of the XMA card without requiring the card. It can be used with a Token-Ring Network gateway to provide full 3270 emulation without the need for a 3278/79 adaptor card and will be available in the first quarter of 1988, again for $1077.

MS-OS/2 tied to OS/2

Last month Microsoft announced a series of software products that closely parallel the new operating systems introduced by IBM for its next-generation PCs.

Concurrent with IBM's unveiling of its Operating System/2, DOS 3.3 and the Presentation Manager graphics interface, Microsoft announced MS-OS/2, MS-DOS 3.3 and the Windows Presentation Manager for delivery to its non IBM customers.

IBM's Operating System/2 and its Presentation Manager graphical user interface are the first products to be released under a joint development agreement announced by IBM and Microsoft in August 1985.

The new products mean that clone builders will be able to purchase from Microsoft the basic software that will allow them to produce operating systems equivalent in function to IBM's DOS 3.3 and to the standard version of IBM's Operating System/2.

However, the extended version of IBM's Operating System/2 may prove to be significantly tougher to duplicate, because it will include IBM developed communications facilities and an IBM relational database which will be compatible with its mainframe-based DB II and SQL/DS products. Therefore, the challenge for clone makers will be to build into MS-OS/2 equivalents to these IBM extensions to enable them to run software written for IBM's OS/2 extended version on their machines.

In addition, Microsoft announced several related products, including version 2.0 of Windows, which conforms with the user-interface specifications of the IBM Presentation Manager.

MS-DOS 3.3 adaptation kits will be available immediately for Microsoft's OEM customers, and Windows 2.0 is scheduled to be available by October.

Also announced were the MS-OS/2 LAN Manager — local area networking software designed to work with MS-OS/2 — and a developers' tool kit for MS-OS/2 that will provide code necessary for software houses to start developing applications for MS-OS/2.

The MS-OS/2 tool kit, which is expected to sell for about $6500, is scheduled for shipment on August 1, although this "may slip into early September" according to Linda Graham, MD of Microsoft Australia. It will include MS-OS/2, a C language compiler, an as-

sembler and other development tools. Purchasers of the tool kit will receive complete specifications and documentation of all modules of MS-OS/2, but will not receive either the Presentation Manager or LAN Manager software until later in the year. The high price tag includes telephone suport to the US. Prospective purchasers are being invited to a seminar in late May where one of the original authors of MS-DOS will be speaking.

The first version of MS-OS/2 is scheduled for a phased release to selected OEM customers in the fourth quarter of this year, but it is not expected to reach end users' hands until early 1988.

Because of the late shipment of the Windows Presentation Manager, the first versions of MS-OS/2 will have a character-based interface as an interim solution, rather than a graphical user interface. MS-OS/2 with the Windows Presentation Manager included is not expected to debut until the second half of 1988.

Windows-based PC applications due

The first of several new Windows-based PC software applications, originally written for the Apple Macintosh, are about to find their way to corporate PC desktops.

At first, there will be only a trickle of new products, but analysts expect the volume of new releases to grow rapidly.

The product announcements should reach flood proportions around October, according to Kathy Lane, a software analyst with the market research firm Dataquest.

The expected releases include a Windows version of Omnis Three, said to be called Omnis Three Plus by sources close to the database manager's developer, Blyth Software; and a new version of More, an enhanced idea processor from Living Videotext .

Also expected are Windows versions of PowerPoint, a desktop presentation product, and Filemaker Plus, a powerful file manager that incorporates a graphics oriented report generator, both from Forethought; and by October, Windows Excel, a spreadsheet product from Microsoft is due.

Omnis Three Plus for Windows will incorporate a number of features not presently found in Blyth's Macintosh product, said a source close to Blyth Software. Included in these features will be a more powerful programming language and the abilities to import data from other popular PC applications and link large relational database files.

A key element in the new version of Omnis will be support of Microsoft's Windows Dynamic Data Exchange feature — an element of Windows that lets users link information in one file, such as a spreadsheet, to information in another file, such as a database.

Omnis Three Plus could be released as early as July and is expected to run under the same Windows release — said to be called Windows 2.0 — as Microsoft's personal computer Excel spreadsheet, sources said. Features of the Windows version of Omnis will be added to a new release of the Macintosh version of the package, which is expected to begin shipping by October, sources said.

A spokesman for Blyth Software declined to comment on the report, but confirmed that the company was developing a version of its Macintosh product for Windows.

The PC version of Excel is expected to incorporate all of the features of the Macintosh version — charting as well as financial modelling — and will also be supplied with an optional driver for Lotus's Signal data link, said sources close to Microsoft.

Windows Excel could represent a major threat to Lotus, Dataquest's Ms Lane said.

According to Dataquest research, Excel for the Macintosh has the same market penetration rate in the US as Lotus 1-2-3 does on IBM personal computers or compatibiles — about 20 per cent.

Forethought's Windows versions of Power Point and Filemaker Plus are expected to be released after Microsoft Excel.

Windows versions of both products are expected to incorporate all of the features of the Macintosh products.

More, from Living Videotext, is expected to be released under Windows much later than other Macintosh products — perhaps as late as October, said industry sources.

A spokesman for Living Videotext declined to comment on delivery dates or specifics of his company's products, but confirmed his company was developing More for Windows.

This little box contains an 80286 running at 10Mhz with zero wait-states. Which means it's pretty fast.Called the Pro-AT, the machine is from Skai and is sold by Porchester Computers, tel: (03) 537 2722.

PostScript clones

Following close on the heels of IBM's endorsement of the Adobe's PostScript page description language — which is used by a large number of desktop publishing packages — third party software developers are trying to tap into Adobe's success by making PostScript-compatible languages.

At least three different software developers have publicly and privately announced the development of lower cost PostScript-like page-description languages which the developers claim will be fully compatible with software applications that use PostScript. The products include a yet-to-be-announced printer controller board from Phoenix Technologies that will include Phoenix's own implementation of PostScript; a recently announced product, called NewScript, from Barry & Associates in California; and CCS-page, from Control-C Software.

PostScript is a powerful page-description language that acts as a translator between a laser printer and desktop-publishing, graphics and other PC applications software programs. The PostScript language is installed on a printer controller board, giving the printer the ability to produce documents.

"In order to have an industry standard page-description language, we had to publish PostScript's

specifications," said Dr. Charles Greshke, the executive vice president of Adobe. "The critical question is whether other versions will support the 300 applications that PostScript supports. I have yet to see any output from other developers."

The portion of PostScript that is not in the public domain is an algorithm, called an interpreter, which makes "a large font look good when it is small," Mr. Greshke explained. Third parties must work to create their own PostScript interpreters.

Phoenix Technologies will be one of the first developers to show a product when it demonstrates at Comdex/Spring a printer running its PostScript implementation, according to Rob Strieby, Phoenix's director of product marketing for the West Coast.

"Phoenix is in the process of developing compatible page- description language interpreters for page printer controller boards based on the Texas Instruments 34010 [graphics processor] and the Motorola 68000 series of [microprocessors]," Mr Strieby said. "Our first interpreter, our version of PostScript, will include support for Windows and Lotus 1-2-3."

Eventually, Phoenix will include its version of PostScript, plus its own version of two other languages — DDL from Imagen *(for a description of this and other page description languages, refer to page 111, April APC — Ed)* and Interpress from Xerox — on one printer controller board that can be installed in either a PC or a printer," he said.

There are, however, potential inconsistencies between printers using Adobe's PostScript and printers with other implementations, according to Charles Bigelow, a professor of digital typography at Stanford University.

"If you send a PostScript file to a compatible device, the width between the characters can be different. The lines in the page may not justify or fit into the same space, resulting in a PageMaker file that looks different."

Clone makers pick up IBM gauntlet

With the ink barely dry on IBM's announcement of a new generation of PCs, some compatibles' makers last week predicted they can clone the machines within a year.

Other manufacturers, including Compaq Computer, Zenith Data Systems and Tandy, expressed a wait-and-see attitude about when they will debut machines compatible with IBM's Personal System/2 (PS/2) line.

"We don't feel a need to respond quickly," said Ed Juge, director of market planning at Tandy. "We feel very comfortable with our long-term product strategy as it stands.

Some clone makers will take a different tack: "We will create a machine that contains a backplane that accepts the same adaptor cards that fit into IBM's Micro channel [bus]," said Michael Dell, president of PCs Limited. "It might take nine months."

Others expect full blown systems — clones of each model in IBM's PS/2 range — to begin to appear within a matter of months. Joe Lazar, Managing Director of Eastern Micro Electronics, expects to have Australian delivery of Model 30 and 50 clones under the Profound label by August. "They're virtually ready to go now — the Micro Channel emulation still has a few glitches, but that should be overcome within a month or two" he said. This implies that BIOS and graphics emulation has already been sorted out by Profound, putting the company well in front of competitors.

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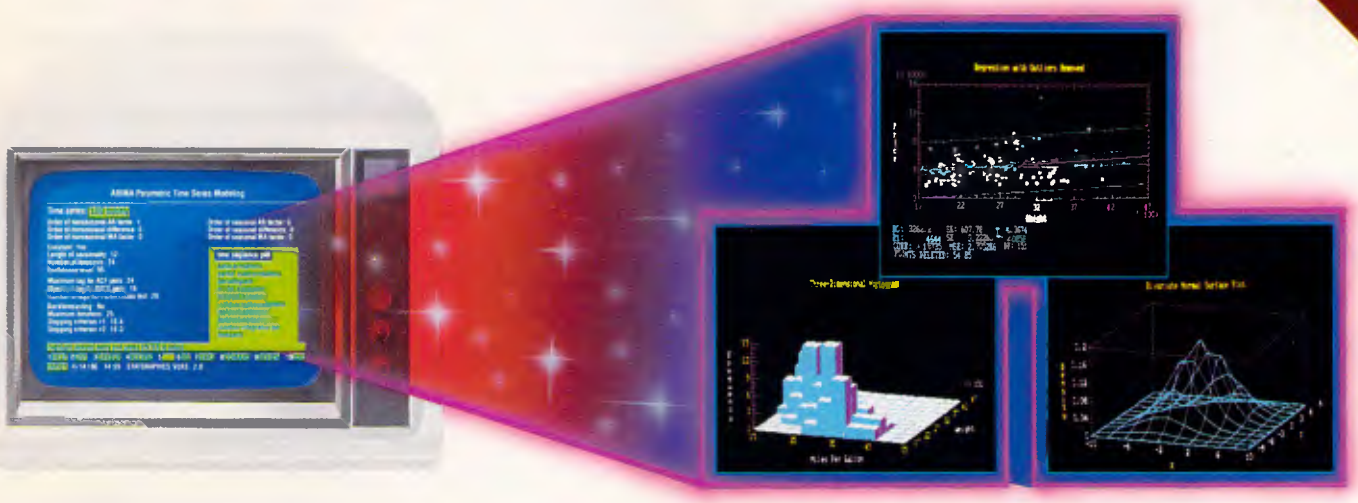

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Data compiled as of April 1986

But most compatible makers feel it's too early to pinpoint exactly when buyers will be able to purchase PS/2 work-alikes. The companies said they are just beginning to dissect the PS/2s, read IBM documents about the computers and survey customers for their opinions of the PS/2 line.

Despite its public attitude to the new IBM range, sources reported last month that Compaq, a well financed firm with a large research and development staff, is developing a bus that performs like IBM's Micro Channel, as well as a graphics chip that matches IBM's new Video Graphics Adaptor.

Other companies, dependent on third-party components, designs and expertise, said they aren't sure when custom chip houses and hardware designers will be able to supply the goods to build PS/2 compatibles. Officials from suppliers such as Phoenix Technologies and Chips & Technologies said they could respond in six months.

Rich Levandov, Pheonix's vice president of marketing, said the company will have a PS/2-compatible BIOS (basic input/output system) and design compatible with IBM's new bus, the Micro Channel, within six months.

Chips & Technologies will have chip sets available in six months to a year, said Raj Jaswa, senior product manager for system logic components. He noted, however, that the company hasn't determined which kind of chip sets it will deliver.

Officials at Paradise Systems, a US, manufacturer of graphics chips, said the firm can deliver a single chip graphics controller that is compatible with the VGA in the PS/2 Model 50, 60 and 80 by June.

Component suppliers and compatible makers agreed that their toughest job is to come up with custom chips that function like the ones IBM is using in the new '286 and '386 machines.

To break down and then duplicate the functionality of IBM's custom chips could require three or four times the effort and money that it currently takes to duplicate components in an IBM AT, said engineers who have studied the Micro Channel.

In addition, those duplicating IBM's new systems aren't sure to what extent IBM is legally guarding its hardware designs. IBM is reportedly seeking more than 100 patents and copyrights on the PS/2s, which is more protection than IBM has sought for its other PCs.

Even if they can duplicate IBM's new computers, some compatible makers said they don't need to rush products to market because the PS/2s won't become well established for a year.

Novell, 3Com go for IBM PS/2

Novell and 3Com have announced local area network products that promise to integrate IBM's new Personal Systems into existing PC networks.

With Novell's new NetWare Workstation Software, users can connect the IBM PS/2 Models 30, 50 and 60 to existing PC networks running Novell's Advanced NetWare operating system, according to the company.

3Coms's new products will permit the same level of integration between the old and the new, according to 3Com President Bill Krause. The products include a new network operating system called 3+ version 1.2, which will work with DOS 3.3 and IBM's new Token-Ring Adaptor. Available in the third quarter of this year, it will be offered on both 5 1/4- and 3.5 inch disks.

By September, 3Com will be shipping its own adaptor board for the Personal Systems, Mr Krause said.

Novell's products are being

shipped now and allow the new 8086 and 80286 based PS/2s running PC-DOS 3.3 to function as workstations on the network, sharing programs, data and peripherals with other network PCs. Novell plans to offer a similar program for the 80386-based Model 80 when the machine is shipped later this year, he said.

The software works with all current NetWare products, including Advanced NetWare 286 for 80286-based servers; Advanced NetWare 86, for 8088- and 8086-based servers; and System Fault Tolerant (SFT) NetWare Levels I and II, for uninterrupted network operation.

NetWare users and network designers welcomed Novell's support of the new IBM machines. "Integrating the PS/2s into existing networks provides an easy migration path from the old PC technology to the new", they said.

Taiwanese government will aid chip-design

The next clone you buy might not only be built in Taiwan; it might be designed there as well. and in an added twist, some of the chips are being designed by a government subsidised group.

The Taiwan government is providing at least some funding for the Electronics Research and Service Organisation (ERSO), said Chris Mead, editor of the Southeast Asia High Tech Review. He contended that 30 per cent of the XT clones coming into the United States from Taiwan in 1985 were based on ERSO designed chips.

ERSO is working on everything from operating systems to electro-optics, said Mr Mead, and its parent organisation is even trying to build a robot that could find defects in computer keyboards. Mr Mead said all these government subsidies could raise the hackles of US chip makers. "I think Taiwan is next in line after Japan for trouble from the United States because its trade surplus is so high," he said.

3-D AutoCAD on the way

Autodesk, leader of the PC computer aided design (CAD) pack, is taking steps to keep things that way.

It has just released a three dimensional version of its flagship program AutoCAD. It was accompanied by an AutoCAD utility for architects, mechanical engineers and contractors who do duct work, plumbing, heating, ventilation and air-conditioning design.

In other attempts to expand on its share of the CAD market, the company is scheduled to release a shading package for architects in June.

Autodesk also plans to release a solids-modelling program called The Engineer Works, company officials said.

The Australian distributor of AutoCAD expects version 2.6 — the 3-D product — to be available in May. Its price is not yet known, however upgrades for existing are expected to be for a moderate fee (perhaps as low as $200)

Eric Lyons, director of technology at Autodesk, said the new AutoCAD "fits the needs of architects and design analysts who have three-dimensional design problems."

In addition to its three-dimensional capabilities, AutoCAD 2.6 has associative dimensioning features that automatically change the dimensions of a design or drawing on the monitor, said Mr Lyons. Another new feature of the software is the ability to interrupt a command and to pan or zoom into a drawing.

Other new AutoCAD features include the ability to change a design's measurement scales and dimension properties.

This release will be followed in June by the unveiling of AutoShade, a drawing enhancement to AutoCAD for architects and designers, priced at $US500. AutoShade is designed to be used with AutoCAD 2.6 to give designs perspective and depth by shading, smoothing and texturing AutoCAD-generated renderings.

"AutoShade gives you the ability to put yourself inside the screen, to view a room as though you were sitting in it," said Mr. Lyons.

"We see it used in architectural rendering and for imaging designs," he added.

Mr Lyons said the three-dimensional AutoCAD would be used to take a series of 'pictures' from different views of a design or architectural rendering, and AutoShade would be used to give the three-dimensional picture or design substance through shading.

Late this year, Autodesk is scheduled to release Engineer Works, which gives users three-dimensional capabilities along with shading and weight and solid representations (mass properties).

"It uses true analytical solid modelling with constructive solid geometry (CSG)," said Mr Lyons.

WordPerfect common interface

WordPerfect Corp.'s namesake word processor, WordPerfect, may dominate its category in the PC software market, but the firm's MathPlan spreadsheet and SSI Data database programs have had only modest success against the established leaders in those product categories.

In an effort to gain ground on Lotus's 1-2-3 and Ashton-Tate's dBASE III Plus in the spreadsheet and database markets, respectively, WordPerfect is developing an integrated-software environment in which all of its applications will share a similar user interface, and WordPerfect software and third- party programs alike can run simultaneously and transfer data among themselves.

According to a company spokesman, the critical ability to switch easily between a number of applications is provided by a special utility product, the WordPerfect Library.

Norton's two products

Programmer and author Peter Norton is restaking his claim as the wizard of disk management with not one but two new versions of the Norton Utilities.

Norton built a well-deserved reputation with his original Norton Utilities, which took advantage of the method DOS uses to erase files and provided personal computer users with an easy and effective way to restore files that had been zapped accidentally. Although the first Norton Utilities included several other helpful programs that improved on the shortcomings of DOS, thousands bought the Norton software only for the unerase feature.

The Norton Utilities 4.0 includes several new features, including a menu from which users can run all the other programs that make up 4.0. It has an easier, faster way to change directories, the ability to tag each file with a description up to 65 characters long — compared to DOS's file-naming limit of 11 characters — and a function that allows batch files to receive input from the keyboard and branch to different instructions within the file.

Most of the old features have been made more versatile. Several formatting

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capabilities, including headers and page numbering, have been added to Norton's printing program. Directory Sort, which previously sorted directories by name, extension, size or date, now allows users to move files around the directory in any order. System Information now gives more information about hardware than simply how fast it's running. Time Mark can run up to four separate stop watches at the same time.

Also announced is the Norton Utilities Advanced Edition. it includes two programs that are helpful for anyone who uses a hard disk — Speed Disk and Format Recover. The first increases the effective speed of a hard drive, and the second tries to restore a hard disk that has been accidentally reformatted.

The other features of the Advanced Edition make it the ultimate tool for computer users who are forced to tinker with the intricacies of how DOS keeps track of the data on a disk — and have the technical expertise to do so without booby-trapping themselves.

The standard Version 4 will retail for $185 and the advanced version for $303. Call PC Extras for more information.

IBM desktop-publishing system

Nine months after setting out to do so, IBM last month debuted its first desktop-publishing system in the US. And, judging by the speed with which the company got its PS/2 range to our shores, it will not be long before its DTP arrives.

The inaugural system includes a PC laser printer, a new Personal System/2 Model 30 8086-based computer and PageMaker software from Aldus Corp. It's called SolutionPac Personal Publishing System.

This is a four megabit chip which IBM claims it is able to fabricate on production lines currently used to produce one million bit chips. It has fast access (65 nanoseconds) and can store the equivalent of 400 pages of double-spaced typewritten text.

IBM also announced a publishing upgrade option for existing PC/AT and XT users and a VM mainframe edition of its new Publishing SolutionPac. The products come from IBM's Publishing Systems Business Unit.

The heart of the IBM publishing system is a 6-page-per-minute laser printer that produces copy at 300 dots per inch and supports Adobe Systems' PostScript page-description language. Unlike other laser printers set up to use PostScript, the printer's adaptor board — which includes the controller and the PostScript software — resides in the host computer, not in the printer.

This design eliminates the 'software bottleneck' that other PostScript printers experience, according to Merry Quackenbush, IBM's director for Publishing Systems. If the adaptor board resides in the printer, the PC and the printer must translate the print information back and forth, slowing the print process. Putting the adaptor in the host computer eliminates the bottleneck, she explained.

IBM is the first printer manufacturer to use this design in a PostScript laser printer.

Existing IBM PC/AT and XT users will be able to upgrade with the IBM SolutionPac Personal Publishing Option. It includes the IBM Page-Printer and adaptor board, adaptor software, PageMaker and Windows. In order to upgrade, however, the PC XT or AT must have 640k of memory, a monitor with EGA, a Windows-compatible mouse and DOS 3.3.

Create vector images

Microtek Lablast week announced raster- to-vector-image conversion software that is designed for graphics applications, including computer-aided design packages. Arnold Roth, MD of Software Corporation of Australia, expects the product to sell for around $1650 when it becomes available in June.

Raster-to-vector conversion software converts paper drawings to electronic images. The electronic image is in a vector format that is used by popular CAD, graphics and desktop-publishing programs, such as Autodesk's AutoCAD, Digital Research's Gem Draw and Xerox's Ventura Publisher.

Traditionally, CAD operators spent hours manually retracing paper drawings into their CAD systems using a digitising pad, or worse, redrawing them from scratch on the screen. An alternative was to buy a raster-to-vector product, which previously cost as much as $300,000 and ran on minicomputers, according to Microtek.

Word scanning

Word searching is starting to become an obsession with today's hard disk users, and products are appearing from all quarters — with Lotus under focus this month.

Proximity specialises in linguistic software and hardware — and at Hanover Fair, announced a package called Friendly Finder. It's designed to do the things that dBase III can't do with dBase files — that is, find information in it when you aren't sure what the information actually is.

To make the product really sing, you need a Proximity board, which analyses text off disk files at a fearsome rate. But it works without it, and although friendly isn't quite the word, it is amazing.

The demo I saw allowed you to set up an enquiry into a large database which didn't include Tip O'Neill, Speaker of the American Congress, but did include T ONeil, Jr. It found a request for Tip, however — it excels at fuzzy-matching problems like that.

Lotus has obviously spotted a similar problem for people using large hard disks, because it is taking over a software company, Computer Access Corporation, which specialises in text search.

Bluefish is the product Lotus is buying. It can find any phrase within seconds from six years' worth of a well-known computer magazine on 18 Mbytes of CD-ROM.

Watch this trend — there's a long way to go, and many people to get into the market, yet.

Guy Kewney

END

IBM Personal System /2

The next generation of micros from IBM brings good news for existing and new PC users. Better graphics and a new operating system will raise the power of PC compatibility and herald new standards for add-ons. Nick Walker, Owen Linderholm and David Tebbutt took the machines for a test drive.

Six years ago IBM launched a 64k Personal Computer and, like most other computers of the time, it was designed to be programmed in Basic and used an ordinary cassette tape recorder for program storage. It stood out from the crowd thanks to its IBM logo and a 16-bit processor.

Despite the relatively primitive nature of this machine, it soon became the most significant standard in the history of microcomputing. Since then, the IBM PC has acquired more RAM, disk drives, faster processors, smaller boxes and enhanced graphics. The result is that when users want to exploit the full power of the system, it almost bursts at the seams.

Now IBM has broken free of its self-inflicted stranglehold while still maintaining compatibility with the previous standard and continuing with its open-architecture policy. Having said this, it's not going to be easy for clone makers to catch up, whereas the add-in board makers and software developers should get all the help they need.

While upping the specification of its machines, IBM has managed to hold the price down. Furthermore, the cost of an old XT has just fallen by about 30 per cent or so. The new range of machines starts with the Model 30 at $3500, rising to over $22,000 for a top-of-the-range system.

Hardware

The new range is collectively known as the Personal System/2, and consists of four machines: the Models 30, 50, 60 and 80. All four machines are important, but the Model 50 is possibly the most significant since it represents the cheapest machine which conforms to the new standard. (The Model 30 is an 8086-based machine which is far more attractive that the previous PC. It has the functions of six add-in cards on the motherboard, but can still take a further three horizontally-mounted standard cards).

The external appearance of Models 30 and 50 is a radical departure for IBM. The systems are still grey/beige but are not big and ugly like the earlier IBM desk-top machines. The Models 60 and 80 are also attractive looking, even though they're solidly built, floor-standing tower systems based on the 80286 and 80386 respectively. This review will concentrate primarily on the Model 50 since it marks the point of departure from the old standards.

External connectors are mounted on the edge of the motherboard and peep out along the back of the machine. Reading from left to right, they comprise a keyboard (mini-DIN), a mouse (ditto), a bi-directional Centronics parallel, a 25-pin RS232C and a 15-pin DIN display output. Like the Model 30, these additions to the motherboard replace the add-in cards required previously. The sixth function mounted on the motherboard is the battery-backed clock/calendar. Like its predecessor, the PC/AT, the Model 50 comes with a security lock. It also provides a facility in battery-backed RAM to prevent unauthorised access. Power is drawn by a 94-watt auto-selecting 110/240-volt supply, operated by a rather stiff red switch recessed into the front of the system unit.

The Model 50 is considerably smaller

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Reinforcing the AT/E as the standard PC keyboard, the 102-key unit includes a separate cursor and numeric pad — and twelve function keys seem to be the new gospel. The stylish mouse is a standard item

The new machines lack the bulk of previous PCs and the 3.5in disk drive may now be here to stay. The mains switch — a clumsy affair — has migrated to the front while the keyboard lock is now on the back

than all previous IBM desktop machines in all three dimensions. The system unit weighs in at 10.5 kilos and measures 14cms high, 36cms wide and 42cms deep. While this poses obvious questions about expansion cards, it at least sits comfortably on a standard desk. One traditional IBM feature which you might miss on the new model is noise. Even though the machine contains an internal 20Mbyte hard disk and a fan, it is practically silent in operation, even when formatting disks.

The CPU in the System 50 is an 80286 running at 10MHz. However, with this machine, IBM has introduced its Micro Channel, a fast, internal bus system which enables the true throughput to be increased. It is actually a 32-bit bus cut down to 16-bit for use on the Models 50 and 60. In addition to the normal processor interrupt lines inherited from the original PC, the Micro Channel provides a bus access priority scheme known as multi-master arbitration. Each device attached to the bus, including processor, DMA and certain expansion cards, has a manufacturer-defined arbitration level. Whenever a device wants the bus, it calls upon some logic circuitry called central arbitration. If there is a conflict, all competing devices bid for attention by putting their arbitration levels onto the bus. Central arbitration then assigns the bus to the highest bidder.

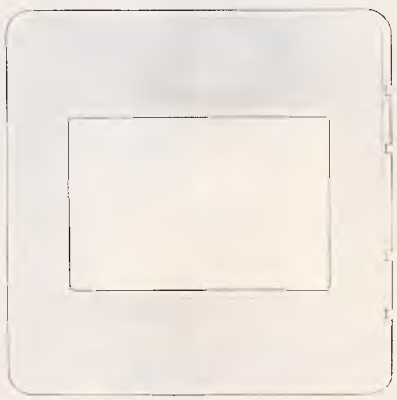
By assigning the processor one of the lowest arbitration levels, future plug-in cards such as an Intel 80486 co-processor could easily take complete control of the system. In addition, certain high-speed data transfer devices can request a burst mode and hold the bus for the entire duration of a transfer.

The Model 50 comes with 1Mbyte of RAM made up of nine 1Mbit chips including one parity chip. The RAM chips are 150-nanosecond access although the Model 80 will have 80-nanosecond access RAM. The 128k onboard ROM includes CBIOS (PC-DOS and PC-compatible BIOS) and ABIOS (for OS/2 support, more of which later). It still contains Basic and a power-on self-test code.

The custom chips make the hardware of the new IBMs particularly interesting. Apart form the processor, the rest of the machine comprises four VLSI gate arrays, the proprietary bus system, and other support chips for graphics and control.

The four chips are: VGA (video graphics array) including 256k of internal RAM; DMA — 16 channels, eight of which can be used concurrently; I/O control; and processor support. These gate arrays come from IBM France. An Inmos chip is used for video to provide a colour look-up table; this allows the machine to provide 256 colours from an overall palette of 262,144 in various resolutions. It also provides synchronisation between the display and processor operations as well as the digital-to-analogue conversion necessary for video displays.

IBM has gained something of a reputation for using old technology: with the Personal System/2, this reputation has been well and truly smashed. Surface mounting is used throughout, and the design of the PCB is elegant and sparse. As the price of the chips decreases, this board should become very cheap to manufacture. A major surprise on this board is the new expansion system — the new connectors are much smaller and denser that the old ones. They are still 8-bit with a 16-bit expansion, but have been redesigned to comply with interference regulations around the world. Three 16-bit expansion slots are provided. A



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Subsequent to the Benchtest of IBM's Model 50 by Messrs Walker, Linderholm and Tebbutt, Kester Cranswick procured a Model 30, and, at APC's request, gave it the once-over.

It came like a bolt out of the blue. Big Blue, to be precise. One moment I was sitting there, pouring over the mountain of press material from IBM about its new Personal System/2 computers. The next, IBM was on the phone asking if I would like to have a Model 30 for review. "You betcha, by golly, by gosh, and don't get me wrong," I said.

A few hours later, and just in time for this issue of *APC*, I had a brand new Model 30, with single disk drive, 20Mbyte hard disk, 30cm colour monitor, DOS 3.3 and Displaywrite 4.0 sitting on my desk — specially cleaned for the occasion. If it had been for sale, I could have sold it a dozen times over, just to the other *APC* staff.

The Personal System/2 range has the most exciting personal computers since the Macintosh. It marks the biggest advance in PC technology since the original PC. The Model 30, combined with the fire sale on existing IBM PCs, will have compatible makers wondering what's hit them. If you are on the verge of buying a PC, get yourself down to an IBM dealer, and check this one out.

The configuration pictured here sets you back $6230. It boasts an 8086 chip, running along at a respectable 8MHz, 640k of RAM, a built-in clock, graphics supported by a new standard called Multicolor Graphics Array (MCGA), three expansion slots, a 1.2Mbyte 3.5in disk drive, a 20Mbyte 3.5in hard disk, and an enormous AT/E keyboard.

Aside from the keyboard, it is a very sexy looking machine. There's even been a change in the appearance of the IBM logo. The main box measures 397 x 406 x 102mm, and weighs around eight kilos. On the front is a centrally located floppy disk drive, with disk eject button, and a prominent, red on/off switch. The sides are bare except for a keyhold on the right to lock the keyboard. You'll find all the ports at the back.

They line up like this: power socket, keyboard, mouse, printer, serial port, monitor output, and three expansion slots above that. The keyboard and mouse ports are of the new mini-DIN variety, so an existing mouse won't fit.

The monitor is of dimensions to match the CPU box. It has an on/off switch on one side, brightness and contrast knobs on the other. What it lacks is a tilt or swivel base.

If you want big, go for the keyboard. It has 102 keys in all, mimicking the IBM AT extended keyboard. Lights for Num, Caps and Scroll lock are easily identifiable. There is a wonderfully convex shape to the keypad, and the keys have a reassuring firmness about them. One thing you can be sure of with an IBM, it makes a great keyboard.

Two 720k disks are supplied with the Model 30. DOS 3.3 is on one. The other has a program demonstrating the features of the computer. Very little is documented as hard copy, other than DOS, so you'll need to use this program.

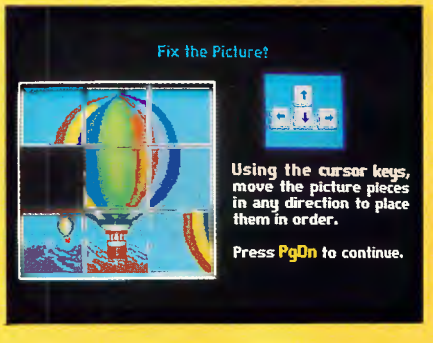
Do so and you'll be impressed, as it uses the graphics facility admirably. The Model 30 has undoubtedly the best graphics I've ever seen on an IBM micro. They are detailed, rock steady and very fast.

The secret is the MCGA standard. It supports 256 colours from a palette of over 256,000, or 64 shades of grey, if you have a mono monitor. In highest resolution, the monitor shows 640 x 480 pixels, though with only two colours. With all colours, you get 320 x 200 pixels, with all points addressable. It makes for fabulous displays, as a quick tour through the explanatory program will show.

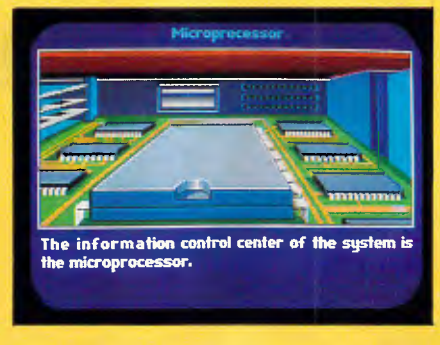
The other major innovation is in the disk department. Three and a half inch disks have been around for some time, on the Macintosh and laptops. IBM has used them for the JX and the Convertible, but not for its mainstream micros. Now that IBM has endorsed the standard with desktop PCs, a flood of 3.5in software can't be far away.

What is certain to happen is that vendors will supply both 5¼ and 3.5in disks. Certainly that's what IBM did with the software it supplied.

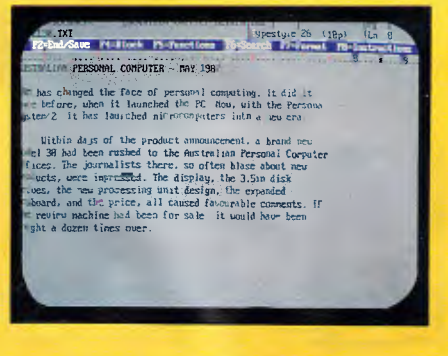
The format does pose problems though. Unless you buy an external 5¼in disk drive, or can link up the Model 30 to an older PC, transferring data to the new disks isn't possible. (There might be an opportunity for entrepreneurs here!) As it is, buyers of the Model 30 are going to find themselves at some disadvantage in the software field, at least for the present. The new disks are also more



A nine puzzle demonstrates the Model 30's graphics capabilities



DisplayWrite was provided on 3.5in disk format



Part of a 'get to know your PC' demonstration provided with the '30

expensive than the old. DOS 3.3 is not a major enhancement, but the improvements are welcome. It has four new commands, enhancements to nine others, will run programs for earlier DOS versions, and seems to run quite happily on standard PCs.

APPEND is a useful program for hard disk users. It allows data files to be accessed from outside the current directory, without changing the directory. It is similar to PATH, but can find extensions other than COM, EXE and BAT.

FASTOPEN is another hard disk utility. To locate files in sub-directories, DOS searches each directory in a path every time that file is accessed. With FASTOPEN, recently accessed directory and file locations are stored in memory and DOS will check this list before starting its normal search procedure. The user can specify the number of locations to be remembered, from 10 to 999, in an AUTOEXEC.BAT file.

A new feature called code paging is supported by the commands NLSFUNC and CHCP. This controls the display of character sets for different countries, and with the new commands, and IBM's new printers, you can easily change from printing in French characters, to German, to English. It is all documented in the DOS manual. GRAFTABL, KEYB and MODE have been enhanced to reflect these changes. DATE and TIME both reset system time and the permanent clock now, while FDISK can now create multiple logical disk drives in a hard disk.

ATTRIB has been extended to modify file attributes in multiple files, selected files in a directory or all files at or below a directory level.

BACKUP has been speeded up, will format a non-formatted disk and creates a log file. RESTORE can now have a given date and time since the last backup specified, and restores files that no longer exist on the target drive.

Within batch file commands, you can now call another batch file from within a batch file, without running COMMAND.COM again, and suppress the ECHO OFF statement.

With all its features, the Model 30 is a pretty impressive machine.

In relation to the other new IBM releases, it runs the risk of being a bit of a dead end. It lacks the 32-bit data bus of the other PS/2 machines, and therefore won't be able to run the new Operating System/2 when that is released.

The MCGA standard is good, but wait till you see VGA running on a Model 50. The Model 30 won't run VGA. Mind you, a Model 50 will set you back another $2700 or so.

The Model 30 is an impressive machine, with an impressive price. As a replacement for the PC/XT, it is just about all you could ask for, at least until the clones arrive on the scene. No doubt it will be imitated before too many moons go by, and clone prices will be even lower.

My only reservation is with OS/2, which might ultimately take over from DOS. To be really future proof, you have to go for the Model 50. Buying the Model 30 might get you a beaut computer, but you could also end up with a machine that has no place to run in a couple of years time.

Technical specifications: Model 30

Processor:	8086 at 8MHz with zero wait states
RAM:	640k as standard
ROM:	64k containing the CBIOS (compatibility BIOS)
Mass storage:	Model 30-002 has two 720k 3.5in floppy disk drives and the Model 30-021 has one 720k floppy drive and a 3.5in 20Mbyte hard disk drive. Optional external 5¼in 360k floppy and 200Mbyte WORM drive
Keyboard:	IBM enhanced keyboard, 102 keys, separate cursor and numeric pads
Monitor/display modes:	MCGA (multi-colour graphics array), giving up to 640 x 480 in mono and 320 x 200 in 256 colours
Standard interfaces:	25-pin serial RS232C and 25-pin bi-directional Centronics parallel, and IBM mouse port
Expansion:	16-bit internal bus and 8-bit expansion bus with three free standard 8-bit PC-type expansion slots
Size:	10.2cms high by 40.6cms wide by 39.7cms deep
Weight:	Floppy model 9.5kg; hard disk model 18.0kg
Bundled software:	PC-DOS 3.3
Operating system:	Existing MS-DOS/PC-DOS standard
Peripherals:	Expanded memory and comms adaptors

Benchmarks

Run on Model 50 in IBM Basic

Intmath	1.448secs
Realmath	2.0375secs
Triglog	12.533secs
Textscrn	27.98secs
Grafscrn	7.93secs
Store (on 20Mbyte hard disk, no cacheing support)	4.837secs
Store (on a 1.44Mbyte floppy)	10.725secs

range of cards has been announced to provide memory expansion, asynchronous comms and a multi-protocol adaptor.

The 3.5in disks are high-density and capable of storing 1.4Mbytes of data, provided you use special high-density floppy disks. To retain compatibility with current 720k 3.5in disks, a software switch allows this format to be used. The Model 50 comes with a high performance 20Mbyte hard disk as standard.

While this system has its graphics standard built into the main PCB, it will automatically support alternative graphics cards. To drive the four new display monitors, the Model 50 uses the VGA to produce graphics resolutions form 320 x 200 to 640 x 480 pixels. A special display adaptor can manage 1024 x 768 with 256 colours. In true IBM fashion, the monitors are available at extra cost. Users do not lose their investment in software since the graphics drivers are CGA and EGA compatible.

This machine's modular construction makes it very easy to dismantle (and reassemble!). Simply undo two thumbwheel screws and whip the lid off; after that, everything unclips and slides out. Inside, a number of featureless boxes cover the main PCB. A narrow, silver block running the entire length of the right-hand side contains the 93-watt power supply. Immediately to the left is space for up to two floppy disk drives, with the hard disk sitting behind. At the back of the machine in the middle is a plug-in removable fan. All these components can be removed in seconds via an ingenious system of pull-up plastic catches.

The keyboard is a new 102-key device with a separate cursor control cluster, a dozen function keys and a separate numeric pad — you know the kind of thing.

The networks supported through the use of add-in cards are: Token Ring and PC Network, both baseband and

broadband. The baseband system offers a low-cost, low-tech approach which would be suitable for schools and other low-traffic installations.

System software

The exciting news is that the Models 50, 60 and 80 have been designed specifically to run a new generation of operating system from Microsoft. Unfortunately, while we can tell you its name and describe some of its capabilities, it looks unlikely that it will be available this year. In the meantime, the machine will be shipped with MS-DOS 3.3.

Operating System/2 (OS/2) is the new operating system and has been designed specifically for the Intel 80286 processor. As such, it should also be capable of running on the 80386 and any further processor from Intel that has an 80286 emulation mode. By running the 80286 in unprotected mode and not in 8088/8086 emulation mode, it is possible to directly address 16Mbytes of RAM as opposed to the 640k imposed by MS-DOS. In addition, the hardware multitasking capability of the 80286 has been utilised, which means that if one program crashes it doesn't bring down all the others running at the same time. Contrary to rumours, OS/2 will run on any compatible 80286-based machine, not just IBM's.

'IBM users, dealers and — possibly more importantly — clone makers can all breathe a sigh of relief.'

OS/2 will also see the demise of the A command line. Each version of OS/2 will contain a bundled version of Windows, Microsoft's WIMP interface. For the purist, it looks as though there will be a way out of Windows, but this merely deposits you in a 'file manager' mode which sounds similar in function to Xtree.

A new version of Windows with support for both MS-DOS and OS/2 will be available *before* OS/2. Windows2, as it will be known, will have drivers for the new Personal System graphic standards, run faster under MS-DOS, and adopt overlapping windows rather than the current 'tiling' approach.

Less clear is the relationship between existing MS-DOS applications and

Technical Specifications: Model 50

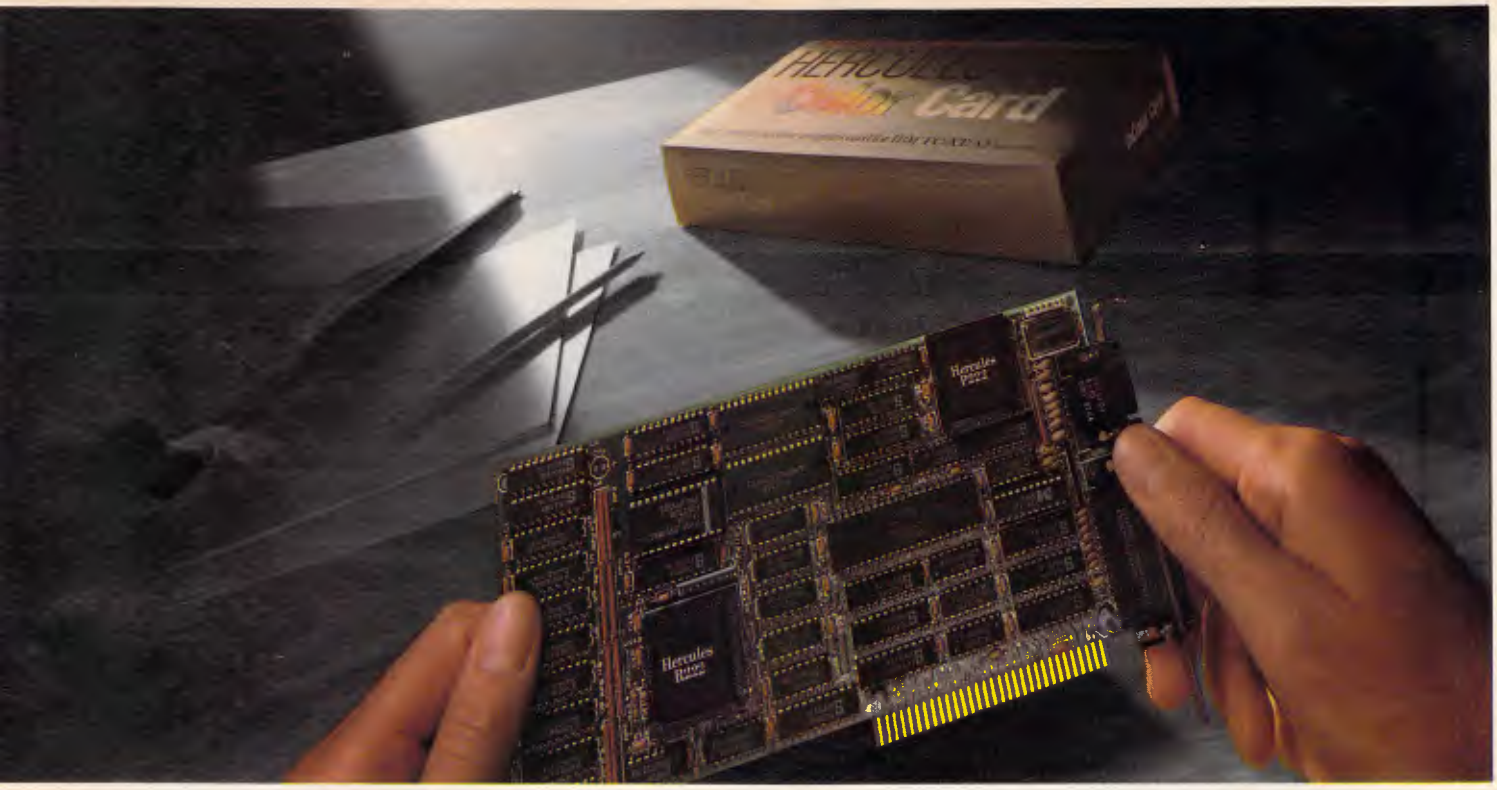
Processor:	80286 at 10MHz
RAM:	1Mbyte as standard, expandable to 7Mbytes
ROM:	128k containing CBIOS and ABIOS (advanced BIOS) for supporting OS/2
Mass storage:	Single 3.5in floppy 1.44Mbyte, 20Mbyte hard disk, optional internal 1.4Mbyte 3.5in floppy, external 5¼in floppy and 200Mbyte WORM drive
Keyboard:	102-key, IBM enhanced keyboard
Display modes:	VGA (video graphics array) giving up to 64 grey scales with 640 x 480 pixels in monochrome or 640 x 480 in 256 colours
Standard interfaces:	25-pin serial RS252C, 25-pin bi-directional Centronics, IBM mouse port and keyboard port
Expansion:	16-bit internal bus, 16-bit external bus with three free 16-bit, new-style connector slots
Size:	14cms high by 36cms wide by 42cms deep
Weight:	10.5kg
Bundled software:	PC-DOS 3.3, OS/2 when available
Operating system:	PC-DOS, MS-DOS, will support OS/2
Peripherals:	Memory expansion and comms cards

Technical specifications: Model 60

Processor:	80286 at 10MHz
RAM:	1Mbyte, expandable to 15Mbytes
ROM:	128k of CBIOS and ABIOS
Mass storage:	1.4Mbyte 3.5in floppy, Model 60-041 has one 44Mbyte hard disk drive and the Model 60-071 has one 70Mbyte hard disk. Optional extra internal disk drive of any size and external 5¼in 360k floppy and external 200Mbyte WORM drive
Keyboard:	102-key, IBM enhanced keyboard
Display modes:	VGA display modes
Standard interfaces:	25-pin serial RS232C, 25-pin bi-directional Centronics parallel,IBM mouse and keyboard ports
Expansion:	16-bit internal and expansion bus with seven free 16-bit, new-style expansion slots
Size:	59.7cms high by 16.5cms wide by 48.3cms deep
Weight:	23.5kg
Bundled software:	PC-DOS 3.3 and later OS/2
Operating system:	PC-DOS, MS-DOS and OS/2 when available
Peripherals:	Expanded memory and comms card

Technical specifications: Model 80

Processor:	80386 at 16MHz; or on Model 80-111, 80386 at 20MHz
RAM:	2Mbytes, expandable to 16Mbytes
ROM:	128 CBIOS and ABIOS
Mass storage:	1.4Mbyte 3.5in floppy, 44Mbyte hard disk on Model 80-041, 70Mbyte hard disk on Model 80-071 and 115Mbyte hard disk on Model 80-111, with room for an optional internal 44Mbyte, 70Mbyte or 115Mbyte hard disk and external 5¼in 360k floppy and 200Mbyte WORM drive
Keyboard:	102-key, IBM enhanced keyboard
Display modes:	VGA display modes
Standard interfaces:	25-pin RS232C serial port, 25-pin Centronics bi-directional parallel port, IBM mouse port and keyboard port
Expansion:	Internal 32-bit bus and external 32-bit bus with three 32-bit, new-style expansion slots and four 16-bit, new-style expansion slots
Size:	59.7cms high by 16.5cms wide by 48.3cms deep
Weight	23.6kg
Bundled software:	PC-DOS 3.3, OS/2 when available
Operating system:	PC-DOS, MS-DOS OS/2 when available and 386 operating systems when available and IBM's AIX
Peripherals:	Memory expansion and comms card



Introducing the Hercules InColor Card.

It runs more software at a higher resolution than any other colour graphics card.

The Hercules® InColor™ Card offers everything you'd expect from a high resolution colour graphics card from Hercules – and more.

Compatibility: The InColor Card is compatible with the thousands of programs that run on our monochrome cards.

Colour: The InColor Card gives colour capability to Hercules-compatible software like 1-2-3® and AutoCAD®.

Resolution: The InColor Card's resolution of 720x348 is the highest of any widely supported standard.

RamFont: The InColor Card has our unique RamFont mode – in colour.

Better graphics

Hercules is known for bringing high resolution monochrome text and graphics to programs like 1-2-3® and AutoCAD®. Now the InColor Card gives you the same high resolution 720x348 graphics in up to 16 colours using an IBM® Enhanced Colour Display, multisync monitor, or equivalent. That's the highest resolution of any widely supported graphics standard.

And no other colour graphics card allows you to move back and forth between colour and monochrome systems *without changing drivers.*

Runs more software.

All Hercules-compatible text, graphics and RamFont software runs on the InColor Card in black and white, or at least two colours.

And many popular programs like 1-2-3®, Symphony,® AutoCAD® and Microsoft® Windows that use graphics or RamFont, run in full colour.

More powerful RamFont.

RamFont is a new mode developed by Hercules that gives your software the ability to display multiple fonts at lightning fast speeds.

RamFont transforms advanced word processors like Microsoft Word from slow to text-mode fast. Technical word processors like Lotus Manuscript™ use RamFont to display onscreen the text you want to print. Even 1-2-3 uses RamFont to almost double the size of the spreadsheet picture.

And now, with the InColor Card, you get an enhanced RamFont with 3,072 programmable characters in up to 16 colours. All the way up to 12,288 characters in four colours. With the InColor Card's RamFont, no program should run out of speed, colour or fonts ever again.

What the InColor Card could mean to your company.

The InColor Card allows you to run a program in colour, and then move to a Hercules Graphics Card Plus and run the same program in monochrome. Without changing drivers.

Compatibility between the InColor Card and our monochrome card allows you to network around one standard – Hercules.

At last your PCs will have compatible graphics, in colour or monochrome.

Remember, only the InColor Card has colour-to-monochrome compatibility, high resolution text and graphics, and the power of colour RamFont.

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The New Hercules InColor Card.

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SOUTH MELBOURNE
VICTORIA 3205
MELBOURNE (03) 690 9055
SYDNEY (02) 319 2622

All the standard ports run off the motherboard, freeing slots for further expansion. From left to right: keyboard, mouse, bi-directional Centronics, RS232C and video out. The centrally-mounted fan is almost noiseless

OS/2. Straight MS-DOS applications will *not* run. Only specially written applications will be able to use OS/2's memory management and multi-tasking facilities.

However, it will be possible to run one standard MS-DOS program in the bottom 1Mbyte of RAM and this can be as well or as badly behaved as it wishes. OS/2 will automatically protect that program and its own applications from each other.

While on the subject of memory, Microsoft is recommending a minimum 1.5Mbytes of RAM and a hard disk to get the most of OS/2. For the Model 50, this means purchasing a RAM expansion card and using up one of the free slots.

We tried out a wide range of software on the Model 50. Everything ran perfectly with the exception of the public domain games — always the crunch test of IBM compatibility.

All in all, the new IBM machines seem very IBM compatible, with the exception of some programs which drive the video hardware directly.

Prices

The Model 30 (two floppy disks) sells for $3500. The Model 50 with a 20Mbyte hard disk but without a monitor costs $7490. The Model 60 with a 70Mbyte hard disk costs $13,140; the Model 80 with a 44Mbyte hard disk will cost $14,600; while the Model 80 will cost $22,820 with a 115Mbyte hard disk.

Four screens are available: a 30cms monochrome model for $596; and three colour units at 35cms ($1368), 30cms ($1510) and 40.4cms ($3500).

Conclusion

IBM users, dealers and — possibly more importantly — clone makers can all breathe a sigh of relief. The new machines are not an attempt by the company to isolate itself from its own industry standard. Instead, they are a realistic move into the future.

The new machines are extremely well-built with a high degree of internal integration and much improved styling. Inevitably, IBM's move is evolutionary rather than revolutionary. Nevertheless, it is the first step towards the new operating systems which will make full use of the power of the 80286.

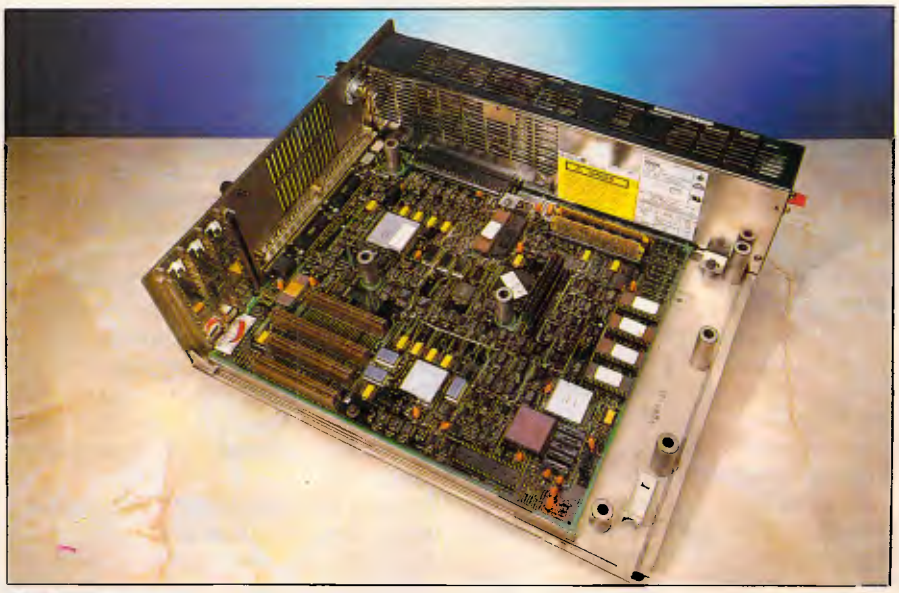
With their much-enhanced graphics and better price/performance than their predecessors, this new range of personal computers from IBM is likely to be a huge success. Considering the machines came from IBM, we were impressed.

END

In perspective

Well, the rumours can now be laid to rest. IBM hasn't gone entirely proprietary, it hasn't exactly come out with a clone-killer, nor has it done a Convertible on us. What it has done is announce a cohesive range of products (198 at the last count) designed not only to provide a growth path for PC users but also to forge meaningful links with IBM's other computer systems.

Very quickly then, the Model 30 is a bargain basement evolution of the present PC/XT; the Model 50 is a new entry-level machine for those wanting to exploit the true power of the 80286; the Model 60 adds extra expansion capability, more memory and a larger hard disk in a tower-shaped box (with a handle!); and the Model 80, due goodness knows when, is an 80386 machine, once again in a tower configuration.



Surface-mount technology features large inside the Model 50, making the machine cheap to manufacture and expensive though not impossible to clone. Subsystems within the box are easily installed and removed

Why RamFont™ is so essential to your software.

Until now, most programs could only display 256 pre-programmed characters.

Just enough for the regular alphabet, some numbers and a few special symbols.

Enter the Hercules™ Graphics Card Plus.

Its extraordinary new RamFont mode can store up to 3072 *programmable* characters, and display them at lightning-fast speed.

And RamFont is so flexible, you can even mix graphics on the same screen as text.

A whole new generation of software is available now, taking advantage of RamFont's unique capabilities to give you more power and speed than ever before.

Lotus® 1-2-3®.

By using RamFont to display smaller-than-standard characters, 1-2-3 Release 2 gives you a spread-sheet that shows almost twice as much data as before.

And, RamFont makes scrolling instantaneous and smooth, rather than painfully slow and jerky.

You can even view a graph in a pop-up window – another RamFont first.

Microsoft® Word 3.

Word 3 was the first PC word processor that let you see boldface, italics, subscripts and superscripts mixed with regular text.

But it was slow

Not anymore.

With RamFont, Word 3 runs almost four times faster.

Lotus Manuscript.™

Manuscript is Lotus' new technical word processor, written to run optimally on the Hercules Graphics Card Plus.

It uses the RamFont mode for fast, multiple-font text editing.

Then it switches to graphics mode to format a page for printing, showing proportionally spaced equations.

Even more goodies.

Besides these dramatic improvements, RamFont also dramatically improves the scrolling speeds of Symphony® 1.1 and Framework II.™

For WordStar,® there's a RamFont add-on that lets you use multiple fonts.

There's even a new word processor that lets you write in Greek, Russian and Hebrew, *on the same screen.*

And there's more incredible RamFont software right around the corner.

And now, the *really* good part.

RamFont is only one of the Hercules Graphics Card Plus, major advantages.

You also get our famous high resolution graphics, to run programs like AutoCAD® and Pagemaker.™

And our high-resolution text mode that runs thousands more programs.

Here are a few of the programs taking advantage of RamFont.

Lotus 1-2-3 Release 2 (and later)
Lotus Symphony Version 1.1
Lotus manuscript
Microsoft Word 3.1 (includes mouse support)
Ashton-Tate Framework II
Nota Bene™
PS™
Computer Linguist

For a complete list, contact the distributors shown below.

And a parallel printer port that can be "unplugged" for greater flexibility.

All for the astonishingly low suggested list price of $595 ex. tax.

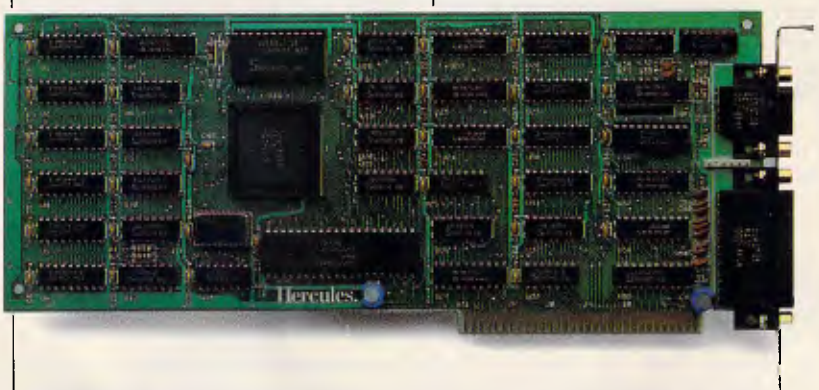
$595 ex. tax.
Suggested Retail Price.

Which, on top of the Plus' performance, has caused a few people in the industry to get unusually excited:

"If you intend to buy an IBM PC or clone and want to run a monochrome system, this is the card to get. I wouldn't even think of anything else."

John C. Dvorak,
PC Magazine *columnist.*

Neither would we.



The Hercules Graphics Card Plus with RamFont.

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Passing the bug

It's little consolation to end users that their software boasts 'undocumented features' when all they want is a bug-free product that does the job it's supposed to. Martin Banks presents his version of events.

There is nothing like being doubly sure and well-protected: it must be true, because I read that once in a book. It is something I have often tried to keep in mind, sometimes successfully.

I was doing just that the other week. I'm off soon on a little trip to the States and, as I am scheduled to be landing at Boston, I have been taking some time out to practise circuits and bumps at Boston's Logan Field Airport with the game Flight Simulator.

Yes, I know an Olivetti M21 is not desperately like the flight deck of a 747, but there is nothing like being well-prepared, that's what I say. So round and round I went, and after a bit of practice I got quite confident and, therefore, more daring. Needless to say, I got caught out and found myself lined up nicely to ditch in the sea. To my surprise, instead of going 'splash', as per normal, the thing landed.

There is, I assume, a bug in my copy of Flight Simulator; actually, there are several, but then, what can one expect in a program that only costs some $130. That isn't meant to sound as snide as it seems, for there is every reason to believe that the bug-free program has never been written.

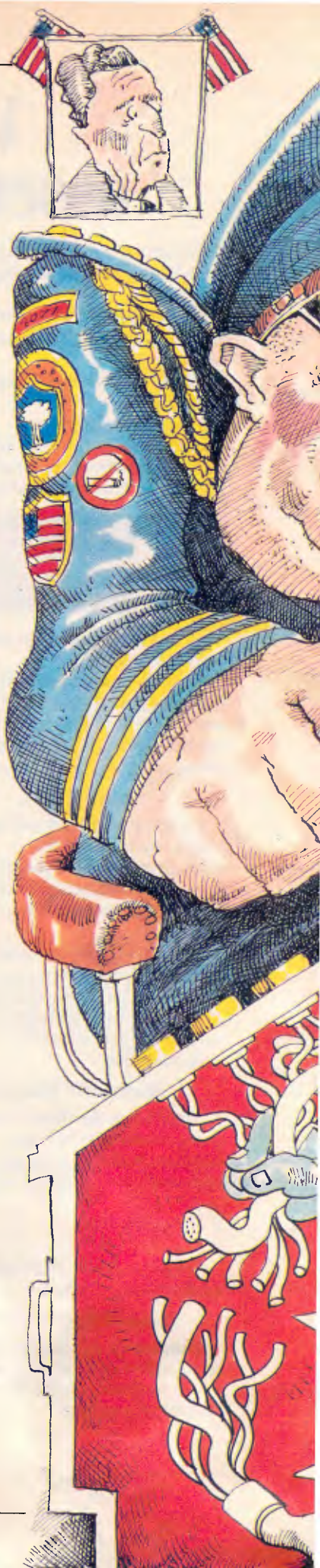
It is a sad fact that every useful program ever written has been issued to an unsuspecting public with all sorts of bugs in it. Given the nature of software this is inevitable, I suppose, for the human race is not terribly logical, especially when it is actually trying to be so.

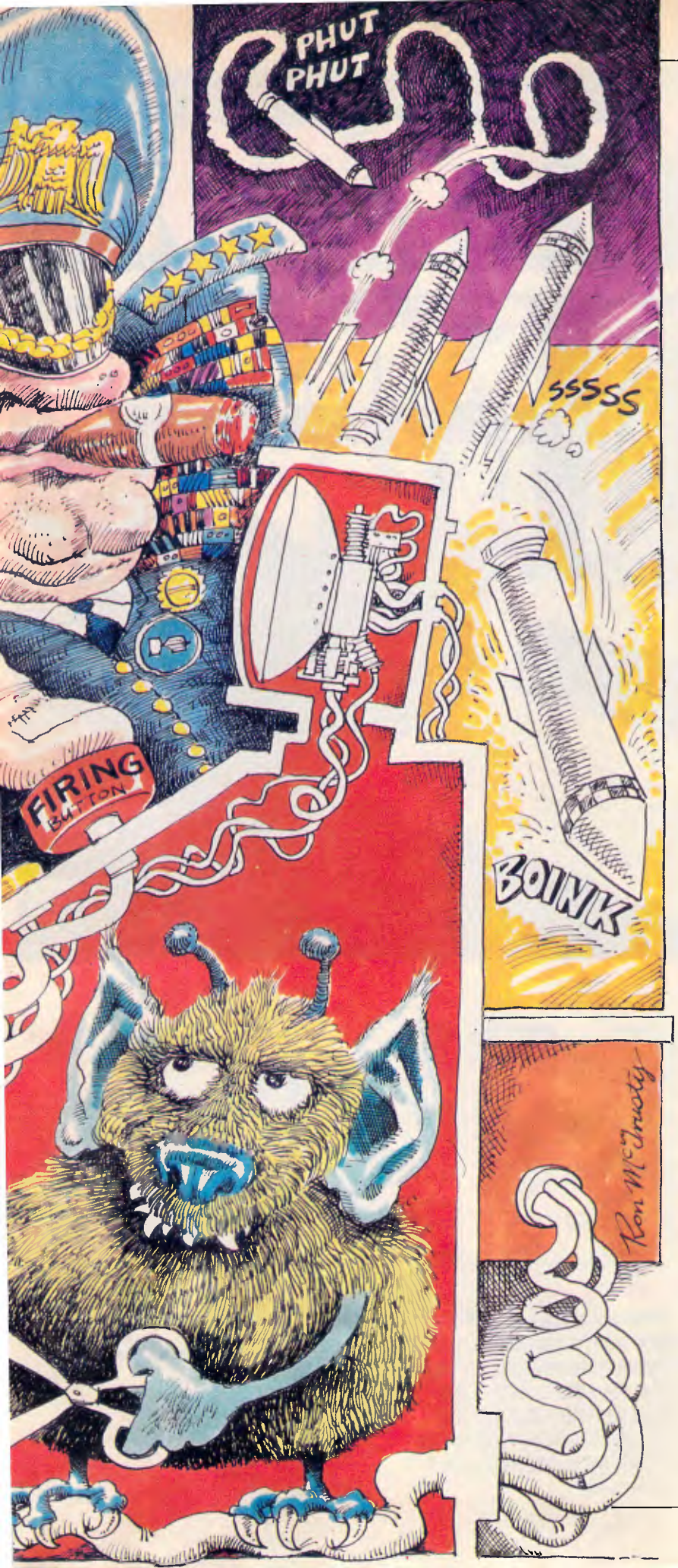
Faced with this sad fact, what are the results? For example, it was my esteemed colleague, Guy Kewney, who pointed out some time ago that the US Strategic Defence Initiative, 'Star Wars', was really quite frightening given that there would probably only be the one chance to try out the software in its working environment, and that past history in software did not bode well.

He quoted MS-DOS as a prime example. Even with hundreds of thousands of users feeding in their observations to Microsoft, it still comes up with the occasional bug, even now. The biggest and the best in this business cannot create software that is bug-free. Indeed, it has been said about IBM that it has turned the 'bug' into a sales advantage. If enough users complain about a bug which proves difficult to cure, then it is said that the IBM marketing department labels it as a new 'feature'. An increasing number of software companies now talk in terms of 'undocumented features' in their software: you can guess what they mean.

But what does the user get from all this? For the mainframe user with a staff of programmers waiting to maintain as well as create applications, bugs are something that are planned and accounted for. But the average PC user doesn't always have such resources. Certainly, there will be a coterie of users who are aficionados, who like getting their hands dirty by diving into the code of their latest application acquisition.

But for the majority, all that they want is the apparently simple objective of a





program that works in the way they expect it to, every time they use it. We all have personal experiences of bug-ridden software — or know someone who has. Many a journalist like myself will have sat in press conferences and sniggered as some overhyped application program crashes ignominiously during its launch demonstration.

Most often, the cause is something simple, such as in one desktop publishing package I know that has a small bug in its pixel-handling routine. This causes the displayed horizontal image to gently and artistically turn vertical at the horizontal scroll command. Sometimes, however, the cause is more fundamentally stupid on the part of the authors.

I remember, for example, a story of an accounting package written by a software house specialising in scientific applications. They wrote it in the language they knew best, Fortran — just about the least suited language to accounting applications. The result was a package that produced the most amazing invoices, as it multiplied the quantity ordered by the line number, and then by the part number to give a value.

Whatever the cause of the bug, however, the end result to the user is normally the same — aggravation and inconvenience. It has been argued before that the PC software industry could and should do better in ensuring that its products reach the market in a satisfactory condition. While many companies do try, there are enough of the other sort to make users suspicious of all applications.

What is worse, many companies offer poor to non-existent levels of support to the user when a bug is discovered, even an old and well-charted one. You telephone to report the problem and, if the phone is ever answered, you can be met with enough tortuous ducking, weaving and buck-passing to rival the most complex set of nested subroutines.

Occasionally I hear of software companies that have offered users highly praised support and have been able to trace and cure bugs both quickly and efficiently. There seems to be a common theme in these operators; their products are in specialist, vertical markets, and they are expensive.

Now I know this is one of my favourite hobby horses, and that I am about to get on it again, *but* . . . you do get what you pay for and given that bug-free software is a practical impossibility for now, paying for support by spending more on the purchase price is maybe an important step. While the economies of scale that PC sales volumes bring do affect product prices, you still can't get something for nothing.

Actually, in this case you do get something, though often it is just a can of worms.

END

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Korea's largest computer manufacturer, now proves its superiority. Just compare the data in the chart below.

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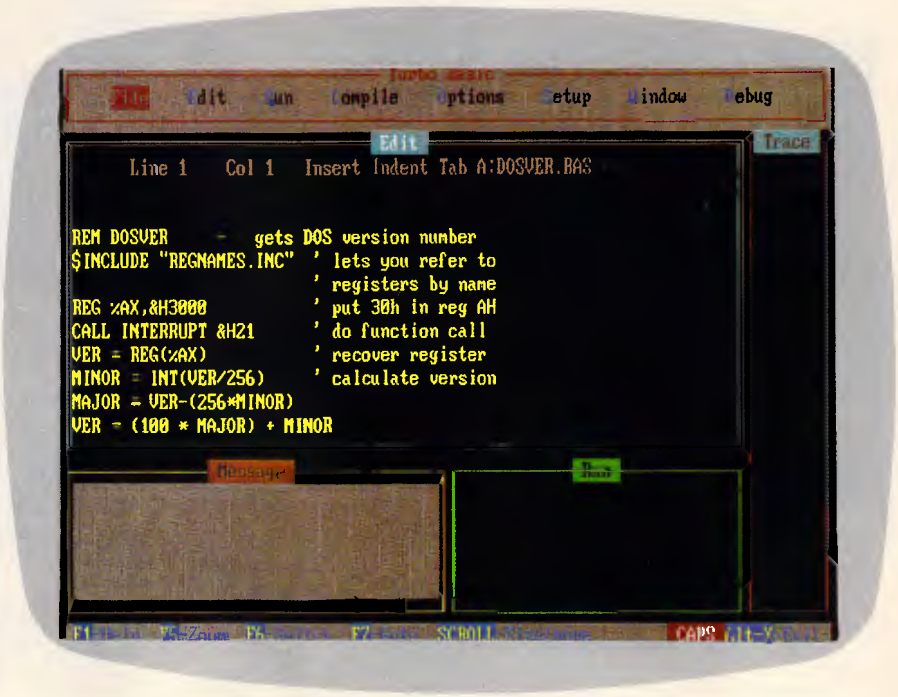
Turbo Basic

Professional programmers dismiss Basic as too slow and clumsy, but its shortcomings have been overcome by a new version from Borland. Turbo Basic should soon be on the best-seller list, explains Robert Schifreen.

Only quiche eaters program in Basic. Admit to any programmers' meeting that you actually use GOTOs and you'll be laughed out of the room. Basic, you'll be informed as they push you out the door, doesn't allow you to write structured programs. It's usually an interpreted language, so your programs are slow, and they can't be given away or sold without revealing the source code. There's no recursion, or support for command line arguments. You don't get a SELECT/CASE statement, which all decent languages have, or any easy way to call the low-level operating system routines that give features no high-level language supports.

If all this were true (which admittedly it is on most machines) then the case against Basic would be proven. But Borland's new Turbo Basic cures all these ills and more.

The package is certain to be a best-seller. It will sell to people who have come to realise that Borland knows how to write cheap, easy-to-use languages. It will sell to users who know Basic inside out from previous micros and, despite hearing wonderful things about Turbo Pascal, have never wanted to learn a new language from scratch. It will sell to PC clone users, who want to write programs in their interpreted Microsoft GW-Basic. It will sell to people who want to write Basic programs that run up to 20 times faster than under GW-Basic. And it will sell to anyone else who wants a damn good Basic programming development system at a damn good price.



Turbo Basic's screen layout will be familiar if you've used any other Borland language. The size and location of all windows can be changed. Compiled .EXE programs run in the full screen — no windows are used

Although this is a review of Turbo Basic, it's hard to avoid mention of its main competitor — QuickBasic from Microsoft. At the end, therefore, I have made some comparisons between the two and suggested ways of deciding which one to buy.

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```
REM DOSVER      -    gets DOS version number
$INCLUDE "REGNAMES.INC"   ' lets you refer to
                          ' registers by name
REG %AX,&H3000            ' put 30h in reg AH
CALL INTERRUPT &H21       ' do function call
VER = REG(%AX)            ' recover register
MINOR = INT(VER/256)      ' calculate version
MAJOR = VER-(256*MINOR)
VER = (100 * MAJOR) + MINOR
PRINT "MS-DOS IS VERSION";VER/100
```

Turbo Basic's CALL INTERRUPT command makes it easy to call MS-DOS and BIOS routines. This example calls MS-DOS function 48, which returns the version of MS-DOS being used

```
REM MTIMER.BAS - Example Turbo Basic program
REM            - to show use of microtimer.
REM
MTIMER          'start the microsecond timer
PRINT "A"       'do something
Z = MTIMER      'and read the microtimer
PRINT "PRINTING THAT LETTER TOOK";z;
PRINT "MILLIONTHS OF A SECOND."
PRINT
MTIMER          'start the timer again
PRINT CHR$(65)
Z = MTIMER
PRINT "PRINTING CHR$(65) TOOK";z;
PRINT "MILLIONTHS OF A SECOND."
```

Turbo Basic's microtimer is designed for measuring very small periods in increments of a millionth of a second. This example times how long a single command takes to execute

as found on the real IBM PC and available (sometimes as an extra) with every clone. Because Turbo Basic was written from scratch, it can handle things that are impossible for any version of Microsoft Basic — recursion for instance, and a straight-forward way of making MS-DOS and BIOS calls.

There are a number of totally new commands and functions, which I'll go through in detail later. A couple of commands behave differently to true Microsoft Basic, because they have been made easier by Borland.

In case you're wondering, Turbo Basic's user interface is just like those of Turbo Pascal and Turbo Prolog.

Installation

Turbo Basic comes on a single 360k disk accompanied by a 450-page *Owner's Handbook*. The entire Turbo Basic environment, including editor, compiler and libraries is in one .EXE file of 190k so it can be easily put onto any work disk, and won't need its own directory on a hard disk. It is not copy-protected.

The other files on the disk are examples and are not required to use the system. The Microcalc spreadsheet program is included, as on Borland's Turbo Pascal disks, converted to Basic, as is a window-based text editor called Nanostar.

There are graphics, animation and sound examples, and one that shows how to make MS-DOS calls.

The manual is thorough, though it doesn't pretend to teach you Basic programming. There is at least a page on every command and, where appropriate, notes on how that command differs from standard Microsoft Basic.

The odd bit of humour's in there, too. When boasting that Turbo Basic programs can be up to 1Mbyte long, it says 'Hell hath no fury like an interpretive Basic programmer trying to get 120k of program into 60k of memory.' It also calls Microsoft's 64k code limit stingy. It is evident that the author hasn't used Turbo Pascal recently.

Starting up

Once the system disk is copied and the original stored safely away, you start by typing TB at the MS-DOS prompt. Those of us who aren't graduates of the Peter Norton school of file naming can rename it to TURBOBAS.EXE instead.

I don't like reading manuals if I can possibly avoid them so I experimented. Within five minutes, I had written a one-line Basic program, tested it and compiled it to an executable disk file.

Creating a program

When you first start up Turbo Basic, you are placed at the main menu. Along the top line of the screen are eight menu headings which you can select with the cursor or by pressing the first letter. Below this are four windows headed 'Edit', 'Message', 'Run', 'Trace'. There is no mouse support. Some of the menu headings lead to further menus, which I'll cover in detail later. For now, though, you just select Edit to go into the edit window.

Having written your program, you return to the main menu. Press R to run, and some numbers flick by in the message window as the program is compiled.

Once the program is compiled, it starts running in the Run window. This window is rather small, but pressing Alt-F5 will zoom it while the program is running. At this point, it is the compiled version of your Basic program that is running. The original Basic commands that you wrote, along with the Turbo Basic programming system, are still in memory so, when your program stops running, you return to the main menu and can continue editing the program immediately — no disk access is required.

If you're used to GW-Basic, you'll keep typing RUN while in the editor, and wonder why nothing happens. It's a shame that the editor doesn't trap this specific word being typed at the start of a line. Because you can't type any immediate-mode commands in the editor, you can't do things like finding the ASCII code for characters you are about to plug into your source code. If this is a problem, SideKick's ASCII table will work quite happily with TB's editor.

Assuming everything works, your program will finish and you are automatically placed back in the editor at the line you left off, to carry on writing your program.

If your program doesn't work, the execution or the compilation stops and

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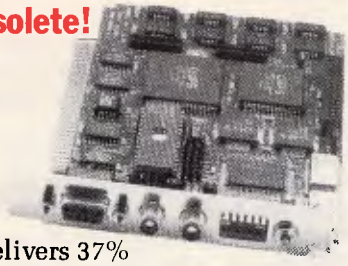

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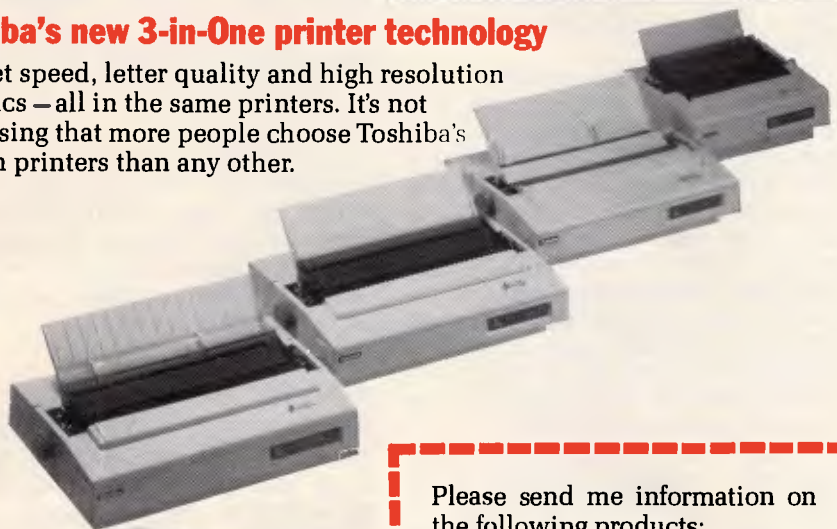

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you are placed back in the editor with the cursor on the line that caused the error and an error message. You correct the error, recompile and rerun, all without leaving the Turbo Basic environment. When you are happy that the program works, one menu option gives it a name and another changes the 'Compile to . . .' setting from 'memory' to '.EXE'. The compiled program gets copied from memory to an executable MS-DOS command file.

Exiting Turbo Basic is done by typing Alt-X from the main menu. If you haven't saved the current version of the Basic source program, you are prompted to do so before exiting.

The menu options

You set options and access Turbo Basic's features through menus which begin at the main title screen.

Looking at each option within each menu is a good way of listing the features available and showing the control the programmer has over the eventual compilation of the program.

The Load option loads a Basic source language program into the editor, ready to amend or compile. The file can be one created with the Turbo Basic editor, or with any word processor that also saves plain ASCII files without control codes or high bits set. If you can't remember the name of the file you want to load, pressing RETURN gives a directory listing.

The New option clears the editor's workspace ready for you to start typing another program into the editor.

If the current Basic program has a name, the Save option will save the current version to disk under the correct name. If you don't specify a name, the file will be called NONAME.BAS and will compile to NONAME.EXE on disk.

A Write To option changes the name of the current file. All files are normally given an extension of .BAS when they're saved, so it's not a good idea to give your own extensions otherwise TESTPROG.V1 and TESTPROG.V2 will be given the same name and one version will be overwritten.

The .EXE version of a compiled program can be up to 1Mbyte long if you use the $SEGMENT metastatement — see later. Source files can't be any bigger than 64k, though. You get round this by breaking large source files into chunks and using the $INCLUDE statement to merge all the modules together at compile time.

The main module, that doesn't include any code but just the $INCLUDE commands, is called the Main File and the Main File option tells Turbo Basic which file this is.

A Directory option lists the files in the current disk directory, while Change Directory is self explanatory.

OS Shell shells you to MS-DOS by running a copy of COMMAND.COM, which must be on the current disk. You can execute DOS commands from here, then type EXIT at the prompt to return to Turbo Basic in exactly the state you left it.

Customising

Turbo Basic works with an 8087 maths coprocessor. This chip speeds up number crunching, and is an optional extra on just about every PC. If you use the Options menu to specify that an 8087 is required, the compiled program will contain the instructions to drive it. Such a chip will typically speed up an empty FOR/NEXT loop tenfold. You don't have to have an 8087 in your machine to compile the program, but you *will* need one to run it. If you intend to give away or sell compiled programs then it's safer not to use the 8087 option or the eventual user will get a 'Sorry — can't run without an 8087' message.

When you write machine code programs in real machine code, they don't normally respond to the user pressing Ctrl-Break. If the program gets into a loop — tough. So it is with compiled Turbo Basic programs. To get round this, Turbo Basic will continually monitor the keyboard while running your compiled program and, if Ctrl-Break is spotted, execution is stopped. All this is monitored though, so a menu option lets you turn the checking off if you are sure that your program is safe. If it's not, you'll have to reboot.

There's a serious limitation to the way that this Ctrl-Break checking works when Keyboard Break is turned on. The extra checking only happens during input/output operations, like displaying text on the screen. So you can break out of an INPUT statement quite happily but something like 10 GOTO 10 will be disastrous. This needs fixing, though Borland doesn't have any plans to do so. Make sure you save the source code to disk before running it — that's not the best solution but it works. Graphics, by the way, is not considered as I/O.

Bounds is another error-checking option which, though useful, shouldn't be turned on in the final version of your program as it makes your code slower and larger. This goes for the in-memory compilation and the .EXE file version too. Bounds checking keeps an eye on your use of arrays and makes sure the program doesn't try to access elements that don't exist. Without bounds checking, anything can happen if you try to access element 20 of a 15 element array.

Overflow is yet another check, with similar reasons for and against its use. This one makes sure that numbers don't get too big or too small.

Stack Test keeps an eye on the size of the stack — the temporary workspace that the compiled program uses when it runs. When you develop a program, turn this test on and, if you find that the stack is too small just increase it with a $STACK command.

The Parameter Line option is really neat. A compiled program can access the command line arguments that started it by looking at variable COMMANDS$. So, if you had a compiled .EXE file called PROG and you typed PROG FRED at the MS-DOS prompt, COMMANDS$ would be equal to FRED.

Now this facility is all well and good in .EXE programs, but you can't normally test it when compiling to memory. This menu option lets you plug values into COMMAND$ before the program runs, so you can make sure that your program handles them properly.

A Metastatements option lets you set the stack size, and the size of the RS232 and music buffers. The music buffer will hold notes so that you can start a tune playing with the PLAY command and then continue processing while the band plays on.

Set-up

The Set-up menu allows full customisation of the colours used by Turbo Basic. Each part of each window can be a different colour. Directories can be specified, too, to tell the system where to find $INCLUDE files, where to put .EXE files and where to find the parameter file that holds all this information.

An auto-save function saves the source file before executing it, and a back-up option makes back-ups of source files when updating them on disk.

Use of windows

When you are developing a program in Turbo Basic, windows are used extensively by the system. There is an Edit window, in which the editor runs; a

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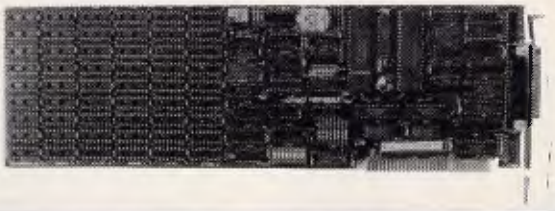

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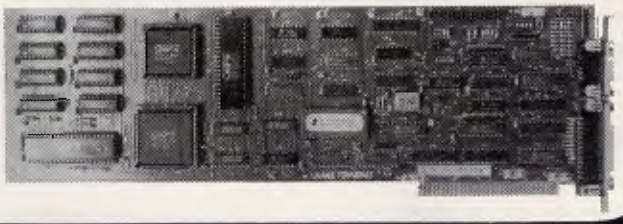

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Non-standard commands added to Turbo Basic

BIN$ Converts a number to binary.

CALL INTERRUPT Calls an MS-DOS or BIOS interrupt. CALL INTERRUPT 5 prints the screen. CALL INTERRUPT &h21 makes an MS-DOS function call. The REG command allows access to registers before and after the function call.

CHAIN Allows you to load in overlay modules, so a Basic program can be larger than available memory. The run-time library is not reloaded each time.

DECR/INCR Decrements or increments a variable.

DELAY Pauses for a specified number of seconds.

ENDMEM Returns the address of the highest memory address.

ENVIRON Allows you to read and write the MS-DOS environment variables.

EXIT Allows you to jump neatly out of a FOR/NEXT loop before its proper completion.

EXP EXP (n) still returns e^n. EXP10 (n) returns 10^n. EXP2 (n) returns 2^n.

IF This has been extended so you can have:

```
IF X = 4 THEN
   FOR P = 1 TO 10
   PRINT "Variable X is equal to 4"
   NEXT
ENDIF
```

INKEY$ This has been extended. Returns a string of length 0,1 or 2. If 0, no key is pressed. If 1, a normal printable key is pressed. If 2, the first byte is 0 and the second is the scan code. This allows you to detect function keys and Alt sequences, though not all combinations worked, especially Ctrl-Alt sequences.

INSTAT Tells you if there is a key waiting in the keyboard buffer, without actually having to read the key.

LCASE/UCASE Converts a string to upper or lower case.

LOG Will calculate logarithms to base e, 2 or 10.

MTIMER A microtimer, only accurate for timing periods of less than 54 milliseconds. Useful for checking exactly how long a single instruction takes to execute.

OPEN...BINARY A more flexible file handling option that lets you change bytes in the middle of a file without having to copy it character-by-character.

PEN Allows you to read the position of a light pen.

REG Lets you put values in a register before making an MS-DOS call, and read back the value from a register afterwards.

SELECT CASE A better way of handling multiple IF...GOTO commands. For example:

```
SELECT CASE X
CASE <20
PRINT "Not big enough."
CASE 21,27,29
PRINT "Sorry, that number not allowed."
CASE >100
PRINT "Nope, too big."
CASE ELSE
PRINT "That'll do nicely."
END SELECT
```

SHELL Gives the user access to MS-DOS. SHELL, "DIR" prints a directory on the screen. SHELL on its own puts the user in MS-DOS where he can execute commands, then return to the BASIC program by typing EXIT at the prompt.

STRIG Lets you read the position and buttons of a joystick.

Note: The following Microsoft commands are missing from Turbo Basic:
AUTO EDIT MERGE RENUM CONT LIST MOTOR SAVE DELETE LOAD NEW USR

Trace window for use in debugging; a Message window that tells you what Turbo Basic is doing, and a Run window in which your program runs.

The Window menu allows you to control the arrangement of windows on the screen. You can opt for tiled windows, in which all the windows fill exactly a quarter of the screen, or you can stack them behind each other like a pile of papers, with only the title line of windows visible behind the front one. You can also open, close or go to any window directly with this option.

When you're developing a program, each window can be zoomed just by pressing F5. So, if you enter the editor and press F5 you get a full-screen editor that looks and works almost exactly like WordStar. There are a couple of minor differences, like being able to use function keys instead of Ctrl-K commands, but basically it's a WordStar-compatible editor that is, I'm told, identical to Turbo Pascal's (and will also be the same in Turbo C).

If you indent a line (with spaces or whatever), then pressing RETURN at the end takes you back to the same indent level. Useful if you indent loop structures for clarity. All the Ctrl key combinations used in the editor are configurable, so you can make it behave like your favourite WP if you want.

Compiled programs that are run as .EXE files from MS-DOS don't use windowing — they take up the full screen.

Borland's changes

Turbo Basic is really a superset of Microsoft GW-Basic, so I'll concentrate only on additions and deletions from the standard Microsoft details. Anything I don't mention behaves like Basica.

Line numbers

Turbo Basic doesn't require line numbers. If you feel lost without them, you can happily put them in and Turbo will happily ignore them. They may come in useful as the destination of a GOTO or GOSUB command, in which case you can put a number on the line in question and nowhere else.

Better than line numbers, though, are labels. The GOTO command in this example is much easier to understand than a command like GOTO 10.

```
Top:
For X = 1 to 10
Print "Testing..."
Next
Goto Top
```

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U306. BROWSE. Examine files with 4 way scrolling.

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U308. DIRECTORY READER. Read a directory from or to a certain point.

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Metastatements

Metastatements are directives that instruct the compiler but don't actually form part of the program. They are in the program's source code, though, and identified by starting with a dollar sign.

There are 16 metastatements in all. Some of the most useful ones are:

$IF/ELSE/ENDIF and $SEGMENT.

Turbo Basic supports conditional compilation. This means you can put some lines of source code in your program and say to the compiler 'if so-and-so variable is set, compile the following statements into the program, otherwise don't'. This allows you to have one source file that can compile into a number of versions.

The $SEGMENT metastatement splits up a compiled program into a number of 64k segments. Unlike the current Turbo Pascal, where the program you generate can be no longer than 64k, Turbo Basic lets you make programs up to 16 segments long, which is 1Mbyte — three times the capacity of a floppy disk.

Functions and procedures

Turbo Basic supports named procedures and functions. Instead of GOSUB 25116 you can have GOSUB Get_String. Defined functions can spread over more than one line, too. Normally, a DEF FN command can only be one line long, but Turbo Basic allows you to have something like:

```
DEF FNcheck_valid(a)
  if a = 4 then flag = 2
  if a = 7 then flag = 2
  if a > 12 then flag = flag + oldnum
END DEF
```

Recursion is supported, so a procedure is allowed to call itself. When you call a procedure, Basic normally stores its current position in a work area called the stack, so that it knows where to return to when the procedure ends. If a procedure keeps calling itself and doesn't return to the place it was called from, the data from the stack is never recovered and will keep filling up, resulting eventually in an out-of-memory error. Turbo Basic gets round this problem by clearing the stack each time you re-enter a procedure.

Interrupts and Inline

It's uncommon for Basics (indeed any other languages) to let you make calls to the MS-DOS operating system or the ROM BIOS. Turbo Basic has a CALL INTERRUPT command that allows you to make a call to MS-DOS easily. You can do this from interpreted Basic and through other compilers, but not easily.

CALL INTERRUPT 5, for example, will print the screen. For more complex DOS and BIOS interrupts, you have to set the registers in the machine. The REG command gives you access to these registers so you can set up the required values before making the call, then read the registers to see what values were returned.

The $INLINE directive lets you specify explicit bytes of machine code in a program. The machine code instruction Int 21h is represented in hex by the bytes CD and 21. To put the command in a program you can just type $INLINE &hCD,&h21.

If you have large chunks of code to put in INLINE commands, you don't want to have to calculate the hex bytes by hand. Instead you can generate them with an assembler and then include the results as a COM file, which is loaded once during the compilation process.

Making comparisons

Turbo's only competitor is Microsoft's QuickBasic, a very similar product that also offers a window-based development environment for Basic programming on the PC.

The price difference between the two is not really significant, so some other factors should be considered.

- **Support and the future**

Borland has built-in features that are not part of standard Microsoft Basic. (It's written in Turbo C, which should be launched soon.) While retaining almost total Microsoft compatibility (most GW-Basic programs can be loaded straight in, as long as they are saved in ASCII format) Borland was able to include 8087 support, recursion and some very useful commands, as well as easy access to MS-DOS and BIOS calls.

- **Speed and size**

To support an 8087 chip, you have to store numbers according to the official IEEE specification, and that's exactly what Borland does. The disadvantage of this is that it takes a lot of time and memory to do this (twice as much as normal). This means that Turbo Basic is not the ideal language for writing number-crunching routines unless you have an 8087 chip, in which case everything whizzes along.

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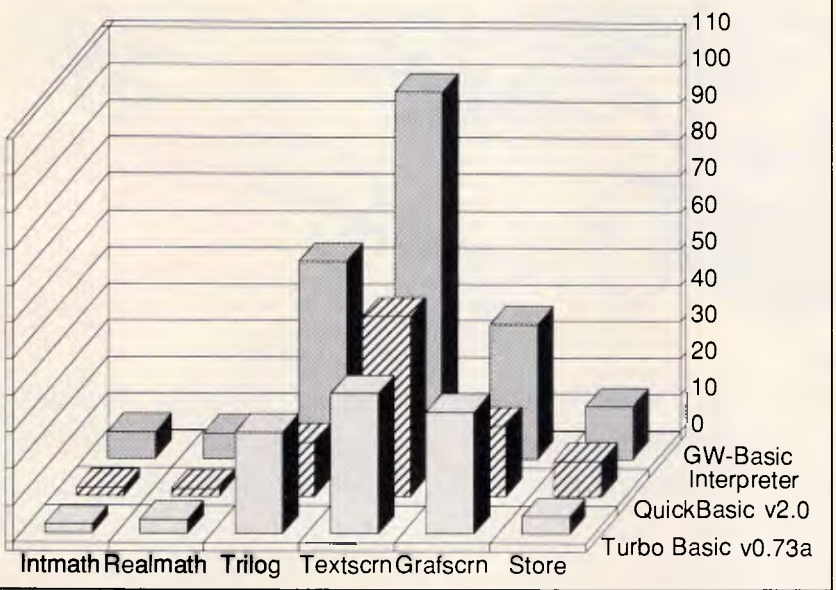
Benchmarks

All times are in seconds. No 8087 was used. Tests were done on a 4.77MHz PC-compatible with a hard disk and EGA. Keyboard Break detection was on. Compilation was directly to memory.

The Benchmarks, which spend all their time doing maths routines, are slower in Turbo Basic than in QuickBasic. The accuracy, however, is greater.



APC's grafscrn Benchmark. Because the FOR/NEXT loops use floating point variables, the machine is spending more time on the maths than on the plotting. The moral is to force Basic to use the lowest precision maths possible. If you want a FOR/NEXT loop to go from 1 to 200, using integer variables (FOR X% = 1 to 200) can double the speed.

The timings in the Benchmarks box table opposite use the non-integer version grafscrn as printed in the November 1986 issue of *APC*.

- **OBJ files**

Turbo Basic doesn't produce .OBJ files, whereas QuickBasic does. The OBJect files have to be passed through a LINK program, which takes extra time. The advantage of OBJ files is that programs produced by different languages can be linked together into one program. The INLINE command in Turbo allows the inclusion of machine code routines and, although much simpler than QuickBasic's method, it's not as versatile.

- **Debugging**

Debugging a program takes a long time, so you'll become pretty intimate with a compiler's facilities.

If QuickBasic detects an error while trying to compile your program, it will remember the details and then carry on compiling. Up to 25 errors can be stored, so you can go and correct them one by one. If Turbo encounters a compile-time error, compilation stops immediately, you correct the error and compilation starts again from the top.

Both packages have error messages in English — no need to get out the manual to look up what numbers mean.

Both have trace modes that let you step line-by-line through a program's execution to find out where errors are occurring.

Conclusion

Turbo Basic is a very usable product. It is quite possible that in a few months, programmers and MS-DOS enthusiasts will think of Microsoft Basic in the way that they now think of Microsoft Pascal. Basic is dead. Long live Basic.

Turbo Basic will cost approximately $210. QuckBasic costs $222.

Turbo Basic requires MS-DOS or PC-DOS version 2.0 or above, both to compile a program and to run it. 640k of RAM is recommended if you want to write reasonably large programs and compile them to memory.

Toolkit routines are promised but no details were available at the time of writing.

END

As this issue went to press, Microsoft announced its counter to Turbo Basic: an upgraded version of QuickBasic which, it claims, outperforms Borland's product. Among the enhancements are support for a maths co-processor; structured programming constructs; and an on-line debugger (allowing programmers to display the source program, variable values and program output at the same time).

Details of Australian availability are not yet known — Ed.

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Micro mania

Using macros with AppleWorks is becoming increasingly popular. Christopher Van Buren serves up a menu of macro programs — Super MacroWorks, AutoWorks, and KeyPlayer.

The latest craze in AppleWorks add-on products is macros. Six months ago 'macro' was a term you'd find primarily in the Lotus 1-2-3 world. Today, AppleWorks users are collecting and programming hundreds of macro files to add power to AppleWorks.

Just what does a macro product do? In short, it lets you reduce any series of keystrokes in AppleWorks (including the Command key) down to a single-key AppleWorks command. By typing the macro command, you're essentially issuing all the keystrokes collected in it. A simple macro might automatically enter your name and address into a word processing file. Just type the macro command (such as solid-apple/N), and the entire name and address appears as if you'd just typed it yourself — except much faster. A more complex macro might automatically enter certain information into a spreadsheet, calculate new values, and then print a specific area of the spreadsheet. Another macro might store all the command sequences you need to set specific page margins in the word processing module.

Macro power is almost a must for AppleWorks users, and you have the luxury of selecting from these three excellent macro programs: Super MacroWorks from Beagle Bros., AutoWorks from The Software Touch, and KeyPlayer from Pinpoint. All these programs are worth recommending, but they have some differences, both in style and in features.

Macro concepts

Let's first cover some common ground. All macros work with solid-apple-key commands which you specify when you create the macro. You can set up one macro, for instance, to be invoked by the solid-apple/C command and another by solid-apple/R. Because each macro is associated with its own command, you can have several macros available at the same time. The three macro programs we're looking at here differ in the number of macros you can have available at once, but each of them lets you combine the solid-apple key with letters and numbers to create many macro commands.

Furthermore, each of the macro programs lets you construct macros in two ways. One way is to record your keystrokes right from the keyboard as you enter them and then play them back at any time by invoking the macro command you've specified. The other way is to create a macro file using a special macro language that consists of keyboard 'tokens'. These tokens represent keys and actions on the keyboard (eg <SPACE> for a press of the space bar). You enter the AppleWorks word processing module and create each macro by typing the tokens you need.

'A macro lets you reduce a series of keystrokes in AppleWorks down to a single-key command.'

The programs can turn the resultant document into a set of working macros by compiling it, a process that resembles programming. You have to know which specific tokens are equivalent to which keystrokes and enter them into the document correctly. If you've made a mistake, a compilation error occurs — just as in Pascal programming. For obvious reasons, you'll find the 'auto-record' method much easier than typing macro tokens, and anyway the programs let you store recorded macros in 'token form' as word processing documents. If you want, you can view them in the word processing module, change them, and restore them.

Although only one word processing document can be compiled and active at a time, you can store as many of them as you like. Thus, you can collect macros into groups and use the group that is most appropriate at any time. Additionally, you can specify in which module (or modules) a macro will be active; some may be for use in the word processing module, others in the database module, for example.

Macro programs require that you 'patch' your AppleWorks disk, meaning that they become part of AppleWorks itself, which makes them fast and easy to use. Unfortunately, many add-on products for AppleWorks also require that you patch the program — and patches of different types don't always work together. Often, you have to patch and repatch AppleWorks in order to get certain products to recognize each other.

Super MacroWorks

Super MacroWorks is an enhaced version of MacroWorks, the first AppleWorks macro program to appear. Because Super MacroWorks is so superior to MacroWorks, I'll concentrate only on it. You should know, however, that Super MacroWorks works only with Version 2.0 of AppleWorks and that MacroWorks works only with the pre-2.0 versions.

Super MacroWorks is the most fea-

At a glance

	Super Macro Works	Auto Works	KeyPlayer
Compatibility with AppleWorks versions	2.0	all	all
Compatibiltiy with other programs	none	Pinpoint	Pinpoint[1]
Maximum length of a single macro (number of keystrokes)	4000	5000	3000
Maximum length of all active macros combined (number of keystrokes)	4000	5000	3000
Number of macro keys active at one time	258[2]	100 plus	70
Number of built-in functions (reserved macros)	10	0	1
Macros operated from menu		●	●
Record mode	●	●	●
Special functions accessible in Record mode	●		●
If/then/else logic	●	●	●[3]
Uppercase/lowercase text conversion	●	●	
Date and time formats	●	●	●[4]
Reads single-character input from keyboard	●	●	●
Reads multicharacter input from keyboard	●	●	●
Can link files	●		
Can print user prompts	●		●
Can tell whether Insert or Edit cursor is active	●	●	
Can read characters from the screen	●		
Dumps the contents of a line to the printer	●		
Compilation errors displayed in context			●
Can create lists in a macro for user selection			●
Can find specific files in a directory	●		
Clock support	●	●	●
Mouse support	●	●	
Auto-start-up macros	●	●	

1. KeyPlayer is also compatible with Point-to-Point, Apple Writer, Word Perfect, and Basic.
2. 56 for each of the modules.
3. KeyPlayer's else logic is more powerful than that of the others.
4. KeyPlayer offers more formats than the others.

ture-packed of the three macro programs under discussion here. It contains dozens of special functions, divided into three types, that you can use in your macros.

Ten of these functions are called 'reserved macros' because you can invoke them by typing specific keystrokes, whether or not you are running the macro program. In a other words, these ten functions are available within AppleWorks — just like having more AppleWorks commands. Since they are always active, you cannot name a custom macro with one of the ten reserved macro names. For example, press solid-apple/' and you get the current date in this format:
November 11, 1986

Other reserved macros include the ability to find any filename when selecting files from disk (especially useful for your custom macros) and the ability to jump to the blank spaces between words (useful in the database module, where you can't otherwise jump between words).

In additon to the ten reserved macros, Super MacroWorks has special functions for recording custom macros. Many of these functions add powerful programming-like abilities to your macros (see Fig 1). For example, the If function tests whether or not a given character matches criteria you've specified. If so, the macro continues; if not, the macro stops.

Other functions let you evaluate information that has been typed from the keyboard and act on that information. The List function lets you run a macro several times; each time the macro uses a different item from the list you created for the function, which comes in handy for simulating random numbers.

Worthy of special note is the Increment function, which changes the character at the cursor position to the next letter in the alphabet, or the next whole number. For example, an *A* becomes a *B*, and a *1* becomes a *2*. The Decrement function has the same effect but in the opposite direction. Used with the logic functions, these commands can change any number to any other number under given conditions.

You can incorporate these special features into your custom macros by simply entering their corresponding solid-apple commands while recording a macro. Super MacroWorks gives you 49 of these functions.

In the ease-of-use department, Super MacroWorks comes out a little behind the other two macro programs. Because of all the special functions and

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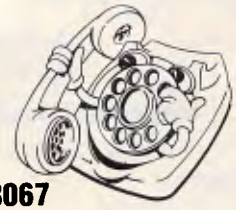

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the difficult-to-remember keystrokes that invoke them, the program can take some time to learn. Also, macro files can be complex and difficult to debug. Super MacroWorks does not show macro errors in context when you're compiling a macro file, but it does have a single-step mode that lets you run a macro step by step. If errors exist, they will certainly turn up in this kind of slow motion.

You'll definitely need the manual for Super MacroWorks. Thankfully, Beagle Bros. did an excellent job on its documentation.

Super MacroWorks comes with some handy bonus programs. One of them lets you personalise the AppleWorks help screens. If you find that you rarely need the help screens, this program lets you replace them with something of your own. You'll probably want to use this feature to display a list of the Super MacroWorks functions. Another bonus program is a simple program selector that lets you see all ProDOS system files in a menu after quitting AppleWorks. You can run any of the system files by simply selecting them from the list. Super MacroWorks also includes a mouse interface for AppleWorks.

AutoWorks

AutoWorks was the first product to introduce 'if/then/else' logic to macros. It also offers many function commands and the ability to load and compile macros right inside of AppleWorks. Since AutoWorks' introduction, the other macro products have also incorporated these features.

AutoWorks is slightly easier to use than MacroWorks because of its handy macro menu. Installing AutoWorks is a breeze, and you can even use it with the Pinpoint accessories. To use both products, however, you must have a memory-expansion card that works in the auxiliary slot of your IIe. Unlike Pinpoint's own macro program, KeyPlayer, AutoWorks can be used while Pinpoint accessories are active. After you've installed AutoWorks on your AppleWorks disk, pressing solid-apple/X calls up the AutoWorks menu (see Fig 2).

The Record Macro command asks you for a macro name and then begins recording your keystrokes. Everything you type is stored until you press solid-apple/X again. To store a recorded macro permanently on disk, use the List command in the word processing module. It lists the macros you've recorded and named (in token version) into a word processing document that you can save to disk. You can use a pre-recorded macro file by loading it into the word processing module and using the Update Macro command, which compiles the macro file and makes it the active set of macros.

```
File: Pseudo Soft              REVIEW/ADD/CHANGE              Escape: Main Menu
start

  -- List Command --
l:<awp><if>L<right><if>I<right><if>S<right><if>T<right
<rtn><rtn>10 FOR I=1 TO 10<rtn>20 PRINT SPC(I*10);I<rtn
30 NEXT I:END<rtn>@<left>'

  -- New Command --
n:<awp><if>N<right><if>E<right><if>W<right>
<insert><oa-e><oa-f>m1<rtn>n<down><oa-d><oa-9><rtn><zoom>
<oa-o>cn<rtn><esc>PSEUDO - SOFT 1.0<rtn>COPYRIGHT BEAGLE BROS, 1986<rtn>
<oa-o>uj<rtn><esc><rtn>@<left>'

  -- Catalog Command --
c:<awp><if>C<right><if>A<right><if>T<right>
<menu><sa-0>5<Rtn>2<Rtn><input><resume><sa-0><rtn>@<left>'

  -- Load Command --
g:<awp><if>L<right><if>O<right><if>A<right><if>D<right>
<sa-ctrl-s><sa-ctrl-g><swap><menu><sa-0><swap><rtn><rtn><find><rtn>
--------------------------------------------------------------------------------
Type entry or use @ or  cmds          Line 24  Column  1       @-? for Help
```

Fig 1 Super MacroWorks custom macros. Notice the If function in the macros; it tests whether or not a given character matches the criteria the macro specifies

When recording macros, you have several special functions at your disposal. AutoWorks calls its functions keywords. One function that does not

```
AutoWorks Menu

1.  Mail Merge
2.  Read Disk
3.  Update Macros
4.  Record Macro
5.  Disable Macros
6.  List Macros
```

Fig 2 The AutoWorks menu

appear in the other products is the keyword SUB, which lets you redefine the keys on the keyboard, substituting any character for any other character.

AutoWorks' functions do not have keyboard equivalents, so you have to enter them into the word processing version of a macro, which complicates adding special functions to your custom macros. AutoWorks comes with sample macro files that you can use right away, but the manual could use more detail regarding the special functions.

The AutoWorks program has more than just macro power. It comes with some extra features that make it excellent value. One is a well-written mail-merge feature for AppleWorks that is useful for pre-2.0 versions of AppleWorks. (AppleWorks 2.0 has mail-merge built-in.) It appears on the AutoWorks menu when you press solid-apple/X. Another bonus program reads ProDOS disk directories into the AppleWorks database after you issue the appropriate command on the same solid-apple/X menu. After reading several disks into the database module, you can print sorted listings of all your files. When AutoWorks is installed on your AppleWorks disk, you get built-in mouse capabilities as another bonus.

KeyPlayer

KeyPlayer is from Pinpoint, famous for its AppleWorks desktop accessories. In fact, KeyPlayer is a desktop accessory — one of its biggest advantages over the other two programs. Because it's a Pinpoint accessory, it works with the other Pinpoint accessories. If you already own Pinpoint accessories, KeyPlayer is easy to add to the list. If you don't already have Pinpoint accessories, you'll need to get them if you want to get KeyPlayer, because KeyPlayer requires the installation disk that comes with the basic accessory kit.

This requirement makes KeyPlayer the most expensive of the macro programs. On the other hand, KeyPlayer is the only macro program that incorporates the interaction of the Pinpoint accessories. Like the other accessories, KeyPlayer works with programs other than AppleWorks, in-

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cluding Apple Writer, Word Perfect, Basic, and all of Pinpoint's stand-alone products. Integration and expandability are the biggest advantages of KeyPlayer (and Pinpoint products in general). The only disadvantage of KeyPlayer's accessory status is that the program takes up to 15 seconds to load from disk when you call it from the accessory menu. Once loaded into RAM, KeyPlayer compiles and runs macros quickly, and if you use the program with a RAMdisk or accelerator card, speed is not a problem. KeyPlayer is still the slowest of the macro programs, however.

Installing KeyPlayer is fairly straightforward. Just copy the KeyPlayer accessory file to the disk containing the other accessories (your AppleWorks disk, if it has the capacity) and then update the installation disk and install Pinpoint onto a fresh copy of your AppleWorks start-up disk. All the accessories will appear in a pop-up menu when you press solid-apple/P.

When you select KeyPlayer from the list of accessories, you enter the Macro mode, where all other accessories are blocked from use. Pressing solid-apple/P no longer brings up your Accessory list; rather, it brings up the KeyPlayer main menu. Like the AutoWorks menu, this menu lets you load existing macros files from disk, compile macro files, record new macros, disable macro keys, and store new macro files onto disk. It also has an option for quitting the macro mode and returning to the other desk accessories.

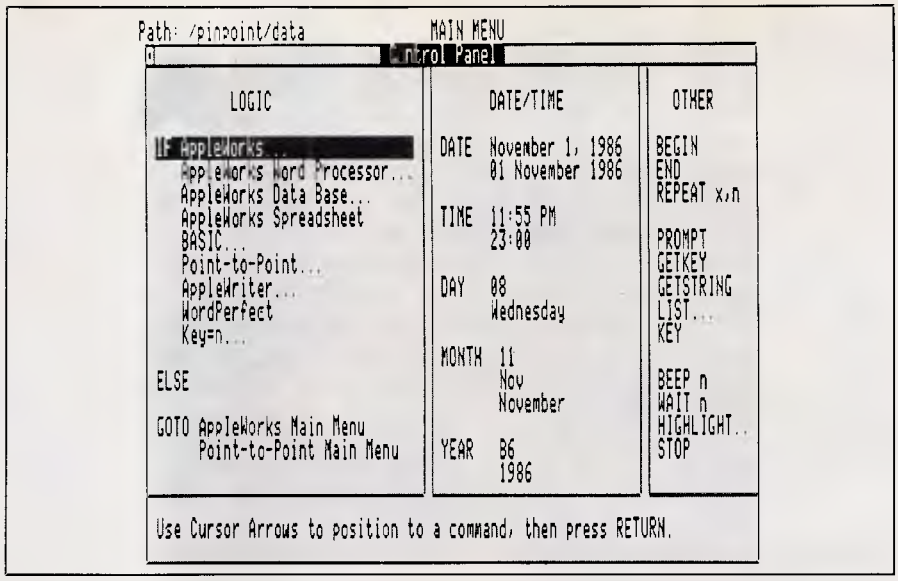

Fig 3 KeyPlayer gives you the option of quitting the macro made and returning to the other desk accessories

This macro menu earns KeyPlayer good marks in the ease-of-use department, but KeyPlayer goes even further. One of its most convenient features is its control panel (see Fig 3).

The control panel is accessible from the KeyPlayer menu and contains all the logical and special functions available for your custom macros. Instead of memorising strange commands to invoke special functions within a macro, simply call up the control panel and highlight the desired function. KeyPlayer has slightly more than 30 special functions, compared to Super MacroWorks' 49 and AutoWorks' 25. (See the comparison chart included in this article for details about the functions each of these products offers. You'll find that each of them has at least a few functions the others don't.)

Pinpoint added some important extras to KeyPlayer for serious macro makers. For example, macro listings in the word processing module are in hierarchical form: branched statements are indented for easier debugging. KeyPlayer is also the only program that displays compilation errors in context. Finally, Pinpoint lets you view all available macro files by using the Load command on its main menu. You can immediately load and compile any of the files.

KeyPlayer offers a few original functions, including one that pauses a macro for a chosen number of seconds from 1 to 255 and another that automatically highlights a chosen range of cells of a spreadsheet.

KeyPlayer comes with a sample macro file and a well-written manual. The program also shows you how to convert AutoWorks and MacroWorks (but not Super MacroWorks) macros to KeyPlayer macros. The same procedures can be translated so that Super MacroWorks and AutoWorks can convert other macro files to their formats.

END

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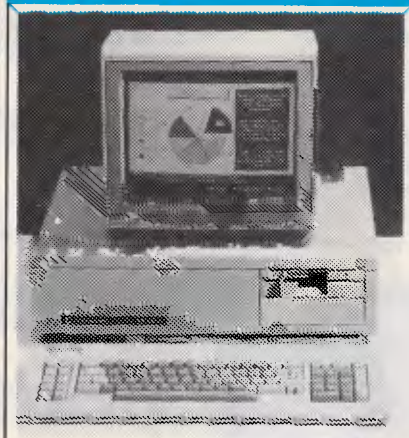

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Balancing the scales

In the third part of his series on programming in Prolog, Mike Liardet introduces the language's list-processing and data-structuring facilities.

There are twelve pool balls, numbered 1 to 12. Eleven of the balls are of identical weight, but one of the balls is slightly 'out'. Devise a scheme for weighing the balls on balance-scales, to determine which ball is the wrong weight and whether it is over or underweight. The outcome of each weighing will either be that the scales balance or else the left-hand pan will be heavier than the right, or vice versa. No more than three weighings are allowed.

No, you haven't turned to this month's problem in *APC*'s Lazing Around: the solution to the 'pool problem' given above is an ideal example for expressing in Prolog.

The first two sections of this article will describe just what are Prolog 'structures' and 'lists', and how they can be used.

The third and final section will describe how Pro-log can solve the pool ball puzzle. Lists and structures are indispensable to the Prolog solution of this problem, so this provides an excellent illustration of how they might be used 'in anger'.

We have already seen how Prolog programs can manipulate and reason with constants — either symbolic constants (for example, names like Sydney, Melbourne, and so on) or numerical constants (for example 12,12.34, 99, and so on). A number of interesting problem areas can be attempted using just constants, but Prolog's problem-solving power can be greatly extended by the use of structures and lists which, between them, allow highly complex data structures to be built.

Remember that all the example programs given here are written in Turbo Prolog and may need some modification before they will work with other versions of Prolog. Most notably, the declarations at the top of each example (everything up to and including the word 'clauses') should be omitted for other Prologs.

Structures

In programming, a structure is typical-

```
domains
        item = clothes(symbol,integer,symbol);
               sweets(symbol,integer,integer);
               book(integer,symbol,symbol,symbol,integer)
predicates
        instock(item)
        reorder_sweets(symbol)

clauses

instock(clothes(sweaters,5,medium)).
instock(sweets(jazz_drops,10,35)).
instock(book(3,algorithms,sedgewick,addison_wesley,1983)).

reorder_sweets(X):-
        instock(sweets(X,Y,_)),
        Y<20.
```

Fig 1 Examples of structures

```
domains
    intlist = integer*
    symlist = symbol*

predicates
    possible_pet(symlist)
    ditty(symlist)
    cent_and_fahr(intlist)
    empty(symlist)

clauses
ditty([yo, ho, ho, with, a, bottle, of, rum]).
ditty([hi, ho, hi, ho, its, off, to, work, we, go]).
cent_and_fahr([0,32,15,59,100,212]).
possible_pet([cat, dog, hamster, budgie]).
empty([]).
```

Fig 2 Examples of lists

ly used when it is desirable to represent, as a single unit, an object with a number of attributes. Languages like Pascal and C have good structure facilities, but some programming languages offer nothing at all. For example, Fortran and Basic programmers must manage without them and most versions of Lisp have only a fairly weak 'property list' facility which is a poor substitute for the real thing.

In Prolog, structures are created almost as a 'side-effect' of stating a fact. For example, a stock-control program may contain the following fact clause:
instock(clothes(sweater,5,medium)).
meaning that there are five medium-sized sweaters in stock. The 'clothes(sweaters,5,medium)' is the structure, a single object as far as 'instock' is concerned, but actually containing three attributes — sweater, 5 and medium. Turbo Prolog differs from other Prologs in that structures have to be declared at the beginning of the program in the traditional manner.

In some situations a programmer could choose to represent the above clause, without using a structure, as:
in_stock(sweaters,5,medium).
But what if there are other different *types* of item in stock as well? Referring to Fig 1, after the sweaters stock record, the two remaining fact clauses state that there are also in stock: 10kg of Jazz Drops, selling at 35c a quarter; and three copies of the book *Algorithms* by Sedgewick, published by Addison-Wesley in 1983. The information on sweets, books and clothes is quite different, but by using structures to represent each different type of item, it would still be possible to make a general enquiry of 'instock'. For example, with the program in Fig 1, try the goal:
instock(X)
This should give a run-down on everything in stock, of whatever type.

With the structure representation, it is also possible to be more specific and write programs to seek out certain types of stock item. For example, the 'reorder_sweets' clause in Fig 1 determines which sweets have to be re-ordered by checking which ones are in stock, but in quantities of less than 20kg. And it ignores entirely any stock items which are not sweets. If you try the goal:
reorder_sweets(X).
the system should tell you that Jazz Drops are running short.

Structures can be nested so that one of the items of a structure can itself be another structure, and possibly of the same type. This facility is invaluable for building up recursive data structures, such as 'trees'. I won't elaborate further here, but the solution to the pool ball problem below uses structures this way to build a 'decision tree'.

In Prolog jargon 'sweets', 'book' and 'clothes', as used above, are called 'functors'. The contents in the brackets following a functor are simply referred to as the arguments — they can be thought of as the attributes of the particular record being represented. Notice that the syntax of structures is the same as that of relations. (We have already dealt with relations — they are simply the goals, or heads of clauses). Out of context, it is not possible to tell whether, say:
person(fred,29,20000,manager)
is a relation or a structure. Used as a relation, it could occur as it stands, in a Prolog program as just a fact clause. Alternatively, as a structure it could appear as a term in a clause such as:
seen_in_my_street(person(fred,29,20000,manager)).

This similarity between relations and structures is deliberate, and advanced users can make use of it by writing programs to create structures which can then be executed as programs. We won't be doing that at this stage, though!

Lists

The list in Prolog is analogous to the array in other programming languages. Prolog does not have arrays, and most other languages do not have lists. In programming, both arrays and lists are used for similar reasons, usually to represent *sequences* of data. There are pros and cons as to which representation is the more effective, but that's another matter.

Lists are written in Prolog in square brackets, with each element separated from the next by a comma. Some typical lists might be:
[cat, dog, hamster, budgie]
[yo, ho, ho, with, a, bottle, of, rum]
[hi, ho, hi, ho, its, off, to, work, we, go]
[0,32,15,59,100,212]
[]
and these might appear in clauses, such as those in Fig 2. Lists can appear anywhere in clauses, and not just in the head as we have shown here. Notice that the empty list, denoted by '[]', is perfectly legitimate.

In most Prologs, lists can also contain other lists as elements, or mixed symbols and numbers, and so on, but

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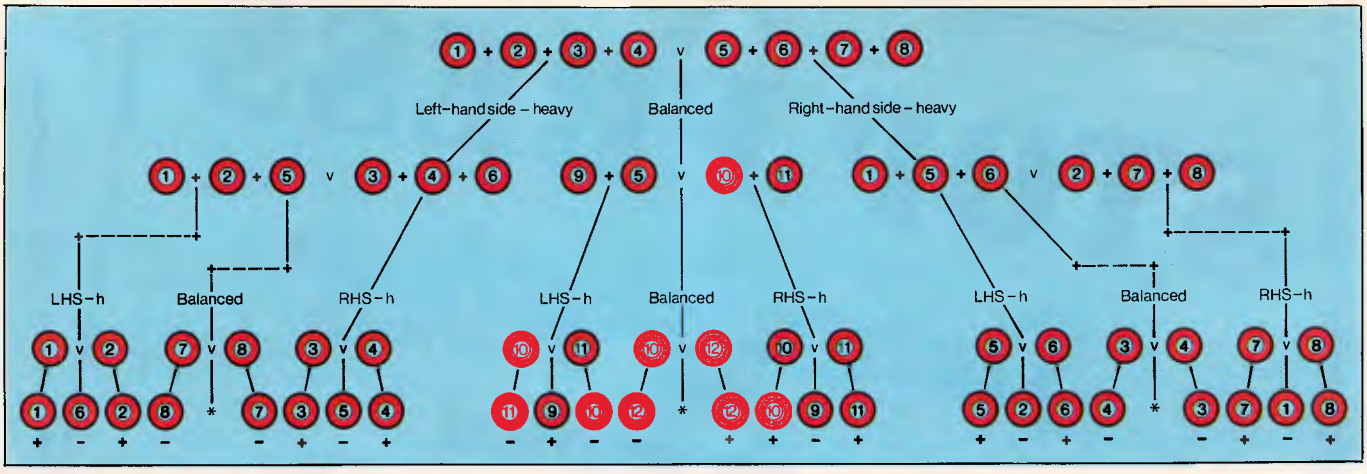

Fig 3 Decision tree solution to the pool ball problem

Turbo Prolog is more restrictive. Concentrating solely on the 'ditty' clause of Fig 2, try the following command-line goals:

```
ditty(P).
ditty([yo, ho, ho, with, a, bottle, of, rum])
ditty([P, Q, R, with, a, bottle, of, rum])
ditty([yo, P, P, with, a, bottle, of, rum]).
```

These goals all match with the ditty clauses in a fairly obvious way. Most of the effects could have been achieved without lists at all — just by dropping the '[' and ']' in both the goals and the fact clauses. Barring any system complaints that the two ditty fact clauses each have different numbers of arguments, the results would be much the same.

Here are some more interesting goals:

```
ditty([yo, ho, ho | Rest]).
ditty([yo | Rest]).
ditty([yo, P, ho, with, a, bottle, of, rum | Rest]).
```

Notice the mysterious ' | ' symbol used in these goals: it is not an exclamation mark, but a vertical bar. It is only used in lists, and it is highly unusual for it to be followed by anything other than a single variable name.

When Prolog matches a ' | 'ed list with another list, everything to the left of the ' | ' must match, element by element, with the other list. But the variable to the right of the vertical bar is simply matched with the remainder of the other list.

The list expression '[X | Y]' is very commonly used. When such a list is matched with another list, it prises apart the first element of the other list (the 'head') from the rest of it (the 'tail'). It will always match with any list, except for the empty list. Try the goals:

```
ditty([X | Y]).
empty([X | Y]).
```

to see what this means.

The ' | ' list notation is indispensable for creating list processing procedures which can handle general lists of any length. The utilities for solving the pool ball problem (Fig 7) contain some general-purpose list processing facilities, and I'll describe some of them here. The reader can try them out in isolation if he or she wishes. They do not require the presence of any other clauses — only the relevant 'domain' and 'predicate' declarations of Fig 5.

- 'member' determines whether or not an element is in a list. The first clause states that an element X, is a member of a list if it is at the head of the list. The second clause states that X is a member of the list if it is (recursively) a member of the list without its head.
- 'append' joins the first two list arguments together, returning the result as the third argument. The first clause states that appending any

```
node([1,2,3,4],[5,6,7,8],
     node([1,2,5],[3,4,6],
          node([1],[2],heavy(1),light(6),heavy(2))
          ...)
     ...
     node([5,6,1],[7,8,2],
          ...
          node([7],[8],heavy(7),light(1),heavy(8))))
```

Fig 4 Formatted printout of part of the data structure

```
domains
        maxwings, count = integer
        balls = count*
        tree = node(balls,balls,tree,tree,tree);
               heavy(count);light(count);impossible
predicates
        solve(balls,maxwings,tree).
        gentree(count,balls,balls,balls,balls,maxwings,tree).
        genleftheavy(count,balls,balls,balls,balls,maxwings,
                     balls,balls,balls,tree).
        genrghtheavy(count,balls,balls,balls,balls,maxwings,
                     balls,balls,balls,tree).
        genbalence(count,balls,balls,balls,balls,maxwings,
                   balls,balls,balls,tree).
        enough_weighings(balls,balls,balls,maxwings).
        select(balls,balls,count,balls,count,balls).
        try_weighing(count,balls,balls,balls,balls,balls,balls,balls).
        eachside(count,count).
        unheavy(balls,balls,balls,balls,balls,balls,balls,balls,balls).
        unlight(balls,balls,balls,balls,balls,balls,balls,balls,balls).
        unboth(balls,balls,balls,balls,balls,balls,balls,balls,balls).
        shift(balls,balls,balls,balls,balls).
        member(count,balls).
        length(balls,count).
        expo(count,maxwings,count).
        append(balls,balls,balls).
        print_tree(tree,integar).
        spa(integer).
        use(tree).
        acton(char,tree,tree,tree).
```

Fig 5 Declarations for the pool ball program

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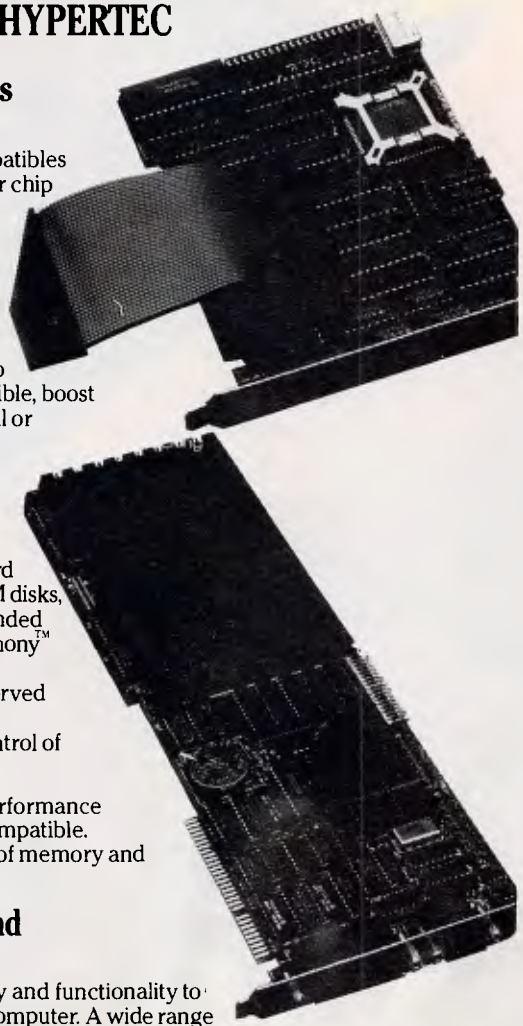

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list to the empty list just results in that list. The second clause states that to append any list to a non-empty list, it is necessary to recursively append the list to the non-empty list without its head and then add the head (X) onto the result.

- 'length' calculates the length of a list. The first clause gives the length of the empty list as zero. The second clause calculates the length of a non-empty list as 1 + (recursively) the length of the list without its head.

Try these predicates with the following goals:

```
length([1,2,3]Ans).
member(99,[1,2,3,99,4,5,6])
append([1,2,3],[4,5,6],Ans)
```

As with many predicates in Prolog, all three of these list processing facilities can also be used in other ways, even though they may not have been conceived with alternative uses in mind. Try:

```
length(Ans,5).
member(X,[1,2,3,4]).
append([1,2,3| X],Y,[1,2,Z,4,5]).
```

The 'length' goal constructs a list of five elements (if working in Turbo Prolog ignore the warning message) and then tries to find alternative solutions *ad infinitum.* The 'member' goal finds the four values of X which are members of the list, and the 'append' goal finds various combinations of values for X, Y and Z which satisfy that 'append' relationship.

Solving the pool ball problem

In this section I'll first describe the methodology for solving the pool ball problem, then define a data structure for representing the problem solution, and then describe how the accompanying Prolog program actually works to produce this solution. This program is more complicated than the average beginner's program so it may be necessary to expend some effort to fully understand it. A useful tip is to try out lower-level predicates, on their own, as goals on the command line. This can be very useful in comprehending how they work.

There are many ways in which the Prolog program can be enhanced, and at the end of this section I'll present some suggestions for improving it. Since the program works extensively with lists and structures, implementing these suggestions should provide ample opportunity for programming practice with both these types of Prolog data structure. At the same time, attempting some of these improvements should give the reader the opportunity to grapple with some real artificial intelligence issues.

```
clauses

/* solve(Balls,Max_num_of_weighings,Tree) */
solve(PLH,Maxwings,Tree):-
        length(PLH,Nballs),
        gentree(Nballs,[],[],[],PLH,Maxwings,Tree).

/* gentree(Number_of_balls,P,PL,PH,PLH,Max_num_of_weighings,Tree) */
gentree(_,_,[],[],[],_,impossible).
gentree(_,_,[Wrongun],[],[],_,light(Wrongun)).
gentree(_,_,[],[Wrongun],[],_,heavy(Wrongun)).
gentree(Nballs,P,PL,PH,PLH,Maxwings,
            node(Left,Rght,Iflheavy,Ifbalance,Ifrheavy)):-
        enough_weighings(PL,PH,PLH,Maxwings),
        try_weighing(Nballs,P,PL,PH,PLH,Left,Rght,Rest),
        Maxwings1 = Maxwings - 1,
        genleftheavy(Nballs,P,PL,PH,PLH,Maxwings1,Left,Rght,Rest,Iflheavy),
        genbalance  (Nballs,P,PL,PH,PLH,Maxwings1,Left,Rght,Rest,Ifbalance),
        genrghtheavy(Nballs,P,PL,PH,PLH,Maxwings1,Left,Rght,Rest,Ifrheavy).
        genbalance(Nballs,P,PL,PH,PLH,Maxwings,Left,Rght,_,Tree):-
                unboth(Left,P ,PL ,PH ,PLH, P1,PL1,PH1,PLH1),
                unboth(Rght,P1,PL1,PH1,PLH1,P2,PL2,PH2,PLH2),
                gentree(Nballs,P2,PL2,PH2,PLH2,Maxwings,Tree).
        genleftheavy(Nballs,P,PL,PH,PLH,Maxwings,Left,Rght,Rest,Tree):-
                unlight(Left,P ,PL ,PH ,PLH, P1,PL1,PH1,PLH1),
                unheavy(Rght,P1,PL1,PH1,PLH1,P2,PL2,PH2,PLH2),
                unboth(Rest, P2,PL2,PH2,PLH2,P3,PL3,PH3,PLH3),
                gentree(Nballs,P3,PL3,PH3,PLH3,Maxwings,Tree).
        genrghtheavy(Nballs,P,PL,PH,PLH,Maxwings,Left,Rght,Rest,Tree):-
                unheavy(Left,P ,PL ,PH ,PLH, P1,PL1,PH1,PLH1),
                unlight(Rght,P1,PL1,PH1,PLH1,P2,PL2,PH2,PLH2),
                unboth(Rest, P2,PL2,PH2,PLH2,P3,PL3,PH3,PLH3),
                gentree(Nballs,P3,PL3,PH3,PLH3,Maxwings,Tree).

        try_weighing(Nballs,P,PL,PH,PLH,Left,Rght,Rest):-
                eachside(Nballs,Capac),
                select(P,      [],   Capac,  Left1,Lcapac1,Prest),
                select(PL,     Left1,Lcapac1,Left2,Lcapac2,PLrest),
                select(PH,     Left2,Lcapac2,Left3,Lcapac3,PHrest),
                select(PLH,    Left3,Lcapac3,Left ,0       ,PLHrest),
                select(PLrest, [],   Capac,  Rght2,Rcapac2,PLrest1),
                select(PHrest, Rght2,RCapac2,Rght3,Rcapac3,PHrest1),
                select(PLHrest,Rght3,RCapac3,Rght, 0,      PLHrest1),
                append(PHrest1,PLHrest1,Rest1),
                append(PLrest1,Rest1,Rest2),
                append(Prest,Rest2,Rest).

        enough_weighings(PL,PH,PLH,Maxwings):-
                Maxwings >= 1,
                length(PL,PLlen),
                length(PH,PHlen),
                length(PLH,PLHlen),
                expo(3,Maxwings,E),
                PLlen + PHlen + 2 * PLHlen <= E.

        /* select(Balls,List,Max,Listnew,Maxnew,Remaining) */
        select(Balls,List,Max,List,Max,Balls).
        select([Ball|Balls1],List,Max,[Ball|List1],Maxnew,Remaining) :-
                Max >= 1,
                Max1 = Max - 1,
                select(Balls1,List,Max1,List1,Maxnew,Remaining).

        unheavy(Allthese,P,PL,PH,PLH,Pnew,PLnew,PHnew,PLHnew):-
                shift(Allthese,P,PH,Pnew,PHnew),
                shift(Allthese,PL,PLH,PLnew,PLHnew).
        unlight(Allthese,P,PL,PH,PLH,Pnew,PLnew,PHnew,PLHnew):-
                shift(Allthese,P,PL,Pnew,PLnew),
                shift(Allthese,PH,PLH,PHnew,PLHnew).
        unboth(Allthese,P,PL,PH,PLH,Pnew,PLnew,PHnew,PLHnew):-
                shift(Allthese,P,PL,P1,PLnew),
                shift(Allthese,P1,PH,P2,PHnew),
                shift(Allthese,P2,PLH,Pnew,PLHnew).
```

Fig 6 Main predicates for the pool ball program

Before reading any further, the reader may care to attempt to solve the problem manually. There are many possible solutions, but they are by no means obvious.

Having solved the pool ball problem manually, it is fairly natural to write the solution in the form of a 'decision tree'. Fig 3 shows one solution (equivalent to the one generated by the program), with the decision tree represented graphically. At the top of the tree is the instruction for the first weighing: weigh balls 1-4 in the left-hand pan of the scales against 5-8 in the right. The three branches immediately below this instruction represent the three possible outcomes of this weighing — left-hand pan heavy, scales perfectly balanced, or right-hand pan heavy.

Depending upon the outcome of the first weighing, different weighings are specified at the end of the three branches. For example, if the result of the first weighing were that the balls in the left-hand pan were found to be heavy, then the second weighing must weigh balls 1, 2, 5 against 3, 4, 6. Depending upon the result of this weighing, one of the three weighings below it should be attempted, and the outcome of this final third weighing will determine the incorrect ball. For example, if 1, 2, 5 and 3, 4, 6 balance and then 8 is found to be heavier than

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```
/* shift(Allthese,Tothis,Fromthis,Tothisresult,Fromthisresult) */
shift(_,Tothis,[],Tothis,[]).
shift(Allthese,Tothis,[X|MoreXs],[X|Tothisresult],Fromthisresult):-
        member(X,Allthese),
        shift(Allthese,Tothis,MoreXs,Tothisresult,Fromthisresult).
shift(Allthese,Tothis,[X|MoreXs],Tothisresult,[X|Fromthisresult]):-
        not(member(X,Allthese)),
        shift(Allthese,Tothis,MoreXs,Tothisresult,Fromthisresult).

/* eachside(Nballs,N) */
eachside(Nballs,1):-
        2<=Nballs.
eachside(Nballs,N):-
        4<=Nballs,
        Mballs = Nballs - 2,
        eachside(Mballs,M),
        N = M + 1.

/* member(X,List) Is X a member of List? */
member(X,[X|_]).
member(X,[_|MoreXs]):-
        member(X,MoreXs).

/* append(List1,List2,Listboth) */
appeod([],List,List).
append([X|Xs],List,[X|XsList]):-
        append(Xs,List,XsList).

/* length(List,N) length of list */
length([],0).
length([_|Xs],N1):-
        length(Xs,N),
        N1 = N + 1.
/* Exponentiation M**N = P */
expo(M,N,P) :- exp(N*ln(M)) = P.
```

Fig 7 Utilities for the pool ball program

7, then 7 is the odd ball and it is light. This is written as '7 —' in the diagram (similarly the notion 'x +' means the ball x is found to be heavy). Notice that 8 and 7 should never balance at this point — this is a logical impossibility represented by '*' in the diagram.

Finding a solution to the pool ball problem involves some logical deduction and some guess work, and Prolog is uniquely suited to doing both. A typical approach used by the program and in manual solutions, is to guess at the weighing instructions at the start/top 'node' in the decision tree, and for each of the three possible outcomes, derive what new information will then be known about the balls. For each of these outcomes another guess at a weighing is made, followed by further deductions, and so on.

Finally, if the result of all the third weighings is that a definite odd ball can be identified, then a solution to the problem has been found. Otherwise, one or more of the weighing instructions must be changed. Of course, the program is very systematic about 'guessing' and changing the weighing instructions; human solvers tend to work more erratically but with greater intuition.

The deductions that can be made following a weighing are as follows:

(1) If the scales balance then all the balls in the scales must be perfect, and there are no further conclusions to be reached about any of these balls.

(2) If the balls in the left-hand pan are heavier than those in the right, then none of the left-hand balls can be light, none of the right-hand balls can be heavy, and all the other balls must be perfect.

(3) If the balls in the right-hand pan are heavier than those in the left, then none of the right-hand balls can be light, none of the left-hand balls can be heavy and all the other balls must be perfect.

(4) If all but one ball in known to be perfect, and that one ball cannot be heavy/light, then it is the odd ball and it is light/heavy.

(5) If all the balls are found to be perfect, then an impossible situation has arisen — the scales are lying!

To see how these deductions work, consider the decision tree in Fig 3 and the deductions that would be made for one possible sequence of weighings. Before the first weighing, all the balls can be considered to be perfect, light or heavy (PLH for short). Suppose the result of the first weighing is that the scales balance. Using rule (1) above, this means that balls 1-8 are perfect (P) and 9-12 are still PLH. If the result of the second weighing, 9 and 5 against 10 and 11, is that the 9 and 5 appear heavier, then using rule 2, 9 and 5 cannot be light, 10 and 11 cannot be heavy and all the other balls must be perfect. Consolidating all this new information, 1-8 and 12 are P, 9 is perfect or heavy (PH), and 10 and 11 are perfect or light (PL). Following this, if the result of weighing 10 against 11 is that 11 appears heavier, then using rule (3), ball 10 is PL and all the rest are perfect. Then, by rule 5, ball 10 must be the odd ball and it is light. This is the outcome recorded in the decision tree of Fig 3.

The objective here is to create a Prolog program that will find a solution to the problem and create a data structure equivalent to the graphical decision tree of Fig 3. This data structure will involve both Prolog lists and structures, and a partial printout of it is shown in Fig 4. The solution is represented by a Prolog 'node' structure which specifies the action to be taken for the first weighing, and then the further actions to be taken depending on the outcome of this weighing. The node structure has five components: a list of the balls to be placed in the left-hand pan; a list of the balls for the right-hand pan; and the three actions to be taken for the three possible outcomes of the first weighing. These three actions are themselves node structures, specifying further weighings and so on. Ultimately this nesting of nodes is terminated by a conclusion: either a structure of the form 'light(N)' or 'heavy(N)' indicating which ball is heavy or light, or the symbol 'impossible'.

The Prolog program (Figs 5-8) has been slightly generalised to attempt to solve the problem for any number of balls, with a maximum number of weighings specified. It can also print out the solution and test it by running an interactive weighing session to identify the odd ball. Fig 5 contains the declarations, needed only by Turbo Prolog users. Fig 6 contains the main predicates involved in the generation of the solution. Fig 7 contains some simple utilities needed by the main predicates while Fig 8 contains the solution printer and tester. Turbo Prologers should combine the code in the four figures into one file; non-Turbo Prologers can omit Fig 5, but may possibly need to modify some of the code to fit their Prolog. To test the program, run it with a simpler problem such as:

```
solve([1,2,3],2,Tree),print_tree(Tree,0),
use(Tree).
```

This three-ball problem in two weighings should be solved almost instantaneously. When this is working, try the real problem:

```
solve([1,2,3,4,5,6,7,8,9,10,11,12],3,
Tree),
print_tree(Tree,0),use(Tree).
```

In Turbo Prolog 'solve' can take up to three minutes, depending on the hardware running it. It may take considerably longer for interpreted Prologs, so be patient.

It is also possible to replace 'use(Tree)' in the above goals with 'fail' to force backtracking and thus generate

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```
/* use(Tree) - dialogue with user */
use(light(N)):-
        write("Ball ",N," is light."),nl.
use(heavy(N)):-
        write("Ball ",N," is heavy."),nl.
use(impossible):-
        write("That's impossible."),nl.
use(node(Left,Right,Iflheavy,Ifbalanced,Ifrheavy)):-
        write("Left  = ",Left),nl,
        write("Right = ",Right),nl,
        write("Result? (L)eft heavy, (B)alanced, (R)ight heavy:"),
        readchar(C),
        acton(C,Iflheavy,Ifbalanced,Ifrheavy).
acton('L',Iflheavy,_,_):-
        write("Left heavy"),nl,
        use(Iflheavy).
acton('R',_,_,Ifrheavy):-
        write("Right heavy"),nl,
        use(Ifrheavy).
acton(_,_,Ifbalanced,_):-
        write("Balanced"),nl,
        use(Ifbalanced).

/* print_tree(Tree,Indent) */
print_tree(light(N),Indent):-
        sps(Indent),write("Ball ",N," is light."),nl.
print_tree(heavy(N),Indent):-
        sps(Indent),write("Ball ",N," is heavy."),nl.
print_tree(impossible,Indent):-
        sps(Indent),write("Impossible."),nl.
print_tree(node(Left,Right,Iflheavy,Ifbalanced,Ifrheavy),Indent):-
        sps(Indent),write("Left  = ",Left),nl,
        sps(Indent),write("Right = ",Right),nl,
        Ind8 = Indent + 8,
        print_tree(Iflheavy,Ind8),
        print_tree(Ifbalanced,Ind8),
        print_tree(Ifrheavy,Ind8).

sps(0).
sps(N):- N > 0,write(" "),N1 = N - 1,sps(N1).
```

Fig 8 Printout and test predicates for the pool ball program

multiple solutions to the problem. The first solution is the one represented in the decision tree of Fig 3, but there are many, many others, as you will see for yourself if you try it. When responding to the 'test' part of the program, make sure that any 'l' and 'r' responses are in lower case. The software treats any other characters, including 'L' and 'R', as a 'b' for 'balanced'.

I'll now give an overview of each of the predicates defined in Fig 6. This is the core of the program, and the rest of it should be easy to follow when this part has been understood.

- 'solve' calculates the number of balls in the problem and hands over the task of problem solution to 'gentree', putting all the balls in the PLH category, with P, PL and PH categories empty (that is, empty lists, written as '[]').
- The first three clauses of 'gentree' check to see if the problem can be solved immediately, implementing rules (4) and (5) above. The fourth clause checks that a solution is possible with the number of weighings left; generates a possible weighing; reduces the number of weighings left; and then generates a decision tree for each of the three possible outcomes, using 'genleftheavy' and so on. These last three calls recursively call on 'gentree' which can fail on the 'enough_weighings' test, or run out of alternative weighings. This will cause backtracking so that an alternative possible weighing will be sought by 'try-weigh'.
- 'genbalance', 'genleftheavy' and 'genrightheavy' implement the rules (1) and (3) above, and create new P, PL, PH and PLH categories for the recursive call to 'gentree'. For example, 'gentleftheavy' uses 'unlight' to move any balls in the left-hand pan from the PL category to P, and from the PLH category to PH. The 'unheavy' and 'unboth' calls cause further category movements to be made for balls in the right-hand pans and for balls not in the scales. 'gentree' is then called with the new category arrangement (but with one less weighing available from before).
- 'tryweighing' generates possible weighing configurations, with all the balls allocated between the left and right pans or not on the scales (the 'Rest'). Used with backtracking it can repeatedly produce alternative weighing possibilities. But in order to allow the program to reach a solution in reasonable time, it avoids regenerating some of the trivial variations of weighings that have already been rejected. For example, for the first weighing (when all the balls are PLH) it only generates the six fundamentally different possibilities — one per side up to six per side (there are actual-

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ly several million possibilities that could be generated). Firstly, it decides how many balls can be used each side, and then uses 'select' to fill up the left-hand pan with balls from each of the four categories. Then it fills up the right-hand pan with balls from three categories, ignoring perfect balls. (There is never a need to place perfect balls on both sides of the scales as they cancel each other out, so arbitrarily they are excluded from the right-hand pan.) All the balls left over after both the pans have been filled are then grouped together into 'Rest' by the calls to 'append'.

- 'enough_weighings' is used by 'gentree' to calculate whether there are enough weighings left to solve the problem. Observe that if there is one weighing left, then there will be three outcomes from it. If there are two there will be 3**2=9, if there are three then it's 3**3=27, and so on. However the number of balls in the PL, PH and PLH categories determines the number of possibilities still to be dealt with, and this cannot exceed the number of outcomes available. Notice that there are always two possibilities still to be dealt with for each ball in the PLH category, but only one for PL and PH.
- 'select' is used by 'try_weighing' to add balls from one category into a scale pan. It can choose to put no balls into the scale pan, or any number right up to filling the scale pan to the maximum, previously determined by 'eachside'.
- 'unheavy', 'unlight' and 'unboth' are used to remove the possibility of specified balls being heavy or light, by moving them as appropriate between the four categories. 'unboth' is used to specify that certain balls are neither light nor heavy — that is, they must all be moved to the 'perfect' category.

Conclusion

There are many ways in which the Prolog program here can be enhanced. One way is to further reduce the number of combinations of weighings that are attempted so that optimally, the system only considers relevant weighings and not weighings that are trivial variations of those it has already considered. It is also possible to improve the efficiency of the program.

Next month: built-in predicates

END

*This is part three of our prolog series. Parts one and two appeared in the March and April issues of **APC**, cpoies of which are available from our Back Issues department.*

Homework

Write a program to sort a list of numbers into ascending order. Use any sorting algorithm you like, or experiment with different ones. The program should transform the list:

[3, 7, 1, 12, 5, 3, 19]

into:

[1, 3, 3, 5, 7, 12, 19]

Solution to last month's homework: tabulating cosines and square roots

The program below solves last month's homework problem. Run it with the goal 'go' to generate the required output. The problem could easily have been solved in a conventional language by using FOR loops, and so on. In the solution here, the 'iterate' clauses fulfil the same function as a FOR loop, with 'doline' being the 'contents' of the FOR loop.

```
predicates
  go
  iterate(integer,integer)
  doline(integer)
clauses
go:—
  write("  I          COS(I)                SQRT(COS(I))"),nl,
  iterate(0,12).
iterate(First,Last):—
  First > Last.
iterate(First,Last):—
  First <= Last,
  doline(First),
  First1 = First + 1,
  iterate(First1,Last).
doline(I):—
  Cos_I = cos(I),
  Cos_I >= 0,
  Sqr_Cos_I = sqrt(Cos_I),
  writef("%4.0          %5.2          %4.2",I,Cos_I,Sqr_Cos_I),n1.
doline(I):—
  Cos_I = cos(I),
  Cos_I < 0,
  writef("%4.0          %5.2          ****",I,Cos_I),n1.
```

One DA at a time

If you want to use more than the legal 15 DAs on your Mac, Billy Steinberg shows how to modify Font/DA Mover to get your way.

So, 15 desk accessories aren't enough? You want more? No problems!

You'll have to make a one-time, one-byte code patch to Apple's Font/DA Mover, and you'll have to use ResEdit to make a one-time addition to your System file. Once you've done that though, you can continue to use Font/DA Mover as you always have, only now you can install up to 36 DAs instead of 15.

Before we start, a couple of warnings are in order. First, the changes and patches only work on Macs with the new, 128k ROMs. They work differently from the old ROMs. Second, be sure you're working on backup copies. The tools you'll be using (ResEdit and Fedit Plus) have the power to totally trash your files if you make a mistake.

Whys and wheres

Whenever you start up your Mac, something called a Device Table is created. It has room for 48 entries or 'slots', each of which can hold a DA or a driver. (A driver is a special file that tells the Mac how to communicate with some external device, like a printer, a modem or AppleTalk.)

Some of the 48 slots have been reserved by Apple, some are assigned to I/O devices such as your disk drive(s), modem port and printer port, and some (15) are available for DAs. The 'official' list of assignments (from *Inside Macintosh,* volume IV, page 215) is shown in Table 1. The only way to fit in more DAs is to use slots you're not supposed to use for DAs. The question is: Which slots do you use? Slots 0 to 11 are pretty well taken up already, and since Font/DA Mover automatically starts renumbering with a resource ID of 12, we'll leave slots 0 to 11 alone.

'You'll have to make a one-time, one-byte code patch to the Font/DA Mover, and use ResEdit to make a one-time addition to your System file.'

Slots 12 to 26 are the 15 standard slots for DAs. A stock Font/DA Mover installs DAs into these slots.

Slots 27 to 31 are for desk accessories built into applications. Most DAs are installed in the System file, and are available in all applications (that support DAs), because the System file is always open (well, almost always).

But DAs can be installed in applications too. Any DA that you install into an application will be available only while you're in that application. Having a DA in the System file with the same ID number as a DA in a running application can cause problems though, so Apple assigned slots 27 to 31 for DAs in applications.

If a DA in the System file and a DA in the current application have the same number, both will show up in the DA menu, and you can choose either DA, but there are problems if both DAs have owned resources of the same type and number. If the DA in the System file with an ID of, say, 31, has a Dialog with a (local) ID of 1, and your application has a DA that's also numbered 31 and also has a Dialog with a (local) ID of 1, you'll get a confused System DA. The DA in the application will work fine, but the DA in the System will try to use the owned resources

Unit number	*Device*
0	Reserved
1	Hard disk driver: Macintosh XL internal or Hard Disk 20 external
2	.Print driver
3	.Sound driver
4	.Sony driver
5	Modem port asynchronous driver input (.AIn)
6	Modem port asynchronous driver output (.AOut)
7	Printer port asynchronous driver input (.BIn)
8	Printer port asynchronous driver output (.BOut)
9	AppleTalk .MPP driver
10	AppleTalk .ATP driver
11	Reserved
12-26	Desk accessories in the System file
27-31	Desk accessories in application files
32-39	SCSI drivers 0-7
40-47	Reserved

Table 1

from the application DA. This can cause weird results at best, and bombs at worst.

Not all DAs have owned resources, however, and those that don't can be safely installed into the System file, in slots 27 to 31. You can tell if a DA has owned resources by holding down the Option key and selecting the DA while in Font/DA Mover. You'll see three lines appear at the bottom of the Font/DA Mover window; they show the size of the resources that belong to that DA. If the top line (picture resources) or the bottom line (other resources) has any value other than 'No Bytes', the DA has owned resources. If the centre line (program resource) is the only line with a positive value, the DA has no owned resources, and can be safely used in an application slot. Though you might wind up (in some applications) with two DAs using the same slot, both will work just fine. You'll be able to use them both; although not at the same time.

Slots 32 to 39 are for SCSI drivers. The Mac Plus (or any Mac with the new ROMs and a SCSI port) supports eight SCSI devices, numbered 0 to 7. Each SCSI device you attach has an 'address', which must be different from the address of any other SCSI device attached at the same time. If you're only running a single SCSI hard drive, you may not even be aware of this; if you are running multiple SCSI drives, you probably know that there is a jumper or switch in each drive that you can move to change the drives' address (so that two drives don't have the same address). The Mac itself is always assigned address 7. Thus that slot is available for a DA, as are any slots not being used by SCSI devices. Table 2 shows which SCSI address corresponds to which slot number.

Putting a DA into a slot already in use by a SCSI device is not healthy, though. Everything will be fine until you try and use that DA, at which point your SCSI device doesn't want to know about it. Because bad things can happen if you open a DA in an active SCSI device slot, you should generally avoid using any of these slots, except slot 39. If you can't use the application slots, or you want to install more than 28 DAs, you can use some or all of these slots; but pay attention to what you're doing.

Slots 40 to 47 are reserved by Apple, but seem to work just fine as DA slots. There may be hidden reasons for not using them, but I haven't heard of any. And I've had no problems using any of them.

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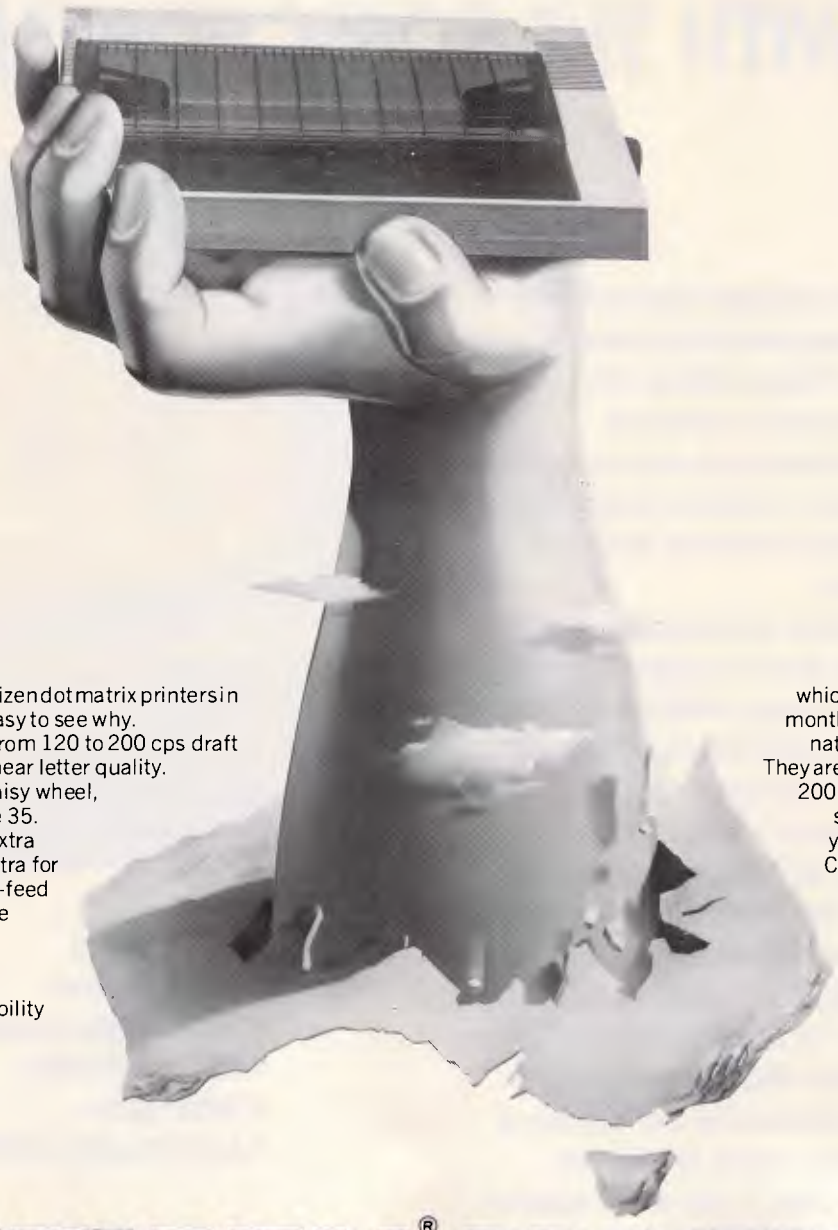

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Driver slot number	SCSI address	
32	0	
33	1	
34	2	
35	3	
36	4	
37	5	
38	6	
39	7	Always available

Table 2

Slotting it together

Now we can intelligently start to pack in the DAs. Here's how we'll install the first 24. We'll use slots 12 to 26 first (that's 15). Then we'll use slots 40 to 47 (8 more, 23 total). Finally we can use slot 39 (1 more, 24 total).

If you try to add more DAs, you're soon going to run into a bug in the Menu Manager that limits the number of items in a menu. Menus can handle up to 32 items (including the title) correctly. If there are more than 32 items, those past number 32 will not behave as they should, but will mirror the behavior of the first 32 items. Since the Apple menu standardly has an About... item and a line as the second and third items (the Apple is the first), there are 29 items before mirroring starts, then one for the title, one for the About..., and one for the line. Thus, the 32nd DA installed will not be selectable. Because of this bug it is of questionable value to have more than 31 DAs installed. Why 28 and not 30? That's because the Apple menu typically has an 'About...' as the first item, and a non-selectable line as its second item.

So although there are 36 slots that can be filled with DAs, the Menu Manager bug will usually limit the total number to 31. Since we already know where we're going to put the first 24, that only leaves seven more to find slots for. If there are no SCSI devices (hard disk, tape back-up units, etc.) attached (and none planned), use the slots in the SCSI group (32 to 38). If there are some SCSI devices installed, some slots can still come from the SCSI group, but you'll have to know which addresses are in use, and make sure you don't use those slots. You might also have to use some of the application slots (27 to 31). Since you can't know in advance what slots a given application may use for its DAs, you'll be taking a chance here. However, applications with DAs are rare (I know of only two). And you should always install DAs with no owned resources in these slots.

Putting in DAs

Font/DA Mover is designed to install DAs (in any file) starting with an ID number of 12, renumbering the original number of the DA (and any resources that go along with the DA) as necessary. It will continue to install DAs until it gets to about 65 thousand DAs; each DA it installs will get the lowest number available in that file, starting with 12.

If the file you are installing DAs into is named System, however, Font/DA Mover will stop installing DAs when all the slots between 12 and 26 are filled. (Font/DA Mover will not allow you to remove all DAs either). The patched version of Font/DA Mover we're going to create does exactly the same except it won't stop until all slots between 12 and 47 are used. We'll also change an error message and the title on the menu bar to indicate that we have patched things, and, while we're at it, we can change one of the Font/DA Mover defaults so that it opens in the DA mode instead of the font mode.

Font/DA Mover doesn't know what slots we don't want to use though, and will just install within a given range, putting DAs into slots that are not occupied. We need to put something into the System file to take up the slots we don't want DAs put in, so those slots will be skipped.

We'll do that using ResEdit to create special dummy drivers that don't show up as DAs. All the conflicts discussed above apply only if there are two DAs, or a DA and a SCSI driver, vying for the same slot. There is *no* conflict if a dummy driver is taking up a slot that a real driver (or DA) wants.

Since drivers don't show up in the DA menu, they can't be 'selected'. When you boot up and your SCSI driver wants to load into a slot, it will replace the dummy driver that's in the slot it wants. Since you can't select the dummy driver, the SCSI driver will remain active all the time. The same holds true for a DA in an application; it will replace the dummy driver, and will be available on the DA menu, but since you can't select the dummy driver, no conflicts can occur.

Nuts and bolts

Let's patch Font/DA Mover now. Get a nice clean copy of Font/DA Mover, version 3.2. These patches only work on version 3.2. Be sure that you make all

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the changes, including those to the error message and the menu bar. If you don't and then give your patched copy to a friend, you'll cause a lot of problems.

Start by making a copy of Font/DA Mover and rename it Patched Font/DA Mover or something similar; don't work with your master copy of Font/DA Mover.

Launch ResEdit (I used version 1.0.1), and open Patched Font/DA Mover. If necessary scroll down the list of resource types until you see resource type STR#. Open it. You'll see one resource of type STR#, with an ID number of 256. Open it. This string list contains most of the messages that Font/DA Mover uses. If you scroll down to the 25th string, you'll see it says: "Sorry, you can't have more than 15 desk accessories in this file." Edit this string to say "Sorry, you can't install a DA with an ID# higher than 47 in this file." Scroll down to the 41st item (the second to last), which is the string 'V3.2'. Add 5 to 10 spaces and the string "Warning! Patched to add DAs up to ID# 47!" Close the windows you opened, and Save Patched Font/DA Mover when asked. Exit ResEdit.

Now launch Fedit Plus (or any program that can edit raw bytes in a file), and open Patched Font/DA Mover. There are two patches: the first will allow Font/DA Mover to install DAs up to ID number 47, the second will change the default open mode for Font/DA Mover so that it comes up displaying DAs instead of fonts. You need not make the second patch unless you want to.

Here's the first patch: search for 001A 5EC0. When you locate it, replace it with 002F 5EC0. Now for the second patch: Search for 6708 3B7C (this occurs twice, you need to patch both places). Replace it with 6608 3B7C in both places. Save everything. It's that simple.

Building the dummies

Use ResEdit to create dummy drivers with IDs from 27 to 38, and move them into the System file. This will give you room for 24 DAs, and you'll never have to do anything special again when you want to add or remove DAs, as long as you use the Patched Font/DA Mover. If you want more than 24 DAs, make your decision about possible conflicts, and remove the appropriate dummy drivers (or just don't install them in the first place).

Start by launching ResEdit again, and make sure the window containing Patched Font/DA Mover is on top. Select NEW from the File menu, and enter a filename of 'Resource Holder'.

With the open file window on top (Resource Holder), select NEW again. You'll get a dialog box full of different resource types; scroll down the list until you see DRVR, and double-click it. Select NEW yet again, and you'll get an arbitrarily numbered driver resource, with a window full of Text Edit items to fill in; ignore them and just close the window.

The window on top should now have your arbitrarily numbered DRVR resource in it. Select the DRVR resource, and instead of opening it, pull down the File menu and choose GET INFO. You'll get a new dialog box; select the radio button that says Driver (as opposed to DA), and then change the ID number (which will be a random number) to 27 and the name (which will be blank) to 'Dummy #27.' Then close the dialog box.

You have just created your first dummy driver resource. If it's not currently selected, select it, and then use the Duplicate command from the Edit menu. This will create an identical duplicate resource in your file, with the ID number changed to some unused random value. Select GET INFO from the File menu again, and edit the new resource so that its ID number is 28 (one more than the last one), and its name reflects its new resource number. Then close the dialog box.

Keep repeating the Duplicate/Edit procedure until you have dummy drivers numbered from 27 to 38, inclusive. Then close all the open windows, confirming when you are asked if you want to save the file. You now have a file with all the dummy DRVR resources you could want, and you can move whichever ones you want into the System file. Here's how.

You should still be in ResEdit. Open up the dummy driver file. Select the resources you've decided upon, and use the Copy command from the Edit menu. Whatever dummy resources you move in will prevent Font/DA Mover from using that slot, so you are choosing slots you *don't* want used. Select multiple items by shift-clicking. Close the dummy file holder, and open up the System file. Once the System file is open, PASTE, and then close the System file, saving as you go. Now whenever you want to add a DA, just your the modified Font/DA Mover to install it as you always did. That wasn't hard, was it?

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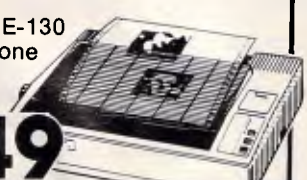

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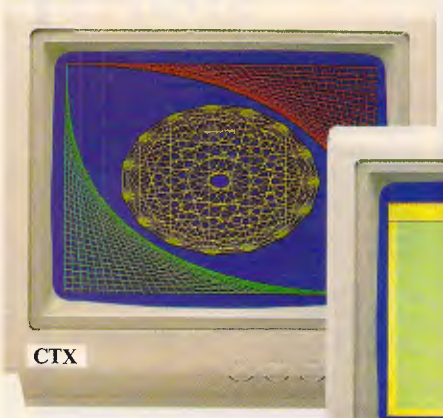

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Xi Plus

There's nothing like an 'expert' to help solve your problems. Kester Cranswick takes a look at Xi Plus, an expert system shell, from Expertech.

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Xi Plus is relatively new on the scene. Developed in the UK by a company called Expertech, Version 1.1 has been available in Australia since February. An update, version 1.5, should be along in a few months, according to the Australian distributor, Software Suppliers.

If you don't know all about expert systems by now, you're obviously not an *APC* reader. Expert systems are the leading edge of software development and the promise is that they will turn the computer into an intelligent machine.

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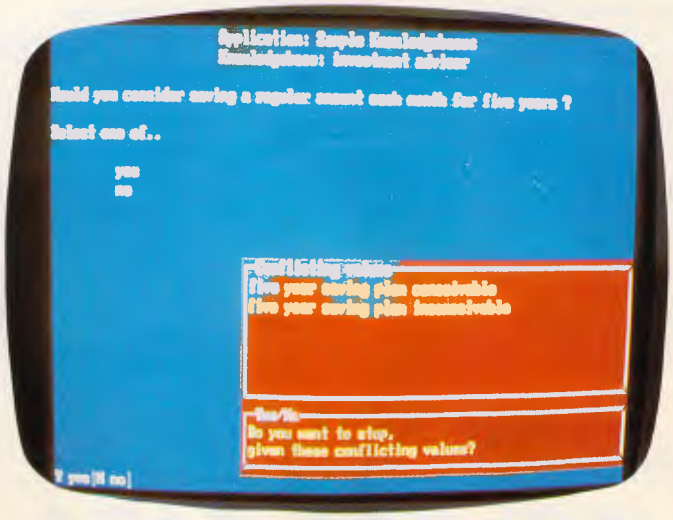
Knowledge engineering is the term that covers the field of expert systems. It is a term that embraces the gathering of knowledge from experts in a field, turning that knowledge into a knowledge base with associated rules, and setting up an interface so that a naive user can consult that knowledge.

As such, it demands not only a computer and the relevant software, but a competent knowledge engineer, with a thorough knowledge of how expert systems are constructed, and how the particular piece of software runs. Such individuals are rare, and I make no claims to being one. But the only way to get that experience is to try an expert system.

The main working menu of Expertech's Xi Plus



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NEC Home Electronics Inc., USA

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EVA/480 APPLICATIONS:

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EVA/480 offers AutoCAD and Dr. Halo in EGA (640×350) and PGA (640×480) or 720×512 (higher resolutions on future EVA Adapters) with hardware window, hardware zoom and smooth panning in window. It more than pays for itself in your first project by just saving the engineer's design time.

Spreadsheet

If you are satisfied with Lotus 1-2-3, it is because you have not used Tseng EVA/480. 132-column × 44 lines spreadsheet is just the beginning. With hardware window and smooth panning on EVA/480, EGA and Lotus 1-2-3 will be much more valuable! If you are a serious Lotus 1-2-3 user, you will be happier with EVA/480.

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For serious computer user, PC-Mini/Mainframe communication application is a definite possibility. Tseng offers proven display adapter hardware and software supported by virtually all major PC-Mini/Mainframe data communication companies such as DCA (IRMA), CXI, Persoft and AST ... Tseng is the trusted display company for data communication.

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Window and Multitasking

EVA/480 supports Microsoft Windows in 640×480. The EVA/480's window capability can also be used to display background processing information efficiently and reliably since hardware window requires minimal programming and no data transfer. With little software modification, future higher resolution EVA display adapters will accomodate 1024×1024 Microsoft Windows. EVA display adapters' EGA compatibility and growth path is what all display adapters should offer.

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EVA/480 includes the popular Dr. Halo II package for graphics presentation and desktop publishing. Halo's DPE (optional) Desktop Publishing Editor software and interface with Aldus' PageMaker and Ventura's Ventura Publisher Edition will provide full graphics and text desktop publishing. The ET2000 has the most powerful EGA graphics(1280×1024 or beyond) and text capabilities to meet the needs of desktop publishing.

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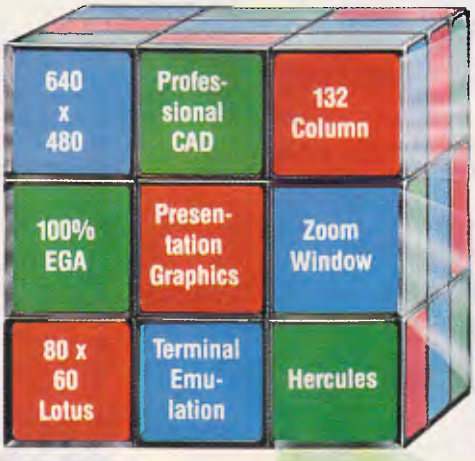

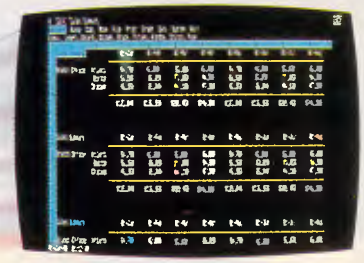

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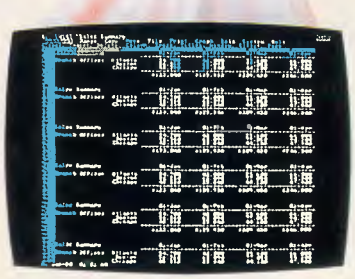
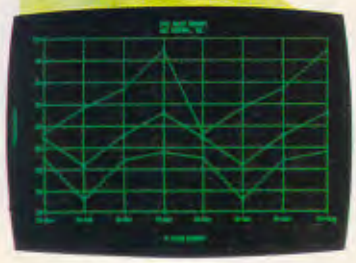


3. 80 × 60 Lotus Spreadsheet in "480" Mode



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Xi Plus comes with an asking price of $2995. That is enough to put off the frivolous user. It also indicates that this is a powerful piece of software. When you have built your expert system, run time licences are available at $720 a throw.

For the asking price, you get five disks and a thick, ringbound manual. Software Suppliers can also put you through a three day education course. To run Xi Plus, you'll need a PC with at least 512k memory and two disk drives, or a hard disk. The program supports colour or mono displays, and a printer is needed to get hard copy of a knowledgebase, or results.

Installation

Before starting to use Xi Plus, it is worth reading the introductory pamphlet supplied. It explains the fundamental concepts behind what it calls 'Know-how Programming', such as what it is, the sort of things expert systems are useful for, the idea of rules and uncertainty, and how to select a possible application. If you are already familiar with expert systems, you'll find little new knowledge here.

The five disks comprise two system disks, a backup disk, a tutorial and a disk of example knowledge databases. The first step is to install Xi Plus. It fits on one disk, and you follow the prompts of the install procedure to specify your system.

To start Xi Plus, put the master copy of the first system disk in drive A, and boot the application from the working copy in drive B, or the hard disk, with the command XIP. It will seek authorisation codes on the master disk, before letting you proceed. The new release does not have copy protection, so booting will not need a master disk.

A title screen appears while the program loads. The first active screen has a four choice menu — consult an application, build an application, run the tutorial, or exit. Use the cursor keys to make your choice, press Return and off you go.

Display

The developers have sensibly opted for a windowing style presentation. The top two lines of the display are reserved for file information. The bottom line is context sensitive and indicates the keyboard options available. Using a systems options utility, background and foreground window colours can be set up to personal preferences, with a preview of the results. With 11 types of windows to choose from, you can get some very colourful displays.

Displayed in the top, or banner, window is the name of the application being used, and the knowledgebase being consulted. Xi Plus allows an application to access any number of knowledge bases, the idea being that you can create a set of related knowledge bases that can be run from the one application. During disk drive access, RUN appears in the top left corner, and when editing a file, either NEW ITEM or UPDATE can appear in the top right corner.

'An expert system is able to cope with unorganised data, deduce new facts from existing information, and generally play the role of an expert . . .'

On the bottom line, the display changes according to what you do. It also flashes up INSERT if the insert mode is activated during text entry.

The working area window is where all the action takes place. This can display up to four windows, of which only one can be active. Each window appears against the grey screen background with a coloured border, and has a window name in the top left corner. Text within windows is multicoloured, to aid legibility.

Text can also be scrolled within a window, using the cursor control keys, or Pg Up and Pg Dn to move a screen at a time. Window size and location is fixed by Xi Plus though, and this can mean that you have to continually scroll from one side of the text to another to read it. It is possible to resize a window to full screen width, and back again. It all makes the Xi Plus display well worked out, and simple to use, particularly with a colour display.

Besides text windows, there are also menu and form windows. Menu windows provide a range of choices, with some allowing more than one option to be selected. Form windows are for the entry of data in a fixed format, as you would find with a database.

There are not many unusual key functions to remember with Xi Plus. F1 is the help key, as usual. Help is context sensitive. F2 dumps the current display to a printer. The Esc key is used to escape from any screen back to the pre-

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- Automatic forecasting of purchases
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vious, as far back as the initial menu. Pressing Ctrl and Return is the way you select multiple menu options.

The rest of the function keys are used for text editing, to add, insert or delete lines, or cut and paste lines within a knowledge base. The base of the display indicates whether they are active or not.

Tutorial

An expert system is more like a programming language than a database. Unless you write an expert system, there's not a lot you can do with the package, other than learn how to write an expert system.

That's where the tutorial comes in. It is an expert system in itself, and aims to introduce the user to expert systems and Xi Plus. It makes use of some very simple sample expert systems supplied with the program too.

Tutorial is one choice on the opening menu. The knowledge base is stored on a separate disk, but at installation, you have the option of installing it, and the sample expert systems, on your hard disk.There are five sections to the tutorial, from getting started to building applications. They introduce you to the keyboard, windows, menus, how to load and consult an application, how to write applications and using the editing tools provided.

Being an expert system, the tutorial is very freeform. You can quit it at any time, ask why certain information is being presented, start halfway through, and generally take it at your own pace.

Working through the whole tutorial will take an afternoon at the least, and at the end, you'll have a good knowledge of how Xi Plus works, and how to start building an application. Then it is over to the manual for more detailed information on any topics you may have missed, and over to you to construct your own expert system.

The sample knowledgebases are very simple, and not to be treated as serious applications. The only way to get a useful application is to write one yourself.

Fundamentals

An application consists of knowledge, and rules with which to derive information from that knowledge. Rules and data are entered as text and can be subsequently edited to make them more suitable to the application. As the expert system grows, more rules are added, and existing rules are refined to improve the system.

Choosing what subject to apply an expert system to is the hardest thing. Xi Plus calls a subject an application. New applications are defined with a selection from the Display/Edit menu, leading to a form that asks for the name of the application, its directory location, the names of any help files, and any report files.

A few terms need to be defined if you are new to Xi Plus. An identifier is a term that identifies a value. It is usually a name, and cannot start with a capital letter unless enclosed in quotes. It cannot contain any reserved words.

An Xi Plus fact is a statement that is always true. An assertion is a textual Boolean statement that is treated as tested for truth. Xi Plus can output an assertion in response to a query.

A relation is a verb or mathematical operator that associates an identifier with a value. For instance 'Xi Plus is an expert system' is a sentence with an identifier (Xi Plus), a relation (is) and a value (an expert system).

A rule is a sentence of the 'if . . . then' construction. It can have multiple conditions. A demon is a special type of rule that fires immediately all its conditions are satisfied, interrupting the inferencing process.

A question is a statement that demands input from the user, and has an optional range of permitted responses. Associated with a question is a text statement that makes the question understandable to the user. A question can also have a report and a help file associated with it. The programmer can set up default values that apply if no answer to a question is given.

A query, on the other hand, states the goal of an inference process. With the query statement, a list of queries can be given in a query window. Queries can also be configured to run automatically when a knowledgebase is loaded, or made to give no displayed answer.

Starting up

To start entering a knowledgebase, type in 'reset kb' as a command. This clears memory of any existing knowledgebase, and lets you get on with entering rules, demons, identifiers, facts and so on.

As the keywords that go to making up the rules are entered, a syntax checker verifies them, with a message appearing in a 'syntax error' window. You will also have a window appear if a new relation is specified. In this case, you will be given the option to treat the new relation as a syntax error, and correct its spelling, treat the line as an

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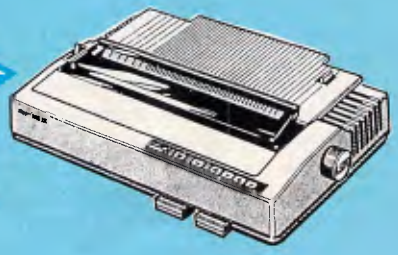

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Monochrome Graphic Card (Optional)	TTL Positive Video Output Display 25 Rows by 80 Character Text with 9 × 14 Character Matrix 64 KB Screen Memory for Graphics and Text Graphic Model: 720 × 348 Addressable Dots Support Graphic Software eg: Lotus graph, Framework graph, AutoCAD, Paint Brush Build in Parallel Port	
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assertion, or define the new relation. Defining a relation or assertion means specifying the negative and positive forms. New data is added to a knowledgebase by the same method, and using the function keys in text input mode. F4 adds text to the existing knowledgebase. You can also edit rules, facts, questions and the like, by searching for them, and then editing the resultant list of items. Using the function keys, lines can be deleted, selected, copied and moved, or blank lines inserted. It is much like using a word processor.

Knowledgebases are saved in protected or non-protected files. Protected files cannot be altered. Items in the knowledgebase may not be displayed, printed or saved, making this the form of expert system you'd give to users. Non-protected knowledgebases are saved as text files. If a new knowledgebase is created, there is an option to have it added to the list of displayed knowledgebases for the current application.

The data in a knowledgebase can be saved separately too. The data is separate from the rules, and this means that you can create one framework of rules and use it to query several sets of data.

Conversely, a new knowledgebase can be loaded, to work on existing data. Xi Plus is intelligent enough to retain all data supplied by the user in response to questions from the previous knowledgebase, and use that data to initiate queries. However, to avoid confusion, it is essential that both knowledgebases use the same identifiers.

Querying a knowledge base is very simple, if the knowledge engineer has done his or her job properly. In theory, a user highlights and selects the 'Start query' option on the opening menu, and is presented with a list of possible queries in a new window. Alternatively, a query can be entered in the command window, where a question mark at the end identifies it as a query.

With a query started, follow the questioning of the expert system. At any stage you can either ask for an explanation of why a question is asked by typing 'why' in the command window; how a conclusion was reached by typing 'how'; or change the base data by selecting the 'what if' option from the main menu.

Rather than go through the process of answering a query, you can choose to display a section of the knowledgebase. Selecting the 'Display/edit' option from the main menu brings up a secondary menu, allowing the programmer to create new applications, function definitions, or selected items from the database according to rules, demons, facts, questions, defaults and queries.

Using the command window you can also print or display items from the knowledge base. Just typing an identifier will display all information it contains on the subject. 'Print' followed by the name of an identifier will dump that information to a printer. The abbreviation 'kb' will dump the whole knowledgebase to the printer.

Other categories you can have displayed or printed include one or all database items, demons, facts, queries, questions and rules. It is a flexible method to see what's in a knowledgebase.

Information about identifiers can be more thoroughly investigated too. When you select the category from the 'Display/edit' menu, a third level menu comes up. Through this, you can select a display of all occurrences of identifiers in the database, or all occurrences in either the forward or backward chaining rules. This enables you to see how the identifier is used.

With forward chaining queries, Xi Plus lists all rules in which the identifier occurs in the left hand side. For backward chaining, all demons and rules except those in which the identifier occurs in the left hand side are listed.

This menu also allows the user to change the way in which the identifier is treated. It can be set as a single value, a multiple value, or a single value with the last entered value overwriting any previous values.

There's another useful feature in the toolbox too. It is much the same as the trace command in Basic. If logging is on, a printer dump or a file of all commands, some menu selections, questions, queries, error messages and 'how' or 'examine conclusion' output is produced. A route command directs the output to a specified file, or the printer.

Xi Plus has a trace command too. This is more detailed than the log command, recording all rules that are fired, and, optionally, the state of the database after each cycle of rules. Trace is a command that can be invoked by a command in the knowledge base, as well as entered at the command window.

When you have completed entering a knowledgebase, there is the facility to have it checked as part of the toolkit. This will produce a list of identifiers, their relations, values and assertions, unused consequences of rules and

demons, any conditions and expressions that cannot be evaluated because of missing values, circular reasoning cases and values that may conflict. Not all these errors will prove fatal, but they can slow down query execution, or waste memory.

The check facility does not check spelling, but it does list identifiers and assertions alphabetically, for the user to check.

Those are just some of the features of Xi Plus. It has much, much more, and it will take a programmer many weeks to get up to steam with it. The learning curve will be quite rapid, but this is not a program you sit down and learn all about in a weekend. The more time you spend studying the manual, the more you will be able to get out of it.

File import

One of the beauties of Xi Plus is that it can use data from other applications, or call other applications, with passing of parameters in both directions. For instance, a small number of mathematical functions, written in C, are supplied on the Examples disk. With linking files, called by Xi Plus, these routines can be accessed. Assembler routines can be accessed too, with a little programming.

When other applications are accessed, what RAM is not in use by Xi Plus can be used by the new application. At present, that doesn't mean much RAM, and no major application will run. But the new release of Xi Plus will roll out to leave all but 4k of RAM for the new application. When done, just go back to the expert system.

'Xi Plus is intelligent enough to retain all data supplied by the user in response to questions from the previous knowledgebase, and use that data to initiate queries.'

Other files are provided, to access DIF, SYLK and WKS files. It all adds up to a great deal of versatility, but needs plenty of experience on the part of the programmer to make it all work.

Conclusion

It is hard to fault Xi Plus. As a tool for writing micro-based expert systems, it is powerful, versatile and easy to use. It is not cheap, but it will do almost anything a knowledge engineer wants at present.

With the new release at least four times faster, and having interfaces to popular PC graphics applications, the future looks bright for this product. It is not a package for amateurs. It is not a package for those who haven't got a serious use for expert systems. For those who have, do have a look at Xi Plus. It could be the answer to your wishes.

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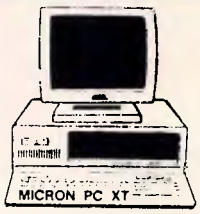

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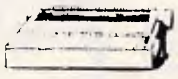

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Instant directory access

Popping up the directory listing of any drive of an IBM PC from within a running applications program is no mean feat, but XDIR.COM makes it easy.

Memory-resident utilities are at once the most despised and the most beloved PC programs. Not even their best implementations are completely satisfactory, as evidenced by the spectacular system crashes that sometimes result when you try to install one right after another. Despite such mishaps, however, TSR (terminate-but-stay-resident) programs are still the most reliable way we have to live beyond the means of an operating system designed to single-mindedly process only one job at a time. Utilities like the pop-up notepad and calculator have reshaped the way we organize our computer desktop.

XDIR.COM is in one sense a classic example of a program that attaches itself to the operating system via DOS interrupt 27h. XDIR allows you to pop up a window at any time (well, nearly any time), even from within a running applications program, and browse through the contents of the directories and subdirectories on any or all of your disks. To do this, however, XDIR must utilise DOS services in a way very unlike most TSR programs. Many of the same techniques that went into programming SideKick are present in XDIR. It's one of the few files that get loaded on my PC every time I boot it up. (It's also completely SideKick compatible, provided it is loaded before SideKick — a claim that only a handful of utilities like itself can truthfully make.)

Using XDIR

The assembler source code is shown in Fig 1. If you don't have an assembler and simply want to get the utility, Fig 2 contains a Basic program that will automatically create XDIR.COM for you. (The advantage of going the assembler route is simply so that you can later modify the program.) The program uses 7840 bytes of memory, though the .COM file is a more-typeable 1442 bytes.

'XDIR generates its own interrupt 28h calls so a program like SideKick can pop up at any time.'

You load XDIR once, either at the beginning of a session or through your AUTOEXEC.BAT file. Subsequently pressing the Alt key in conjunction with the period key will call up a blank window with a blinking cursor on the topmost line. If you then Enter any legal and existing pathname, you'll get a listing of the files in that directory. The window can display 40 filenames at a time. If there are more than 40 files in the directory, the first 40 are exhibited initially and the entire list can be examined using the PgUp and PgDn keys to move backward and forward. Up to 360 filenames can be read in and buffered. Filenames beyond that limit are ignored by the program.

Pathname specifications follow the standard DOS format. To view contents of the root directory of Drive A:, for example, simply type A: or A:\ at XDIR's input prompt. You could examine the contents of the subdirectory DISKUTIL located several levels down from the root directory on the C: drive like this:

C:\UTIL\PCM\DISKUTIL

Any reachable directory is a valid target for XDIR.

When you're finished with a directory listing, press the Esc key once to clear the directory window and return to the

XDIR at a glance

Syntax:[d:][*path*]XDIR

Operation: XDIR is a memory-resident utility that displays the filenames (up to a maximum of 360) in any legal drive and directory from within a running applications program. Once loaded, either at the DOS command line or from within an AUTOEXEC.BAT file, pressing

Alt-.

(Alt-period) opens a window that can hold up to 40 filenames. The desired drive and/or path is then entered, and the PgUp and PgDn keys are used to display files in excess of the initial 40 listings. (To display the current directory it is not necessary to type in its path; pressing Enter will suffice.) Pressing Esc returns the cursor to the command line, and pressing it a second time closes the window and restores the contents of the interrupted applications program.

Because of its unusually thorough interrupt handling, XDIR is fully compatible with SideKick and with most other 'difficult' TSR programs.

```
;XDIR.COM for the IBM Personal Computer - 1986 by Jeff Prosise
code            segment para public 'code'
                assume cs:code
                org 100h
begin:          jmp initialize                  ;goto initialization code
;
copyright       db 'Copyright 1986 Ziff-Davis                ',1Ah
global          db '\*.*',0                     ;global directory filespec
dos_segment     dw ?                            ;DOS segment
busy_flag       dw ?                            ;offset of DOS BUSY_FLAG
program_status  db 0                            ;XDIR processing status
flag_13h        db 0                            ;status of interrupt 13h
request_flag    db 0                            ;status of processing request
adapter         db 2                            ;0 = MDA, 1 = CGA, 2 = EGA
video_segment   dw 0B800h                       ;video segment address
video_page      db ?                            ;current video page
border_attr     db 4Fh                          ;window border attribute
text_attr       db 0Fh                          ;window text attribute
video_address   dw ?                            ;window start address
cursor_mode     dw ?                            ;cursor shape
cursor_pos      dw ?                            ;cursor position
maxlen          db ?                            ;maximum input string length
max_page        db ?                            ;number of highest directory page
dir_page        db ?                            ;current directory page
end_flag        db ?                            ;status of text write routines
error_flag      db ?                            ;critical error status
default_cursor  dw 0607h                        ;default cursor shape (color)
addr_6845       dw ?                            ;CRT Controller base address
search_attr     dw 0                            ;file search attribute
;
path            dw 0                                 ;pointer to pathname buffer
dta             dw 64                                ;pointer to Disk Transfer Area
screen_buffer   dw offset initialize                 ;pointer to screen buffer
text_buffer     dw offset initialize+1536            ;pointer to filename buffer
;
keyboard_int    label dword                     ;old interrupt 9 vector
old9h           dw 2 dup (?)
timer_int       label dword                     ;old interrupt 1Ch vector
oldlch          dw 2 dup (?)
bdisk_int       label dword                     ;old interrupt 13h vector
old13h          dw 2 dup (?)
bp_int          label dword                     ;old interrupt 28h vector
old28h          dw 2 dup (?)
;
old_dta_segment dw ?                            ;old DTA segment address
old_dta_offset  dw ?                            ;old DTA offset address
old24h_segment  dw ?                            ;old interrupt 24h routine segment
old24h_offset   dw ?                            ;old interrupt 24h routine offset
enable_values   db 2Ch,28h,2Dh,29h              ;values to enable CGA output
                db 2Ah,2Eh,1Eh
errtext         db 'No Files Found',0
;
;-------------------------------------------------------------------------------
;Execution comes here thru interrupt 9 every time a key is pressed or released.
;-------------------------------------------------------------------------------
keyboard        proc near
                sti                             ;set interrupt enable flag
                push ax                         ;save AX
                in al,60h                       ;get scan code from keyboard
                cmp al,52                       ;was the '.' key pressed?
                jne kb2                         ;no, then exit to normal handler
                mov ah,2                        ;check shift key status
                int 16h
                test al,8                       ;is the Alt key pressed?
                je kb2                          ;no, then exit
                call kb_reset                   ;reset keyboard, issue EOI
                pop ax                          ;restore AX
                cmp program_status,0            ;XDIR routine already active?
                jne kb1                         ;yes, then don't set request flag
                mov request_flag,1              ;set request flag
kb1:            iret                            ;end interrupt routine
kb2:            pop ax                          ;restore AX
                jmp keyboard_int                ;goto original keyboard routine
keyboard        endp
;
;-------------------------------------------------------------------------------
;Interrupt 1Ch handling routine.
;-------------------------------------------------------------------------------
timer           proc near
                pushf                           ;call original routine
                call timer_int
                cmp request_flag,0              ;request flag set?
                je timer1                       ;no, then exit
                push es                         ;save ES and DI
                push di
                mov es,dos_segment              ;get DOS segment in ES
                mov di,busy_flag                ;address of DOS BUSY_FLAG in DI
                cmp byte ptr es:[di],0          ;DOS service currently active?
                pop di                          ;clean up the stack
                pop es
                jne timer1                      ;yes, then we must wait
                cmp flag_13h,0                  ;BIOS disk service active?
                jne timer1                      ;yes, then don't interrupt it
                mov al,20h                      ;issue EOI to 8259 PIC
                out 20h,al
                mov request_flag,0              ;reset request flag
                call directory                  ;invoke directory routine
timer1:         iret                            ;done - exit
timer           endp
;
;-------------------------------------------------------------------------------
;Interrupt 13h handling routine.
;-------------------------------------------------------------------------------
bdisk           proc near
```

Figure 1: The assembly language listing for XDIR.COM.

input prompt. At that point, you can either enter another pathname and start another search or press Esc again to close the window and return to the interrupted applications program. Pressing the Esc key by itself while typing a pathname will also close the directory window.

You can obtain a listing for the current working directory simply by hitting the Enter key with the input line empty. No pathname is required. XDIR shows only "normal" files, that is, those that aren't hidden and are neither system files nor subdirectories. If that doesn't suit your needs, one small change with DEBUG will allow the program to display any or all files found, regardless of their attributes. That process will be outlined later.

If you request a search of a directory that contains no files, XDIR will respond by printing the message "No files found" inside the window. Simply pressing any key will then return you to the input line. Note that the same message is issued if you specify an illegal or nonexistent pathname, or if you accidentally attempt to read a directory from an empty drive. The press of any key will let you recover from the error unscathed. To use XDIR in parallel with SideKick, just be sure to load XDIR first in accordance with the exhortation in the SideKick manual. XDIR should coexist peacefully with most software, including other programs like itself.

TSR types

Before examining the code for XDIR in detail, it may be useful to consider some of the general characteristics of terminate-but-stay-resident programs. There are basically two kinds of memory-resident programs. The garden variety don't make use of DOS's rather extensive file I/O services; the more complex ones do.

The first kind are relatively easy to write, and many examples have appeared in this column. Typically, these programs take over the keyboard interrupt and lie quietly in memory until a certain combination of keys triggers them into action. In the interests of simplicity and brevity, the utility is normally written so that control is blindly transferred to the memory-resident routine, without checks to ensure that critical system functions aren't under way. Usually that's just fine. The programmer assumes that the user is knowledgeable enough to know not to pop up a window during the middle of, say, a disk formatting process, when an interruption might result in an im-

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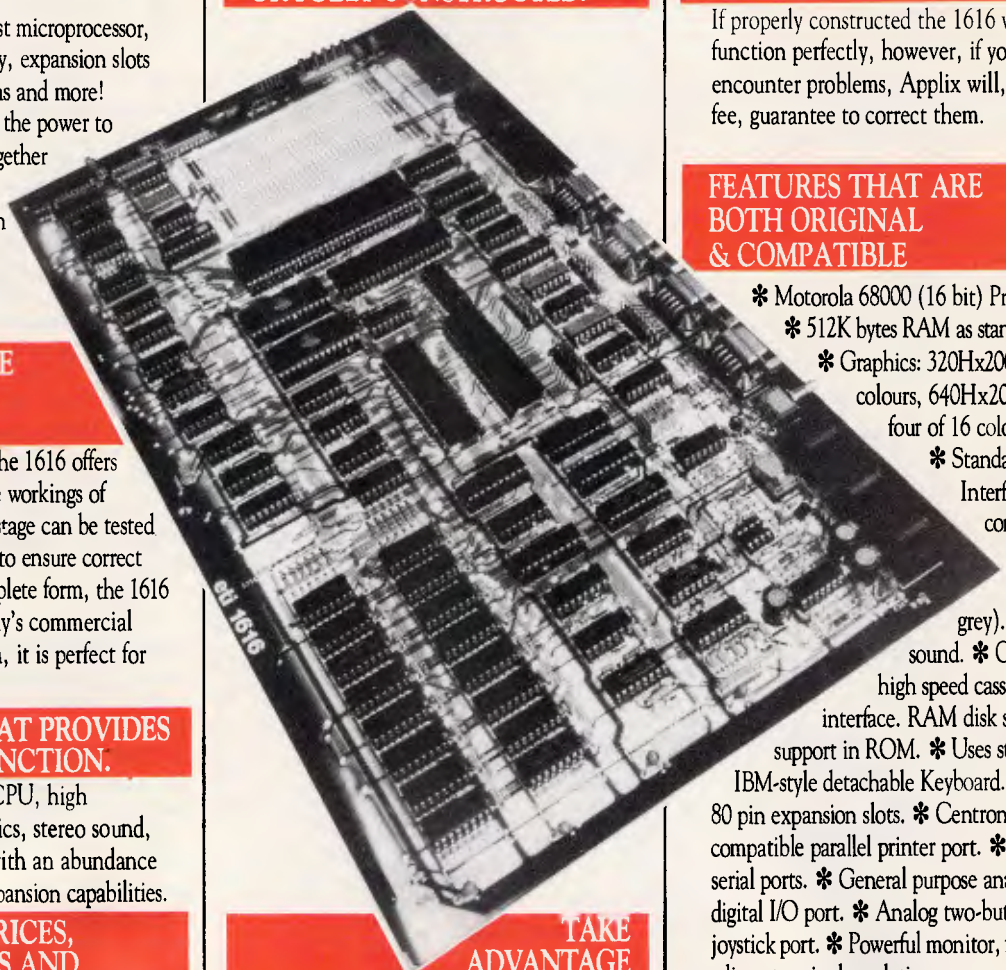

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APPLIX 1616

```
                inc flag_13h                    ;set 'busy' flag
                pushf                           ;call original routine
                call bdisk_int
                dec flag_13h                    ;clear flag
                iret
bdisk           endp
;
;-------------------------------------------------------------------------
;Interrupt 28h handling routine.
;-------------------------------------------------------------------------
backproc        proc near
                pushf                           ;call original routine
                call bp_int
                cmp request_flag,0              ;request flag clear?
                je bpl                          ;yes, then exit
                mov request_flag,0              ;clear request flag
                call directory                  ;execute directory routine
bpl:            iret                            ;done - exit
backproc        endp
;
;-------------------------------------------------------------------------
;Interrupt 24h handling routine.
;-------------------------------------------------------------------------
ioerr           proc near
                sti                             ;restore interrupts
                mov error_flag,1                ;set external error flag
                mov al,0                        ;tell DOS to ignore the error
                iret                            ;give control back to DOS
ioerr           endp
;
;-------------------------------------------------------------------------
;DIRECTORY is called by other routines to pop up and control the window.
;-------------------------------------------------------------------------
directory       proc near
                mov program_status,1            ;set program active flag
                sti                             ;enable interrupts
                push ax                         ;save registers
                push bx
                push cx
                push dx
                push si
                push di
                push ds
                push es
                push cs                         ;set DS to the code segment
                pop ds
                assume ds:code
                push cs                         ;set ES to the code segment
                pop es
;
;Make sure the current video mode is a text mode.
;
                mov ah,15                       ;get video mode and page
                int 10h
                cmp al,2                        ;mode 2?
                je dir1                         ;yes, then continue
                cmp al,3                        ;mode 3?
                je dir1                         ;yes, then continue
                cmp al,7                        ;mode 7?
                je dir1                         ;yes, then continue
exit:           mov program_status,0            ;clear status flag
                pop es                          ;restore registers and exit
                pop ds
                pop di
                pop si
                pop dx
                pop cx
                pop bx
                pop ax
                ret
;
;Save video parameters that must be used now or restored later.
;
dir1:           mov video_page,bh               ;save current video page
                mov ah,3                        ;get cursor mode
                int 10h
                mov cursor_mode,cx              ;save it
                call cursor_address             ;get cursor address from CRTC
                mov cursor_pos,ax               ;save it
                cld                             ;clear DF for string operations
;
;Save the screen contents and open the directory window.
;
                cmp adapter,1                   ;disable video if CGA installed
                jne dir2
                call disable_cga
dir2:           call save_screen                ;save memory to be overwritten
                call open_window                ;draw window to the display
                cmp adapter,1                   ;re-enable CGA video
                jne dir3
                call enable_cga
;
;Set the DTA and interrupt 24h vector to areas inside XDIR.  Then get a
;directory path string from the keyboard.
;
dir3:           call ioset                      ;set DTA and 24h vector
dir4:           mov di,path                     ;point DI to directory path buffer
                mov dx,020Ah                    ;specify input line location
                mov cl,59                       ;specify max length of 59
                call readln                     ;get path string from keyboard
                cmp al,27                       ;was ESC pressed?
                jne dir5                        ;no, then continue
                jmp escape                      ;ESC was pressed - exit
dir5:           push cx                         ;save character count
                mov ah,1                        ;hide the cursor
                mov ch,20h
                int 10h
                pop cx                          ;retrieve count
                mov dx,offset global+1          ;point DX to '*.*' text
                or cl,cl                        ;any characters entered?
                je dir7                         ;yes, then skip ahead
```

properly initialised disk. These utilities do their job, get in and out quickly, and do nothing more fancy than sending a few printer control codes or saving a screen for later recall. They're short, straightforward, and useful, if somewhat inelegant.

Then there are programs like Borland's SideKick. SideKick does everything a memory-resident utility isn't supposed to, from stealing a whole block of interrupts to accessing the disk. From a user's point of view, what separates SideKick from the rest of the pack is that it reads and writes to disk just like a normal application. From a programmer's perspective, that means it makes unrestricted use of DOS interrupt 21h services.

Unless some special precautions are taken, the DOS services provided through interrupts 21h, 25h, and 26h can't be used from within a memory-resident utility. To use one is in all likelihood to crash the system hard. Yet programs like SideKick (and DOS's own classic, PRINT.COM) are proof that there must be some way to do it. There is, and the footwork required to pull it off is the distinction between the two classes of resident utilities (of which XDIR is one of the latter).

Ian Davies has covered this subject in his 'MS-DOS Programming' series (see *APC* April 1987) to which further reference could be made as to the intricacies of using interrupts 21, 25h and 26h.

There are a couple of things to be understood before embarking on a discussion of how DOS routines can be used inside resident utilities. The first is why the DOS interrupts can be executed without discretion from a normal application but can't be from within an interrupt handler. The reason is that DOS services are non-reentrant. Non-reentrancy means that one routine can't call another.

Normally, of course, the programmer has no means of calling one DOS service from inside another because once an interrupt 21h is executed, control of the system is revoked until DOS transfers it back with an IRET instruction. But if a memory-resident program interrupts a DOS service in progress (and at any given time a DOS service may very well be in progress) and then itself issues an interrupt 21h, the reentrancy problem arises. The roof usually won't fall in until the *second* call completes its processing and the resident utility tries to pass control back to whatever was running when it was invoked, but the collision is sure to come and it's sure to be messy.

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```
                cmp byte ptr [di-1],'\'         ;is last character a backslash?
                jne dir6                        ;no, then append backslash to path
                dec di                          ;decrement path string pointer
dir6:           lea si,global                   ;append '\*.*' text to path
                mov cx,5
                rep movsb
                mov dx,path                     ;point DX to path string
;
;Read filename information from the specified directory.
;
dir7:           call get_dir                    ;read directory information
                mov dir_page,0                  ;initialize page number
                or cx,cx                        ;any files found?
                jne dir9                        ;yes, then continue
;
;No files were found - print message and return to input loop.
;
                mov dx,0721h                    ;set cursor position
                lea si,errtext                  ;point SI to error message
                call write_string               ;write error message
                call getkey                     ;wait for a keypress
                call clear_input_line           ;clear input line
                call clear_window               ;then clear the window
                jmp dir4
;
;One or more files were found.  Display them and look for keystrokes.
;
dir9:           call write_dir                  ;write one directory page
dir10:          call getkey                     ;wait for a keypress
                cmp al,0                        ;extended code entered?
                je dir11                        ;yes, then branch to handler
                cmp al,27                       ;ESC pressed?
                jne dir10                       ;no, then ignore keypress
                call clear_input_line           ;clear window and loop back
                call clear_window
                jmp dir4
dir11:          cmp ah,81                       ;PgDn pressed?
                jne dir12                       ;no, then continue testing
                mov al,dir_page                 ;last page displayed?
                cmp al,max_page
                je dir10                        ;yes, then ignore keypress
                inc dir_page                    ;advance page number
                call clear_window               ;clear window
                jmp dir9                        ;go back and display new page
dir12:          cmp ah,73                       ;PgUp pressed?
                jne dir10                       ;no, then ignore keypress
                cmp dir_page,0                  ;first page displayed?
                je dir10                        ;yes, then ignore keypress
                dec dir_page                    ;update page indicator
                call clear_window               ;clear window
                jmp dir9                        ;loop back
;
;Reset the 24h vector and DTA address, close the window, and exit.
;
escape:         call ioreset                    ;restore DTA and 24h vector
                cmp adapter,1                   ;disable CGA video
                jne esc1
                call disable_cga
esc1:           call restore_screen             ;restore screen contents
                cmp adapter,1                   ;re-enable CGA video
                jne esc2
                call enable_cga
esc2:           mov ah,2                        ;set cursor position
                mov bh,video_page
                mov dx,cursor_pos
                int 10h
                mov ah,1                        ;then unblank the cursor
                mov cx,cursor_mode
                int 10h
                jmp exit                        ;exit
directory       endp
;
;-----------------------------------------------------------------------------
;SAVE_SCREEN saves the contents of the screen that underlie the window.
;-----------------------------------------------------------------------------
save_screen     proc near
                mov dx,0208h                    ;first window row and column
                mov bl,video_page               ;retrieve active video page
                xor bh,bh                       ;byte to word in BX
                call video_offset               ;determine video memory offset
                mov video_address,di            ;save offset address
                mov si,di                       ;transfer it to SI
                push ds                         ;save DS
                mov ds,video_segment            ;then set it to the video segment
                assume ds:nothing
                mov di,screen_buffer            ;point DI to storage buffer
                mov cx,12                       ;12 lines to save
save1:          push cx                         ;save line count
                mov cx,64                       ;64 characters per line
                rep movsw                       ;transfer one line to storage
                pop cx                          ;retrieve line count
                add si,32                       ;point SI to next video line
                loop save1                      ;loop until all lines are saved
                pop ds                          ;restore DS
                assume ds:code
                ret                             ;exit
save_screen     endp
;
;-----------------------------------------------------------------------------
;RESTORE_SCREEN restores the saved contents of video memory.
;-----------------------------------------------------------------------------
restore_screen proc near
                push es                         ;save ES register value
                mov di,video_address            ;point DI to starting video offset
                mov es,video_segment            ;point ES to video memory
                mov si,screen_buffer            ;point SI to storage buffer
                mov cx,12                       ;12 lines to restore
restore1:       push cx                         ;save line count
                mov cx,64                       ;64 characters per line
                rep movsw                       ;restore one line
```

The second thing to understand is just why DOS routines are non-reentrant. When an interrupt 21h is executed, one of the first steps DOS takes is to switch to one of three internal stacks it maintains. The same is true with interrupts 25h and 26h. The switch is accomplished by simply saving the contents of the SS and SP registers for restoration upon exit, then changing them to point to an area of memory set aside within the operating system's reserved workspace. If one routine calls another, everything that was stored on the stack by the first (like the register values on entry) is overwritten by the second. One of the items likely to be destroyed is the return address of the second routine, which was pushed onto the stack by the micro-processor when the interrupt instruction was processed. Thus, when the latter routine executes an IRET, control is vectored to some random place in memory where it was never intended to go.

Which internal stack is used depends on the interrupt number and, for interrupt 21h, the function number. Interrupts 25h and 26h always use the same stack. Interrupt 21h functions 1 through 0Ch and a few higher-numbered ones use another stack. Functions 0 and 0Dh and higher (with a few exceptions) use the same stack employed by interrupts 25h and 26h. (There are even provisions within DOS to let one routine call another and avoid the stack switch. DOS is one complicated piece of code, and exceptions will be found to almost any blanket generalities.) Why some applications, like DOS, choose to use an internal stack is a matter of programming philosophy. BIOS routines are reentrant (a flexibility the video BIOS takes advantage of) because they don't employ a special stack. They rely instead on the assumption that the program that calls them has enough stack space to handle the PUSHing and POPing of several words. In almost all cases that's a safe assumption. Many memory-resident utilities use their own stack, however, to make absolutely sure that their stack requirements won't overtax the system and crash the computer. The trade-off is that simply using the default stack is easier, requires less code, and is usually a sound practice. It's a shortcut often taken without being given a second thought.

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```
                pop cx                          ;retrieve line count
                add di,32                       ;set DI to next video line
                loop restorel                   ;loop until done
                pop es                          ;restore ES
                ret
restore_screen endp
;
;-------------------------------------------------------------------------
;VIDEO_OFFSET calculates the offset address in video memory that corresponds
;to the indicated row, column, and video page.
;Entry:  DH,DL - row, column             | Exit:  DI - offset
;        BX    - video page              |
;-------------------------------------------------------------------------
video_offset  proc near

                mov al,160                      ;row * 160
                mul dh
                shl dl,1                        ;column * 2
                xor dh,dh                       ;byte to word in DX
                add ax,dx                       ;add the results
                mov di,ax                       ;save result in DI
                mov ax,1000h                    ;length of one video page
                mul bx                          ;page * 1000h
                add di,ax                       ;add result to DI
                ret
video_offset  endp
;
;-------------------------------------------------------------------------
;DISABLE_CGA and ENABLE_CGA disable and enable CGA video output.
;-------------------------------------------------------------------------
disable_cga   proc near
                mov dx,3DAh                     ;address of Status Register
disable1:       in al,dx                        ;get status
                test al,8                       ;vertical retrace active?
                je disable1                     ;no, then wait
                sub dx,2                        ;MSR address in DX
                mov al,25h                      ;value to disable video
                out dx,al                       ;disable video output
                ret
disable_cga   endp
;
enable_cga    proc near
                mov ah,15                       ;get video mode
                int 10h
                lea bx,enable_values            ;get value to enable display
                xlat                            ;value in AL
                mov dx,3D8h                     ;MSR address
                out dx,al                       ;enable video output
                ret
enable_cga    endp
;
;-------------------------------------------------------------------------
;KB_RESET resets the keyboard and issues an EOI to the 8259 PIC.
;-------------------------------------------------------------------------
kb_reset      proc near
                in al,61h                       ;get current control value
                mov ah,al                       ;save it in AH
                or al,80h                       ;set the high bit
                out 61h,al                      ;send it to the control port
                mov al,ah                       ;recover original value
                out 61h,al                      ;send it out
                cli                             ;suspend interrupts
                mov al,20h                      ;load EOI value
                out 20h,al                      ;send it to the 8259
                sti                             ;restore interrupts
                ret
kb_reset      endp
;
;-------------------------------------------------------------------------
;SHOW_CURSOR sets the cursor to its default state.
;-------------------------------------------------------------------------
show_cursor   proc near
                mov ah,1                        ;interrupt 10h service 1
                mov cx,default_cursor           ;set scan line definition
                int 10h                         ;set cursor shape
                ret
show_cursor   endp
;
;-------------------------------------------------------------------------
;CURSOR_ADDRESS reads the current cursor position from the video controller.
;-------------------------------------------------------------------------
cursor_address proc near
                mov dx,addr_6845                ;get CRTC Address Register port
                mov al,14                       ;OUT register number
                out dx,al
                inc dx                          ;point DX to Data Register
                in al,dx                        ;read high byte of cursor address
                mov ah,al                       ;save it in AH
                dec dx                          ;point DX back to Address Register
                mov al,15                       ;OUT next register number
                out dx,al
                inc dx                          ;point DX to Data Register
                in al,dx                        ;read low byte of address
                and ax,07FFh                    ;strip 'page' bits from address
                mov bl,80                       ;then divide by 80
                div bl
                xchg ah,al                      ;reverse bytes for proper form
                ret
cursor_address endp
;
;-------------------------------------------------------------------------
;GETKEY waits for a keypress and returns the keycode in AX.
;Exit:  AX - keycode
;-------------------------------------------------------------------------
getkey        proc near
                mov ah,1                        ;check keyboard buffer
                int 16h
                jne getkey1                     ;jump if buffer contains a keycode
                int 28h                         ;no key pressed - issue int 28h
                jmp getkey                      ;loop back to try again
```

characteristic of DOS services to allow a resident utility to make use of them boils down, then, to making sure that your routine will take control only when an interrupt 21h, 25h, or 26h is not being processed. The obvious way to accomplish that would be to intercept calls to each, set a flag indicating that processing is taking place when a DOS service is requested, and clear that flag upon exit. But there is an easier way, as described by Ian Davies in his 'MS-DOS Programming' series (see *APC* April 1987.)

As it happens, DOS itself maintains an internal flag, sometimes called the Busy Flag, which any program can access to see whether a DOS routine is currently active. The address of that flag is obtained by calling interrupt 21h, function 34h. The segment address is returned in ES and the offset in BX. By checking that byte within the operating system's work area before activating a pop-up utility, and by refusing to hand control to it if the byte is nonzero, a program can ensure that one service call will not overlay another.

If you look up DOS function 34h in the DOS *Technical Reference* (or almost any programming manual, for that matter), you'll find it simply listed as 'Used internally by DOS.' That explains why the knowledge of how to use DOS services in memory-resident code isn't widespread: Microsoft didn't document services like 34h, apparently in an attempt to discourage programmers from using them. All of us paid good money for DOS — and an outrageous amount for the *Technical Reference* — yet Microsoft won't treat us as programming adults. Fortunately, other people have spent a great deal of time investigating these forbidden territories (and disassembling PRINT.COM), and they have passed the useful information on to the interested public.

A few sharp programmers may have already spotted a problem in the offing. If resident utilities are to be prevented from acting when a DOS interrupt routine is in progress, what happens if a request for the resident program occurs during the execution of a prolonged function like 0Ah, which reads an entire line of text from the keyboard? It's a real problem, because function 0Ah is active when DOS awaits command line input adjacent to the A prompt.

Enter interrupt 28h, another undocumented DOS resource vital to the programming of advanced resident code. When function 0Ah is waiting for a keystroke, it continually issues calls

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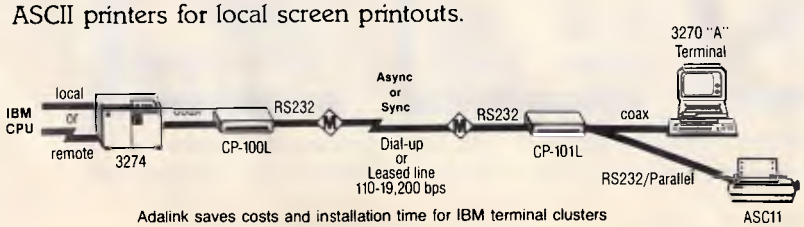

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```
getkeyl:        mov ah,0                        ;get keycode from buffer
                int 16h
                ret                             ;exit with keycode in AX
getkey          endp
;
;-------------------------------------------------------------------------------
;OPEN_WINDOW writes the blank directory window to display memory.
;-------------------------------------------------------------------------------
open_window     proc near
                push es                         ;save ES
                mov es,video_segment            ;set ES:DI to video memory
                mov di,video_address
                mov al,218                      ;write first character
                mov ah,border_attr
                stosw
                mov cx,62                       ;then do the next 62
                mov al,32
                rep stosw
                mov al,191                      ;finish the first line
                stosw
                add di,32                       ;set DI to start of next line
                mov cx,10                       ;10 lines to do
openl:          push cx                         ;save line counter
                mov al,179                      ;write first character on line
                mov ah,border_attr
                push ax                         ;save character/attribute pair
                stosw                           ;write them to video memory
                mov cx,62                       ;write next 62 characters
                mov al,32
                mov ah,text_attr
                rep stosw
                pop ax                          ;retrieve saved word for final char
                stosw                           ;finish the line
                add di,32                       ;set DI to start of next line
                pop cx                          ;retrieve line counter
                loop openl                      ;loop until 10 lines are done
                mov al,192                      ;first character of last line
                stosw
                mov cx,62                       ;write the next 62 characters
                mov al,196
                rep stosw
                mov al,217                      ;finish the last line
                stosw
                pop es                          ;restore ES
                ret
open_window     endp
;
;-------------------------------------------------------------------------------
;READLN accepts input of a string entered from the keyboard.
;Entry:  ES:DI - buffer address          | Exit: CL - string length
;        DH,DL - cursor start position |
;        CL    - max length accepted   |
;-------------------------------------------------------------------------------
readln          proc near
                mov maxlen,cl                   ;save max length
                mov ah,2                        ;set cursor to start position
                mov bh,video_page
                int 10h
                call show_cursor                ;make sure cursor is visible
                xor cl,cl                       ;initialize counter
readl:          call getkey                     ;get a character
                cmp al,13                       ;ENTER key?
                je read_exit                    ;yes, then exit
                cmp al,27                       ;ESC key?
                je read_exit                    ;yes, then exit
                cmp al,8                        ;backspace key?
                je backspace                    ;yes, then do backspace function
                cmp al,32                       ;ASCII 32 or greater?
                jb readl                        ;no, then ignore it
                cmp cl,maxlen                   ;room for another entry?
                je readl                        ;no, then ignore it
                push ax                         ;save character just entered
                push cx                         ;save character count
                mov ah,10                       ;print the character
                mov cx,1
                int 10h
                inc dl                          ;advance the cursor
                mov ah,2
                int 10h
                pop cx                          ;retrieve count
                pop ax                          ;retrieve character
                stosb                           ;deposit entry in buffer
                inc cl                          ;update count
                jmp readl                       ;go back for more
backspace:      or cl,cl                        ;any characters to delete?
                je readl                        ;no, then ignore keystroke
                push cx                         ;save count
                dec dl                          ;move cursor back one space
                mov ah,2
                int 10h
                mov ah,10                       ;print a space character
                mov al,32
                mov cx,1
                int 10h
                pop cx                          ;retrieve count
                dec cl                          ;decrement it
                dec di                          ;decrement buffer pointer
                jmp readl                       ;go back for more
read_exit:      ret                             ;exit
readln          endp
;
;-------------------------------------------------------------------------------
;IOSET saves the current DTA address and interrupt 24h vector, then replaces
;them with pointers to XDIR routines.  IORESET restores the original values.
;-------------------------------------------------------------------------------
ioset           proc near
                push es                         ;save ES
                mov ah,2Fh                      ;get current DTA address
```

to interrupt 28h which can be picked up by anyone caring to intercept them. When an interrupt 28h is executed, DOS services higher than 0Ch may be safely invoked without risk of causing a system crash even if the DOS Busy Flag is set. A resident routine can set up its own interrupt 28h handler and feel secure in utilizing interrupt 21h from inside it.

Just why we can use only services numbered higher than 0Ch from within an interrupt 28h routine is answered by remembering how DOS is structured. Of the three internal stacks that DOS maintains, one is used almost solely for calls to services 1 through 0Ch. Interrupt 28h is executed only by DOS routines in that range. Thus non-reentrancy restrictions are circumvented if calls to functions numbered higher than 0Ch are used and calls to 0Ch or lower are tenaciously avoided. Memory-resident routines can utilise disk services and other DOS functions if the guidelines are followed. There are still a few times when such programs can't pop up, however. Use the DOS TYPE command to list a long file and try to bring up SideKick in the middle of the listing. You'll find that SideKick won't come up. The DOS Busy Flag is set the whole time and interrupt 28h is not executed, so a resident routine like SideKick that performs file I/O can't break in on the running TYPE command. The system isn't perfect, but it's the best that can be done until versions of DOS are developed that have real multi-tasking capabilities.

Interrupting politely

In addition to guarding against violating DOS non-reentrancy characteristics, a memory-resident utility that accesses a disk must also be sure not to interfere with the applications program it is interrupting. Every application, resident or not, that reads disk information has to set aside some portion of memory (or use the default area DOS provides) to serve as a Disk Transfer Area, or DTA. Data brought in from the disk passes through this area on its way to the program that requested it. A resident program must define its own local DTA so that it doesn't overwrite data in the interrupted program's DTA. In addition, it must save the original DTA address and restore it before exit.

Another important but often overlooked consideration is what happens in the event of a critical error. A critical error is a special class of error that causes DOS to respond by generating an interrupt 24h. Control is shifted to

```
                int 21h
                mov old_dta_segment,es          ;save it
                mov old_dta_offset,bx
                mov ah,1Ah                      ;set new DTA address
                mov dx,dta
                int 21h
                mov ah,35h                      ;get interrupt 24h vector
                mov al,24h
                int 21h
                mov old24h_segment,es           ;save it
                mov old24h_offset,bx
                mov ah,25h                      ;then set it to IOERR routine
                lea dx,ioerr
                int 21h
                pop es                          ;restore ES
                ret
ioset           endp
;
ioreset         proc near
                mov ah,25h                      ;restore interrupt 24h vector
                mov al,24h
                mov dx,old24h_offset
                push ds
                assume ds:nothing
                mov ds,old24h_segment
                int 21h
                mov ah,1Ah                      ;restore original DTA address
                mov dx,old_dta_offset
                mov ds,old_dta_segment
                int 21h
                pop ds
                assume ds:code
                ret
ioreset         endp
;
;-----------------------------------------------------------------------------
;GET_DIR reads the specified directory and stores the ASCIIZ filename text.
;Entry:  DS:DX = pathname                | Exit:  CX = number of files
;-----------------------------------------------------------------------------
get_dir         proc near
                mov error_flag,0                ;initialize critical error flag
                mov ah,4Eh                      ;find first filename
                mov cx,search_attr              ;set search attribute
                int 21h                         ;initiate file search
                mov cx,0                        ;zero CX in case no files found
                jc getdir4                      ;done if no files found
                cmp error_flag,0                ;critical error flag clear?
                jne getdir4                     ;no, then exit immediately
                inc cx                          ;initialize file count
                mov di,text_buffer              ;set buffer address
                call copy_filename              ;copy filename to buffer
getdir1:        mov ah,4Fh                      ;continue file search
                int 21h
                jc getdir2                      ;done if nothing found
                cmp error_flag,0                ;did a critical error occur?
                jne getdir2                     ;yes, then exit
                call copy_filename              ;copy next filename
                inc cx                          ;update counter
                cmp cx,360                      ;buffer full?
                jne getdir1                     ;no, go back for more
getdir2:        sub di,13                       ;go back to start of last filename
getdir3:        inc di                          ;point DI to next byte
                cmp byte ptr es:[di],0          ;is this a zero byte?
                jne getdir3                     ;no, then advance to next byte
                dec byte ptr es:[di]            ;mark end of text with a 255
                mov ax,cx                       ;calculate number of pages
                dec ax
                mov bl,40
                div bl
                mov max_page,al                 ;save highest page number
getdir4:        ret
get_dir         endp
;
;-----------------------------------------------------------------------------
;COPY_FILENAME copies an ASCIIZ filename from the DTA to the indicated address.
;Entry:  ES:DI - destination address
;-----------------------------------------------------------------------------
copy_filename proc near
                mov si,dta                      ;get DTA address
                add si,30                       ;point SI to start of filename
                push cx                         ;save CX
                mov cx,13                       ;filename length is 13 bytes
                rep movsb                       ;copy filename to storage
                pop cx                          ;restore entry value of CX
                ret
copy_filename endp
;
;-----------------------------------------------------------------------------
;WRITE_DIR writes one page of directory data to the directory window.
;-----------------------------------------------------------------------------
write_dir       proc near
                mov end_flag,0                  ;initialize END_FLAG
                mov ax,520                      ;520 bytes per directory page
                mov bl,dir_page                 ;get page number in BL
                xor bh,bh                       ;byte to word in BX
                mul bx                          ;find offset into TEXT_BUFFER
                mov si,ax                       ;transfer offset to SI
                add si,text_buffer              ;complete address calculation
                mov dx,030Ah                    ;specify starting cursor position
                mov cx,10                       ;do 10 lines
wdir4:          push cx                         ;save line counter
                call write_line                 ;write one line
                inc dh                          ;set cursor to next line
                mov dl,10
                pop cx                          ;restore line count
                cmp end_flag,0                  ;END_FLAG set?
                jne wdir5                       ;yes, then terminate
                loop wdir4                      ;loop until all lines are done
wdir5:          ret
write_dir       endp
```

the operating system's own handling routine. That's the routine that presents the infamous "Abort, retry, ignore?" message when the user tries to read from a drive without a disk in it. Any serious applications program written for PC-DOS that doesn't use a teletype-style interface must employ a custom critical error handler to prevent it from bombing in the event of an error condition, and the resident utility is certainly no exception. In fact, it's probably more important in resident code, because the crash of a resident routine would probably destroy the underlying program as well. A full-featured memory-resident program that performs file I/O must, therefore, point the interrupt 24h vector to its own routine on entry and then be sure to restore it to its original value on exit.

Inside XDIR

As is usually the case, knowing the theory behind the method is a necessary, but not sufficient, condition for implementing it. There is a multitude of details to take care of, from how to coordinate simultaneous interrupt interceptions to how to make one resident program compatible with another. The best way to understand these, however, is to look inside a program that uses them, such as XDIR.

Like all resident utilities, XDIR begins by executing a section of code that sets the stage for the part of the program that will remain behind after termination. Once completed, the initialisation code is effectively erased when the space it occupies is turned back over to DOS.

XDIR begins by determining what kind of video adaptor is installed. This information is important because if a standard colour/graphics adaptor is being used, the program has to take special precautions when opening and closing the directory window. Writing directly to CGA video memory causes unsightly video snow unless memory modifications are undertaken only during one of the retrace cycles or the display is turned off altogether before the writing takes place. XDIR does the latter when it writes the window to the screen.

One popular way to detect the presence of an EGA video adaptor is to check for the three letters "IBM" (even the non-IBM EGAs have them) in the EGA BIOS area. XDIR uses another method. The EGA BIOS includes additional functions above and beyond the normal BIOS video services available through interrupt 10h.

```
;
;-------------------------------------------------------------------------
;WRITE_LINE writes a single line of directory text to the display.
;Entry:  DH,DL - starting row and column
;-------------------------------------------------------------------------
write_line      proc near
                mov cx,4                        ;4 entries per line
wline1:         push cx                         ;save counter
                push si                         ;save text address
                push dx                         ;save cursor address
                call write_string               ;write one entry
                pop dx                          ;retrieve cursor address
                add dl,16                       ;set cursor to next field
                pop si                          ;retrieve text address
                add si,13                       ;set it for next write
                pop cx                          ;retrieve count
                cmp end_flag,0                  ;END_FLAG set?
                jne wline2                      ;yes, then exit
                loop wline1                     ;loop until done
wline2:         ret
write_line      endp
;
;-------------------------------------------------------------------------
;WRITE_STRING writes an ASCIIZ string to the display.
;Entry:  DH,DL - starting row and column
;        DS:SI - string address
;-------------------------------------------------------------------------
write_string    proc near
                mov ah,2                        ;set cursor to start position
                mov bh,video_page
                int 10h
                mov cx,1                        ;output one character at a time
writel:         lodsb                           ;get a character
                or al,al                        ;is it a zero?
                je write3                       ;yes, then exit
                cmp al,255                      ;is it 255?
                je write2                       ;yes, then set END_FLAG and exit
                mov ah,10                       ;print character
                int 10h
                mov ah,2                        ;advance cursor
                inc dl
                int 10h
                jmp writel                      ;loop until done
write2:         mov end_flag,1                  ;set END_FLAG
write3:         ret
write_string    endp
;
;-------------------------------------------------------------------------
;CLEAR_WINDOW clears the contents of the directory window.
;-------------------------------------------------------------------------
clear_window    proc near
                mov ah,6                        ;clear window with BIOS routine
                mov al,0                        ;specify clear function
                mov cx,030Ah                    ;specify window coordinates
                mov dx,0C45h
                mov bh,text_attr                ;attribute to be used
                int 10h
                ret
clear_window    endp
;
;-------------------------------------------------------------------------
;CLEAR_INPUT_LINE clears the window input line.
;-------------------------------------------------------------------------

clear_input_line proc near
                mov ah,2                        ;set cursor to start of input line
                mov dx,020Ah
                mov bh,video_page
                int 10h
                mov ah,10                       ;then write a string of spaces
                mov al,32
                mov cx,60
                int 10h
                ret
clear_input_line endp
;
;-------------------------------------------------------------------------
;INITIALIZE prepares the program for residency.
;-------------------------------------------------------------------------
initialize      proc near
;
;Determine what type of video adapter is installed.
;
                mov ah,12h                      ;prepare for call to int 10h
                mov bl,10h                      ;function - request EGA info
                int 10h
                cmp bl,10h                      ;BL=10h?
                je init1                        ;yes, then no EGA installed
                or bh,bh                        ;BH=0?
                jne init2                       ;no, then it's a monochrome system
                jmp init3
init1:          dec adapter                     ;decrement ADAPTER value
                mov ah,15                       ;get video mode
                int 10h
                cmp al,7                        ;is it mode 7?
                jne init3                       ;no, then it's a color system
                dec adapter                     ;set ADAPTER to 0
;
;Modify video parameter values for monochrome, then initialize the cursor.
;
init2:          sub video_segment,800h          ;set VIDEO_SEGMENT for monochrome
                mov border_attr,70h             ;change attributes for monochrome
                mov text_attr,07h
                mov default_cursor,0C0Dh        ;set monochrome cursor definition
init3:          call show_cursor                ;set cursor to default mode
;
;Determine the port address of the CRT Controller and store it.
;
                mov ax,40h                      ;point ES to BIOS data segment
                mov es,ax
                mov di,63h                      ;point DI to address word
```

One of these is function 12h. With the BL register set to 10h on entry, function 12h returns a 0 or a 1 in BL that indicates whether the EGA is in colour mode (connected to a colour RGB monitor) or monochrome mode (linked to a display like the IBM Monochrome Display). If there's no EGA in the system, however, a call to 12h simply returns the value of BL unaltered. XDIR uses that key, and if no EGA is present, then the current video mode number is used to determine whether a CGA or a monochrome board is installed.

Next, the port address of the CRT Controller is obtained from the BIOS data area and stored away for later use. Then the undocumented DOS function 34h is called to let XDIR determine the address of the DOS Busy Flag. Why do it this early? We find ourselves in something of a catch-22 when we want to check the Busy Flag to see if the current ongoing process can be safely interrupted because if the PC is presently in the middle of servicing an interrupt 21h request, function 34h will crash the system. Therefore its address is saved during the nonresident phase, and the flag is accessed directly from inside the resident portion whenever XDIR needs to check it.

The final initialisation step is to save and replace all of the interrupt vectors that XDIR will need. The program intercepts four interrupts (not including interrupt 24h, whose vector is manipulated when the directory window is called up — not during installation), each of which plays a vital role in orchestrating the pop-up process. The keyboard interrupt, interrupt 9, is borrowed so that XDIR can look for a press of the Alt-period trigger key combination. The timer interrupt and the background process interrupt (1Ch and 28h, respectively) are used in a coordinated manner to process a request to pop up the window. The final interrupt that's intercepted, interrupt 13h, is used in a way that deserves comment.

Interrupt 13h provides all of the low-level BIOS diskette services for reading, writing, and formatting individual sectors and tracks. In a sense, these services are non-reentrant, just like the DOS interrupt 21h services, but for a different reason. There's no problem with stack locations: BIOS routines don't use an internal stack. Instead, however, there is the omnipresent danger of interrupting the movement of the drive head from one track to another. If the resident routine performs any file I/O, the head will be

. . . continued on page 181

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Inside GEM

The intricacies of the traditional machine operating system can be a big deterrent to the novice computer user and preclude him from getting to grips with his machine. The WIMP environment (in the form of windows, icons, mice and pull-down menus) goes some way to overcoming this obstacle by presenting a friendly front-end, and many popular machines have now adopted the GEM interface as a standard. In this article Nick Walker examines GEM's architecture and discusses its implications for future system design.

It's taking a long time for the micro industry to disentangle itself from its mainframe roots but there are signs that it is now happening. A few years ago, one of the major turn-offs for the novice computer user was the terse and cryptic mainframe-inherited operating system commands that were needed before the machine could do anything useful. However, a type of operating system is now evolving that is specifically designed to use the graphics capabilities of most modern micros, which employs the same easy-to-use commands across different machines. This wonderful system that runs on the IBM PC, the Apple II, the Atari ST, the Commodore 64 and the Macintosh, to name but a few machines, has acquired the name 'WIMP' (for windows, icons, mice and pull-down menus).

WIMP is not an operating system in the sense that CP/M or MS-DOS are operating systems. You can't take a disk from a Macintosh WIMP system and run it on an IBM WIMP system, but once you've learned the 'point and click' controls, the chances are that you'll be able to use *any* WIMP system without much effort.

The only problem now is rekindling the interest of those who have been discouraged in the past. One way to achieve this is to convince existing users that it really is worth converting to one of these systems. Not an easy task with users who use the existing OS commands efficiently and would also resent the 200k or so that such systems typically need. Despite this, however, I believe that all users should take a serious look at the WIMP environments available for their machine and, if possible, start to use them. Who knows, if everyone uses a WIMP interface, software developers might eventually be inspired to create a truly (software) compatible OS for a range of machines.

In this article I will take one of the most successful of these WIMP systems, GEM (Graphics Environment Manager from Digital Research), and describe its architecture, the latest versions and the problems involved with customising and programming it. Whether you just want to use a WIMP system more efficiently or you want to tinker with its innards, understanding how GEM works will be of benefit.

GEM is a good example to use as it is an increasingly popular WIMP system, and at present is the only operating system you can easily use on an Atari ST as well as being bundled with the Amstrad PC range. It is also available for the vast majority of IBM PC and clone configurations.

Architecture

One of the main advantages of a WIMP system is that you need no knowledge of its architecture in order to use it. However, as processors offer even greater power, the major factor in determining what the user can achieve is the software author's ability to harness this power. To write a modern integrated package in assembly language would be a monstrous task for a 68020 or 80386 if a full WIMP system had to be written to go with it: just as the efforts of a craftsman may be limited by his tools, so the results of a software developer are determined by the tools offered by the operating environment. So an understanding of the architecture of a WIMP system will help you to realise the constraints that apply to all applications running in that environment.

The interface between your machine's hardware and the program you use is a complex one, with many hidden software components. Nowhere is this more true than in the case of a WIMP environment which adds extra layers of software in order to produce what appears to be a slick, easy-to-use front end. Whereas it is straightforward to describe the hardware components of a machine, the system software is much more nebulous; and, unfortunately, both the user manuals and those supplied with programmers' toolkits are notoriously bad at describing the components of a software environment.

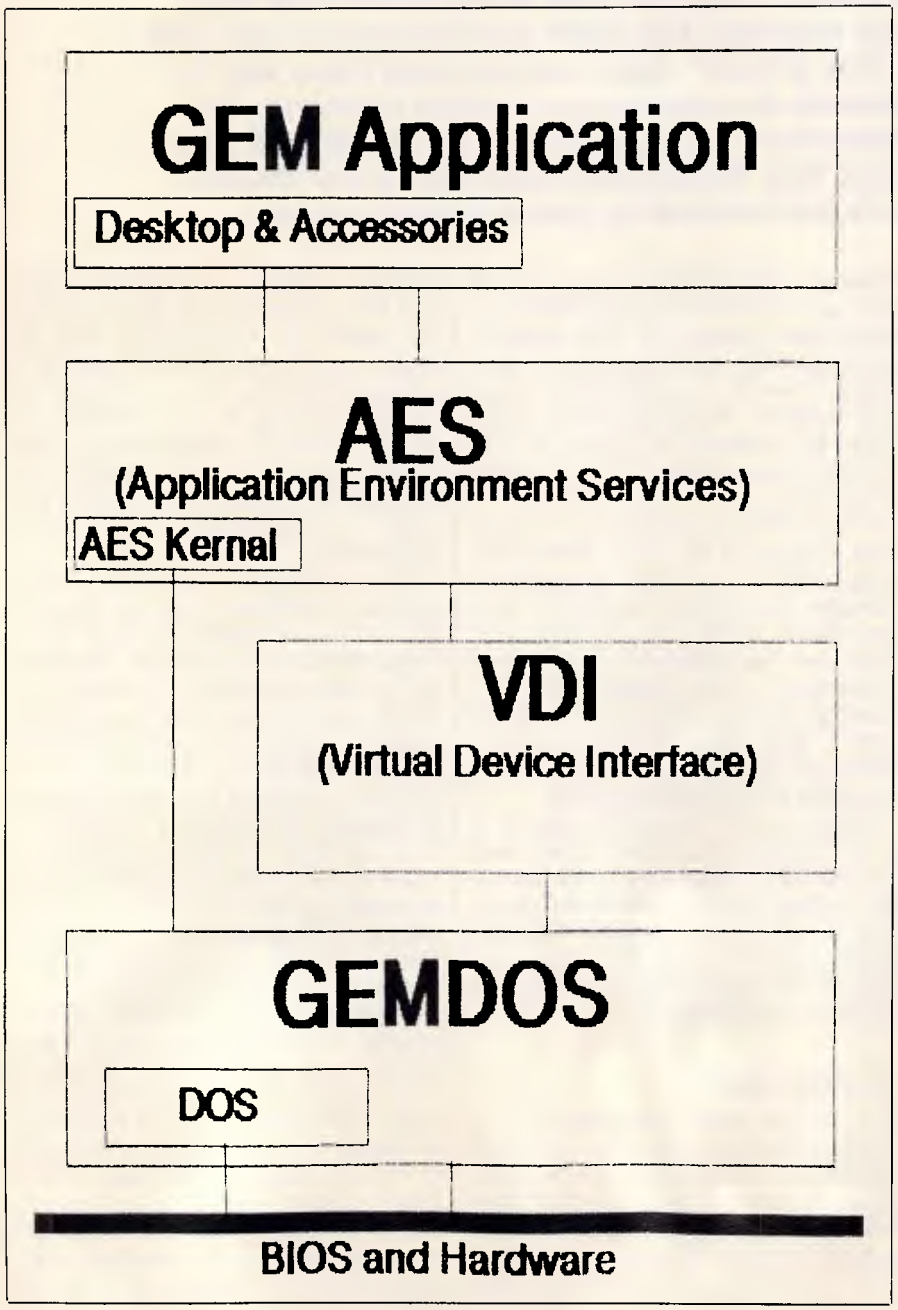
A good WIMP environment should provide a series of cushioning layers between the user and the hardware, each of which is divided into functional units. The major concern of a traditional operating system such as MS-DOS is the management of disks. In a WIMP system this is further complicated by such things as: text and graphics handling; inter-program communication; multiple tasks; and, possibly, having to cope with more than one user accessing the system at the same time. Many different levels of com-

plexity of function are needed, from the extremely basic ability to read the button on a mouse to smooth manipulation of windows and menus.

GEM consists of three main functional blocks which are illustrated in the box below: GEMDOS, the VDI (Virtual Device Interface) and the AES (Application Environment Manager).

GEMDOS

Underneath all the graphics goodies lies a good old-fashioned operating system. On the IBM PC this is MS-DOS, on the Atari it is TOS, both with a conventional BIOS (Basic Input/Output System), although on the Atari ST this is extended by a set of graphic BIOS commands (when accessing these BIOS calls from GEM applications, they are collectively known as GEMDOS). The main functions of GEMDOS are: monitoring hardware ports, keyboard and mouse handling; disk access and file manipulation; and machine-specific control of screen and sound generation. In short, the function of GEMDOS is to normalise the machine-specific features so that the VDI and AES have a standard interface on all machine architectures.



GEM's three main functional blocks: GEMDOS, the VDI and the AES

Virtual Device Interface (VDI)

Early micros provided a cheap medium for the storage, transmission and manipulation of text as well as their already proven number-crunching ability. However, the handling of fast colour graphics is a far more difficult task which is fraught with obstacles, not least of which is the lack of standardisation in the way in which screen images are represented. Whereas ASCII code allows text to be moved from one machine to another, it is still a great challenge to successfully move a screenful of graphics from an IBM PC to a Commodore Amiga, for example. Even worse, a universally accepted kernel of standard graphics commands does not yet exist.

GEM addresses both of these problems. First of all it defines a standard for the representation of graphics images which can, in theory, be transferred from a Motorola 68000 GEM system (the Atari ST) to an Intel 80xxx system. Secondly, an older Digital Research kernel of graphic commands known as GSX is supported in kind by GEM, giving some graphic-command independence.

The secret behind the portability of graphics is one of a 'best-fit' approach. The routines implemented on a particular machine will scale the pixel address range from a value in the range 0-32767 to one in the machine's own coordinates. This means that a line across the screen from the bottom left to the top right on an Atari ST would be called as 0,0 to 32767,32767, but in fact would be translated to the positions 0,0 to 640,400. In effect then the target hardware is of no consequence and the programmer just has to hope that the final result on the machine is visually acceptable.

The higher-level graphics and text functions of GEM are contained within the Virtual Device Interface (VDI). This responds to a large set of commands, ranging from the very primitive, such as plotting single pixels, to the complex drawing and filling of rectangles with rounded corners, or text characters in a variety of styles.

On the Atari ST, a substantial part of the VDI, the Graphics Device Operating System (GDOS) is missing. This provides additional machine-independence in the form of device drivers, object-orientated graphics using 'metafiles', and the loading of further fonts. Unfortunately, neither Atari nor Digital Research have made GDOS officially available, so the only way it can be obtained is by extracting it from an application that uses it — such as

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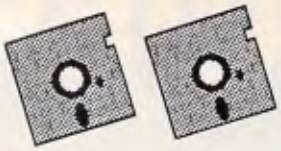

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The Virtual Device Interface offers a very wide range of graphics routines, but it is relatively weak on text-handling facilities. Before an application can use these, it must determine the type of device with which it is to work. Each device has a set of parameters associated with it known as its 'physical workstation'. Alternatively, a generalised scheme can be used which is later translated and is known as a virtual workstation. The VDI open workstation command does this (which is distinct from initialising an application with the AES, mentioned below). On the Atari ST, without GDOS, it is only possible to open a virtual workstation for the screen, and attempting to open physical workstations for other devices leads to GEM crashing. However, PCs and STs with GDOS can open physical workstations for a wide range of other devices — printers, plotters, cameras (like Polaroid Palette) and metafiles, for instance. These are assigned device numbers and made available by a configuration file ASSIGN.SYS, which is read at boot time. This is very similar to the MS-DOS CONFIG.SYS file, and tells GDOS which device drivers and fonts to load.

There are about 108 functions available from the VDI. These fall into seven main groups: the main controls include commands to open, clear, update and close physical and virtual workstations; enquiries about various GEM attributes like the current line colour and style; attribute controls to set these attributes; input functions for access to the mouse/pointer, keyboard and other input devices; a large range of graphics commands, from simple line-drawing to complicated text font displays; raster commands for the manipulation of blocks of screen pixels and, finally, escape-like control functions, such as cursor controls for the screen, printer output, camera control, and the handling of graphic command files (metafiles).

For the programmer just beginning to program in GEM, the VDI functions are best left alone. Their purpose is mainly to give the portability requirements that will arise in the future as more and more physically different hardware adopts the same graphic standard. The important point to grasp is that programs that use the VDI graphic calls are completely portable to other machines, provided that the program interrogates the hardware in advance to identify the screen resolution.

There are several features of the VDI, with GDOS, that are only beginning to be used and which offer remarkable potential. In the first place, multiple fonts are available, provided that they are either loaded at boot time (specified in the ASSIGN.SYS file), or using the font load command during a program. This does not only mean fonts for the screen, but for any output, including that to laser printers. This greatly reduces the burden on programmers who are producing CAD or desktop publishing software, as all they need to do is produce a device driver for the printer and a range of font files, and they can provide an impressive choice of screen and printer fonts (which can actually look similar too).

Metafiles are disk files containing a series of GEM commands which specify an object or a group of graphic objects. There are two basic ways of re-drawing a saved graphic image: you can either load a memory image of the screen, which is simply a large matrix of pixels, or you can redraw each line from the original sequence of commands which created it. The metafile is just such a sequence of commands, and has many advantages over simple screendumps.

'. . . if everyone uses a WIMP interface, software developers might eventually be inspired to create a truly (software) compatible OS for a range of machines.'

In the first place, a metafile can be edited, so that if you decide that a certain square should be a bit larger, you can alter the parameters of the commands which produce that square. This is almost impossible if you can only access the square as a mass of pixels.

Furthermore, you can redirect the metafile commands to any output device, or another machine, knowing that a device driver will be able to turn the commands into a representation of that image, independent of scaling or resolution considerations. This device-independence is consummated in the ability to manipulate groups of commands, which represent discrete objects, on the screen or any other output device — true object-orientated graphics. Over the next few years, this will have many new applications, such as in image databases, or the production of animated sequences.

Application Environment Services (AES)

The third main component of GEM is the Application Environment Services (AES), which uses the graphics primitives of the VDI, various functions in GEMDOS, as well as a number of its own routines to provide the user interface. It is the AES which manages menus, dialogue boxes and windows as well as the other resources which programs use. The AES is also the right way to address GEM from the programmer's point of view as it ensures that the proper route is taken through all the underlying system software. In many ways this is the most complicated part of GEM, as it contains all the code for controlling events, communications between tasks, and the like.

The AES contains 11 function libraries, and is organised in its own hierarchy. The two core parts of the AES are the Window Manager and the controlling kernel, which implement limited multi-tasking of desk accessories and windowing functions. While the VDI does not use AES facilities, the AES is heavily dependent on the VDI for the drawing of windows and many other functions.

The 11 libraries cover: the handling of applications, including their initialisation and passing messages between processes; the handling of events, from keyboard, mouse, timers, and message passing; control and use of the menu bar displayed on the first line of the screen; the loading and use of resource files which provide menus, dialogues, and so on; the location and display of objects (data structures from resource files); the display and use of alert boxes and other dialogues; the manipulation of boxes onscreen, such as their movement and sizing; cutting and pasting between processes using scrap files; the selection of files for the use of applications; the creation and maintenance of windows; and, finally, the ability to run other applications within an AES shell.

One of the snags with window management using the AES is the problem of re-drawing overlapped windows. Digital Research has adopted the same policy as Apple in that it is the responsibility of the programmer to save and redraw areas of windows that become overlapped, except in two situations. You are spared the task if

the overlapping occurs as a result of the user dropping a menu down from the menu bar, or of display of an alert box. In those instances, the affected screen area is first saved by the AES to a small buffer area, then restored when the menu or alert is erased. There are also a large number of sizeable and somewhat cryptic system data structures, with unusual names like Tedinfo and WorkOut, which appear (and often are) confusing, but a language with a good interface will coax you past these painlessly.

Programming

Although both Digital Research and Atari supply developers' kits, complete with extensive documentation, examples, and utilities such as a Resource Construction Set, these are at present fairly expensive and confined to C and assembler; also they are really aimed at the professional. Furthermore, interpreted languages which give full access to GEM are only easily available for Atari STs, so the essential initial phase of trying out the facilities is difficult on IBM and PC-compatibles. For the purist, you are welcomed to try MacroAssembler, and versions for the Atari do contain the requisite binding libraries; lesser mortals such as I will continue to watch in amazement.

Compiled languages for GEM are dominated by many versions of C, with which much of GEM was written. In order to make the example program work on both the Atari ST and the IBM PC I have written it in C. There is no reason why, with a little modification, it can't be translated into any language that gives full access to the GEM procedures. My personal favourite is the superb Modula-2/ST which has all the advantages of a souped-up Pascal, full GEM access in very much cleaner ways than with C, and the ability to write at a very high or very low level.

GEM programs usually consist of two files, one containing the main code, and the other (with the extension .RSC) with a collection of preformed menus, dialogue boxes, and the like — although this means that the user must take care to ensure that both files are accessible at once. Although failure to provide the .RSC resource file means that the program cannot run, it has many benefits.

In the first place, software can easily be translated into other languages, as only the text in the resource file should require alteration. This approach can also allow for machines working in dif-

Example C program for the Atari ST and the IBM PC

```
/*******************************/
/* Display a warning box with */
/*       form_alert            */
/*******************************/

#include "gemdefs.h"  /* Gem procedure and data definition */

int contrl[12],       /* VDI command and array size info */
    intin[128],       /* Integer input parameter array */
    ptsin[128],       /* Input co-ordinate array */
    intout[128],      /* Integer output parameters */
    ptsout[128];      /* Output co-ordinate array */

int handle;           /* Device identification handle */

int work_out[57],     /* Status info for workstation */
    work_in[12];      /* Control data for workstation */

int phys_handle;      /* GEM defined handle */

int gl_hhbox, gl_hwbox;   /* Graphic co-ordinates of */
                          /*       desktop           */
int gl_hhchar, gl_hwchar; /* Character co-ordinates  */
                          /*     of desktop          */

int fo_aexbttn;           /* Button number to acknowledge */
                          /*          warning             */
char fo_astring[] = "[1] [This is a warning box] [Key 1]
                     [Key 2]"; /* Warning message */

/*******************************/
/*        OPEN_WORK            */
/*******************************/

open_work()
{
     int i;

     /* Initialise workstation control parameters */
     for (i=0; i<10 work_in[i++]=1);
     work_in[10] = 2;

     /* Pass over device handle and open workstation */
     handle = phys_handle;
     v_opnvwk(work_in, &handle, work_out);

}

/*******************************/
/*        CLOSE_WORK           */
/*******************************/

close_work()
{
     gemdos(0x1);         /* Close DOS channels */
     v_clsvwk(handle);    /* Close workstation */
     appl_exit();         /* Close and exit application */
}
/*******************************/
/*          Output             */
/*******************************/

alarmbox()
{
```

(continued over)

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ferent resolutions (as with the IBM PC working with CGA and EGA graphics systems). Perhaps its greatest effect, though, is in separating the design of the user interface to a program from its actual coding, enabling consistent friendly interfaces to be produced readily. However, it also means that before any serious GEM programming can begin, you first have to get hold of a Resource Construction Program. Digital Research provides one in its Programmer Development Package and for IBM owners this is the only way I know of getting one. Atari ST owners, however, have a wider choice as they are bundled with a number of programming languages.

Having obtained a Resource Construction Program (RCP), its operation is far from simple. The most important point to remember is that the majority of resources are standard in their composition: that is, they are made from a number of general purpose templates or 'objects' that can be efficiently stored in a small amount of space using only their vital attributes. In fact, the RCP only allows 30k of memory to be used by a single resource file.

There are five types of resource recognised by GEM: Menus, Dialogs, Warnings, and two free types. As the operation of resource programs differs it is pointless to go into depth about any particular one. The only general advice I can give is: look at the resources of an existing program first, make a copy and start modifying resources to see what happens; save your work about every five minutes as all the RCPs I've seen have numerous bugs in them; stay away from the free types as they require a very comprehensive understanding of GEM.

Another potentially useful program for the GEM programmer is an 'icon editor'. This should in theory let you produce your own icons for application, menu, alert box or even the trashcan. Unfortunately, for IBM owners, the icon editor supplied by DR is so bug-ridden as to be totally unusable. If you have a genuine IBM with a straight CGA graphics adaptor it might run, but, don't be fooled: the chances are that within five minutes it will have irrevocably crashed. The icon editor supplied with the Atari ST seems robust enough. Once created, icons are generally incorporated into your program via the RCP.

I used to believe that it was a big step from the simple Basic programs that most tutorials teach you to write to a semi-serious application. When programming for GEM it's a very big step to be able to write anything at all.

```
/* Display warning message and wait for acknowlegement */
fo_aexbttn = form_alert(1,fo_string);
}
/*******************************/
/*        MAIN PROGRAM         */
/*******************************/

main()


{
     appl_init();     /*. Initialise GEM application */
     phys_handle =    /* Get device (screen) parameters */
     graf_handle(&gl_hwchar,&gl_hhchar,
                      &gl_hwbox,&gl_hhbox);
     open_work();     /* Open workstation */
     vq_extnd(handle,1,work_out); /* Enquire workstation */
                                  /*       status        */
     alarmbox();     /* Display warning box */
     close_work();   /* Close workstation and GEM */
                     /*       application         */

}
```

There is a vast and daunting overhead in just informing GEM that the program is a GEM application and even more in obtaining the GEM windowing system. For this reason I have provided a heavily commented GEM program shell. As it stands all it does is display a warning box and disappear when one of the two action boxes is clicked. More importantly, however, it provides a shell for both the Atari and IBM GEM which will let you experiment with the capabilities of GEM.

Future developments

One of the problems with offering a graphic environment on a number of machine architectures is that it can easily lead to disparities between versions. The problem is a lot worse with regards to GEM because: a) the Atari version of GEM is in ROM and hence very difficult to update: b) Digital Research seems to have no updated policy for existing PC users; c) version 2.0 of GEM contains a sub-standard desktop due to an out of court settlement with Apple; and d) relations between Digital Research and Atari are less than perfect.

At the moment multi-tasking is only implemented in a limited form, in that GEM alone allows you access to Desktop Accessory programs together with a main application. You can summon these accessories, which are often equivalents of SideKick with calculator, diary, address book, and so on, from within any well-behaved GEM application. However, both PC and Atari ST operating systems also allow programs to terminate and stay resident, so in theory there are more extensive possibilities. On the ST it is perfectly acceptable to run non-GEM memory resident programs and call them up as required; however, the graphic screen handling that GEM controls on the PC means that most memory-resident applications fail to work.

To add to the complexity of this situation, there is now a new release of GEM called GEM XM which is aimed at high-powered IBM and IBM clone users. GEM XM adds the two extra features to those provided in previous versions: the ability to start and switch among multiple applications; and the ability to cut and paste characters between DOS and GEM applications.

Contrary to what Digital Research would have you believe, GEM XM is not multi-tasking: to be truly multi-tasking the background applications would have to keep running while you use the foreground application. The classic example is that of a spreadsheet re-calculating while you work away on, say, a word processor. Of all the applications started, only one is running at any given time; the other applications are suspended. GEM XM is not equivalent to Microsoft's Windows or even DR's own Concurrent XM which do offer true multi-tasking.

Control of the switching ability is by means of the desk accessories menu. All applications have to be launched from the GEM desktop in the usual manner. Once launched, the applica-

tion name is added to the desk accessories menu. If the application is a GEM application it is possible to switch by pulling down the menu and selecting the application you desire. From within a DOS application, pressing the '+' on the numeric keypad brings up the desk accessories menu as a text window in the top left-hand corner of the screen. From here it is possible to switch to any running application or back to the GEM desktop; it is not possible to run any of the desk accessories listed on this menu.

While there is no doubt that the application switch works, and works well, there is a fairly heavy overhead to its use. The minimum system configuration to run GEM XM and application is 640k of memory and a hard disk. However, because GEM XM needs to save the current status of all suspended applications to disk, it only really becomes feasible speed-wise when using a decent size RAM-disk, otherwise your hard disk is rapidly eaten up by temporary files. Additional limitations are: there is a maximum of 12 channels for the AES, the desk accessories and each application (this means that if, for example, you have six desk accessories loaded there will only be room for five of them); it is only possible to invoke the application-switching menu in text-based DOS programs; the switching menu invoke key is the '+' on the numeric keypad which could clash with some applications such as Ashton-Tate's Framework.

The copy/paste feature allows character data to be copied from one DOS application to another. The copy/paste is an option at the top of the desk accessory menu which allows you to define an area on a DOS text screen and copy it into a temporary storage area. From here you can paste it into any other DOS or GEM application.

Conclusion

GEM is a powerful extension to the basic operating system of the Atari ST and IBM clones. An advantage of writing for GEM is that the great majority of the code is portable across all machines which use it.

The primitives GEM offers are an excellent base for the writing of graphical applications, but unfortunately it isn't as consistent as you might expect. For example, GEM offers a wide choice of line styles but none of these are available when using the Outline and Fill commands.

The most serious problem with GEM, however, is the amount of memory it requires in order to run effectively. To be able to take full advantage of GEM, you really need a minimum of 512k memory in addition to the 384k used by GEM itself. While this is no problem for the Atari ST, it is an impossibility for the IBM and compatibles with their 640k addressable limit. The situation is further complicated by different versions of GEM taking different amounts of memory. Digital Research could help here by updating all the registered GEM users to the latest version.

Despite these criticisms I am quite definitely a fan of GEM. I look forward to it maturing into a stable product with complete and accurate documentation, following the path of the Macintosh.

END

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SCREENTEST

Microsoft Word 3.0

Microsoft's Word 3.0 competes well with any word-processing software on any machine, and may serve as an important catalyst in Apple's drive for office credibility. Mick O'Neil is impressed.

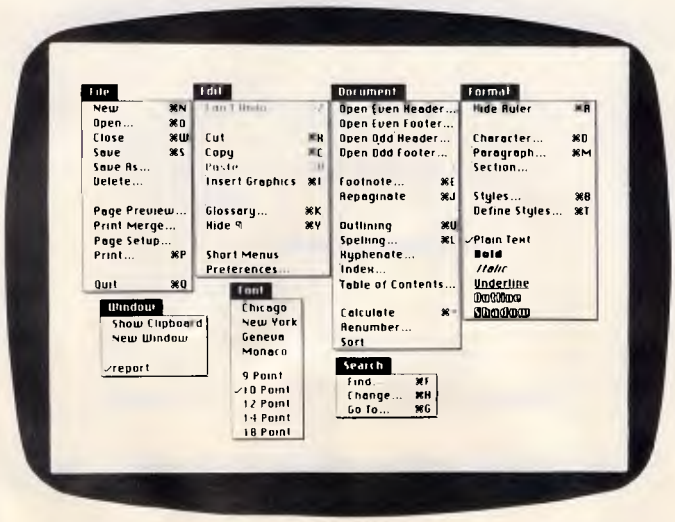
'They sought it with thimbles, they sought it with care;
They pursued it with forks and hope;
They threatened its life with a railway-share;
They charmed it with smiles and soap.'
(Lewis Carroll — *The Hunting of the Snark, An Agony in Eight Fits.*
London: Macmillan, 1876)

The search for a complete Macintosh word processing program has proven every bit as elusive as Lewis Carroll's *Snark*. A program like Write Now for the Macintosh has a unique approach to word processing and will no doubt compete head-on for the lower end of the Mac word processing market, but is lacking features that are now commonplace in many MS-DOS word processors. With its introduction of Word 3.0, priced at $904, Microsoft has expanded the definition of Macintosh word processing to include page make-up facilities and outline processing, and offers a program with features unrivalled on any machine.

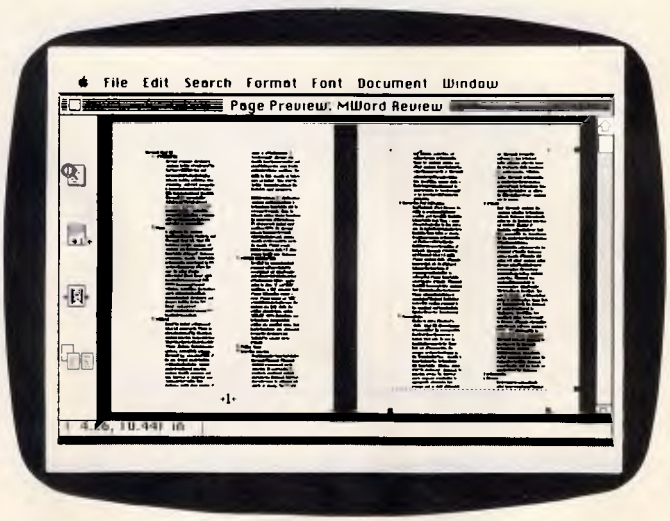
Improved features

- **Menus**

In addition to the standard facilities offered by MacWrite and Microsoft Word 1.0, Word 3.0 includes a variety of unique and powerful new features, many of them 'state of the art' for word processors.
In order to minimise any confusion experienced by the novice, the program offers the user the option of using abbreviated 'short menus' while learning the program and 'full menus' to access

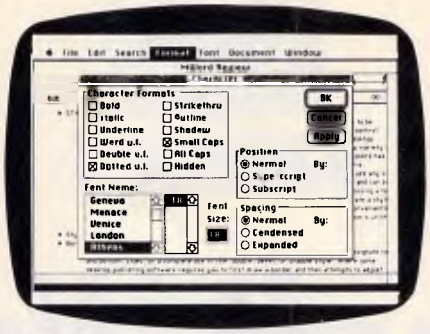


The Microsoft Word menus reveal new and powerful tools. Selecting 'Short Menus' simplifies the program by hiding the highlighted options

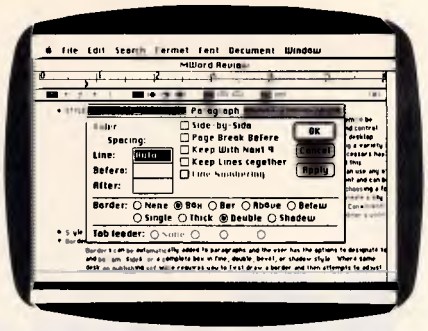


Page Preview allows the viewing of two pages at a time. Note that the margin markers on the right-hand page allow for WYSIWYG formatting

The Magnifying Glass icon allows the user to view multiple columns at actual size



Formatting options include double underlining, dotted underlining and strikethrough



Paragraph formatting can include some interesting border options as well as automatic numbering

advanced features. In addition, Word allows you to add customised fonts, formats, styles, documents and glossary entries to the full menus, and, as work requirements change, menus can be adjusted accordingly. For repetitive tasks, a customised work menu can be created and added to the menu bar.

- **WYSIWYG**

One of the fairest criticisms of Word 1.0 concerns its failure to take advantage of the Macintosh graphics interface to provide true 'What-You-See-Is-What-You-Get' headers, footers, footnotes, page numbers and multiple columns. Microsoft has gone 95 per cent of the way toward resolving this problem by displaying headers, footers, footnotes and page numbers directly onscreen, and has provided an important new 'page preview' option that displays a scaled-down version of a page or of facing pages. In 'Preview' mode, the user can directly insert a page number and can adjust margins, page breaks, and header/footer positions. The ability to preview fully up to two pages of text at a time prior to printing is a major advance for Macintosh word processors.

Multiple columns are displayed as one long, continuous column in 'regular' mode, and side by side in 'page preview' mode. Thus, in order to make a change based upon the appearance of the columns, it's necessary to choose 'print preview', locate the required change, leave preview mode, make the change and, perhaps, re-enter preview mode to verify the results.

Although a vast improvement on Word 1.0, this process is still very awkward.

- **Merging information**

Word 3.0 has comprehensively expanded options related to merging text and data. Precise control over individualised text printed in form letters can be gained by using IF and ELSE conditions; a 'SET' command that updates information across a range of form letters: an 'ASK' prompt that queries the user for contents of a field during the printing of each form; and an 'Include' option that allows you to insert one document into another at a specified place. Note that in the latter case, documents are stored separately but 'included' or merged during printing.

- **Keyboard menus and commands**

One of the problems in designing a Macintosh word processor is catering to the large group of touch typists, who view the prospect of manipulating a mouse 'mid-text' with considerable

Section formatting includes number of columns, distance between columns, line numbering and endnotes options

The Style Editor allows the user to define styles in terms of fonts, and so on. Editing a style effects a change everywhere the style is used

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scepticism, while offering the formatting and font control that seems integral to the Macintosh interface. Microsoft has addressed this dilemma by providing the user with the alternative of using a keystroke combination for virtually every menu command, and access to the pull-down menus via the keyboard.

- **Importing graphics**

Graphics can be imported via the clipboard from any Macintosh graphics program and can be resized to fit your needs. A graphic is considered a single character by Word and, like other characters, can be selected, cut, copied or pasted. You can add bold, shadow, underline and outline formats to the graphic frame for emphasis, and you can offset a graphic from the baseline using the superscript or subscript options in the character dialogue box. In addition, you can paste a blank frame into a document to reserve space for later paste-up or for drawing with Postscript commands.

- **Copying formats**

Character and paragraph formats can be copied with a simple keystroke combination. The user simply highlights the source paragraph or text, types Command-Option V, highlights the paragraph or text to be reformatted, and then presses Enter to pass on the formatting.

- **Find and Replace**

The Find and Replace commands have been enhanced to allow for searching with wildcards, searching for special formats (Command-Option-R), searching for special characters like tabs or end-of-paragraph marks, and the replacement of text by the contents of the clipboard. Usefully, the latter allows for substitution of formatted text: for example, it is a simple process to replace Word 3.0 everywhere in this review with **Word 3.0**!

- **Glossary**

The glossary is used to store frequently used pieces of text or graphics for easy insertion into a document, and Word 3.0's Glossary feature includes the ability to save 'boiler plate' text with formatting. Thus, an inside address or a heading inserted into a document via the glossary will automatically be tabbed or centred, and in the correct style.

The program comes with a standard glossary that contains time and date entries, and the user can add entries to this or create an entirely new glossary.

New features

- **Spelling checker**

The program includes a menu-driven 80,000-word spelling checker and includes an optional (English as opposed to American) dictionary. User dictionaries can be created to include names, acronyms, technical terms, and so on, and can be associated with a particular document or can be used generally. In the case of a misspelling, the program can suggest replacements which can then be universally substituted.

The spelling algorithm within the program seems particularly smart as suggestions include phonetic substitutes as well as similar spellings, and where a capitalised word is misspelled, capitalised suggestions are made.

- **Styles**

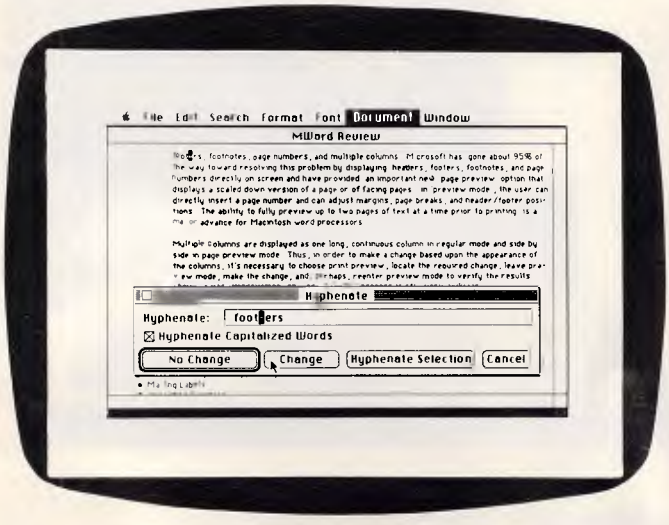
Text formatting and font, size and style selection are powerful features that seem to be uniquely suited for the Macintosh interface. In fact, this kind of flexibility and control over text was responsible to a large degree for the Mac's impact in the world of desktop publishing.

Unfortunately, as anyone who has processed a lengthy document using a variety of formats and styles will attest, applying these features using Macintosh word processors has always been disappointingly tedious and time consuming. Microsoft has resolved this dilemma by incorporating a sophisticated 'Style' editor in Word 3.0. The user can use any of 33 predefined styles, or create unique styles that are then saved with the document and can be transferred to 'stationery'.

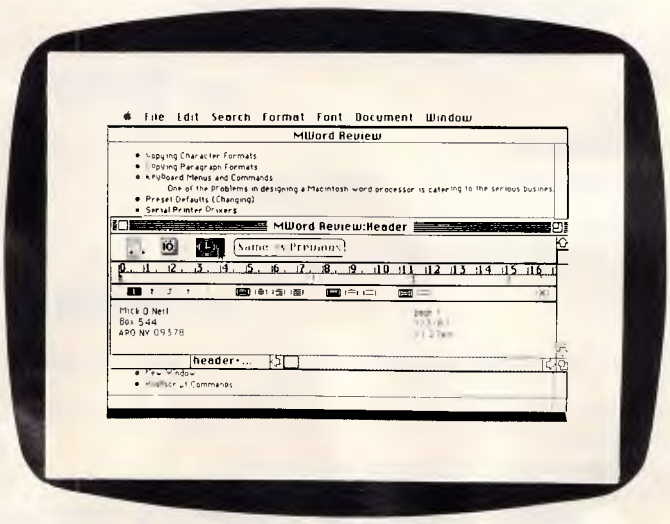
- **Outlining**

Word 3.0 includes a built-in outline processor similar in concept to ThinkTank or MORE from Living VideoText. Although the advantage of using this facility while already in a word processor might seem quite compelling, Word's implementation is non-instinctive at best. An attempt is made to remain

consistent with the Mac interface through use of an icon bar with arrows for rearranging headlines and text, but the logic seems cumbersome. Perhaps



Hyphenation can be accomplished step by step or automatically. Word's hyphenation dictionary seems to do a good job breaking words logically



The header window includes its own ruler and page number, clock and calendar icons similar to MacWrite

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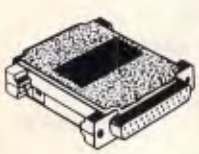

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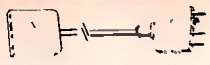

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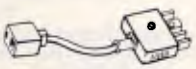

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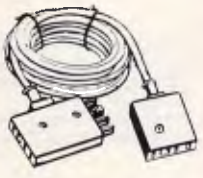

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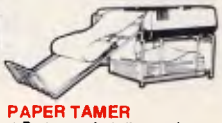

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-Mitchell Waite, David Fox
If you are learning programming or have dabbled in the popular language BASIC and wish to learn the capabilities of Pascal, this book is definitely written for you. Written and illustrated with a touch of humour, the informative text describes Pascal program structure, Pascal variables, Pascal procedures, and many other features. There are chapters on decision making statements, numeric functions, string functions, arrays and sets, and much more. The eight appendices present facts about the advantages and disadvantages of Pascal, components of a Pascal system, interfacing assembly language routines, and other useful information.
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I was spoiled by the rest of Word 3.0 — I really expected MORE! It's as if some of the MS-DOS boys were turned loose on this section and told to use icons. Alas, it just doesn't come off.

- **Index & table of contents**

Word 3.0 can create a multi-level table of contents either directly from an outline or by individually marking those items to be included in the table with a hidden text code. The table is created at the beginning of the document complete with page numbers and fitted tabs, and may be reformatted by the user like standard text. Similarly, an index can be created by individually marking index items with another hidden code, and Word's flexible 'Search and Replace' function makes this otherwise cumbersome task fairly simple.

- **Hide/Show command**

By choosing 'Show ¶' from the 'edit' menu, the user can display all paragraph marks, tabs, optional hyphens, non-breaking spaces, page numbers, and so on, and these characters can be copied, moved, deleted and 'searched for' in the same manner as normal characters. This feature adds considerably to control over document set-up and design.

- **Hyphenation**

Selections can be hyphenated line by line with optional user intervention or can be completed automatically. A special hyphenation dictionary is included on the utilities disk, and in testing several documents, this process seemed to behave flawlessly. Although I'm not an expert, words appeared to be hyphenated fairly logically despite the fact that the English language and logic appear sometimes to be mutually exclusive.

- **Borders**

Borders can be automatically added to paragraphs and the user has the options to designate top and bottom, sides, or a complete box in fine, double, bevel or shadow style. Where some desktop publishing software requires you to draw a border first and then attempts to adjust text to fit within the limits defined by your drawing, Word's approach is more text orientated. The user adjusts the margins, indents and formatting to get the text right, and then automatically sizes the border to fit the paragraph.

- **Hidden text**

A special character format called 'Hidden Text' can be used to designate text not intended for final printing. Hidden text must be used to designate codes for entries in tables of contents and indexes, to embed PostScript commands in a Word document, or to insert characters for QuickSwitch. Hidden Text is also useful for editing notes or comments during document creation or review.

- **QuickSwitch**

QuickSwitch is a unique feature that allows the user to alter a graphic in MacPaint or MacDraw, with changes immediately effected in corresponding graphics contained in a Word document. Similarly, changes can be made in Excel worksheets or graphs, saving the business user a great deal of time. A monthly balance statement, for example, could be updated and printed in a fraction of the time it would take to create a new graph, delete the old, paste in the new, and check the formatting.

- **Converting text to graphics**

The Macintosh offers the user the ability to create sophisticated graphics, and incredible flexibility in formatting text. Thus, a cause of great frustration to Mac users was the task of combining the two to create fancy tables or charts. Graphics programs like MacPaint and MacDraw don't offer the facilities for easy formatting of text; and, of course, MacWrite and Microsoft Word 1.0 don't provide graphics tools. Attempts to move data via the clipboard between the two types of programs resulted either in unformatted text or horizontal space-hogging graphics.

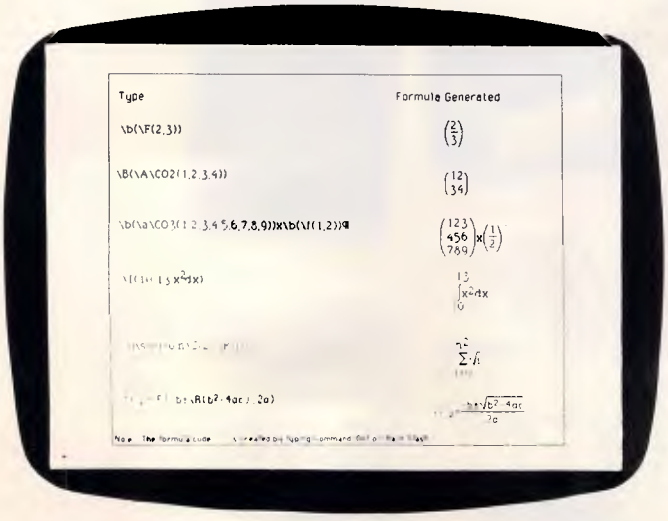
Microsoft Word 3.0 has completely resolved this dilemma by allowing the user to take a formatted clipboard snapshot of blocks of highlighted text, which can then be pasted in the scrapbook and imported into Paint or Draw for 'dressing-up'.

- **Delete**

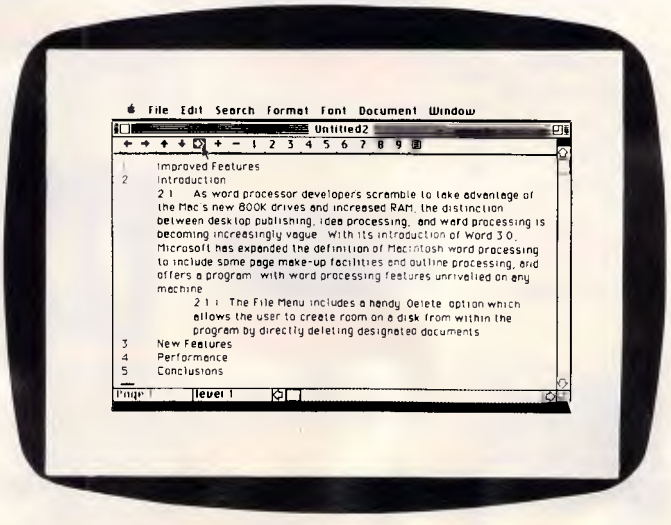
The 'file' menu includes a handy 'Delete' option which allows the user to create room on a disk from within the program by directly deleting designated documents.

- **Linked documents**

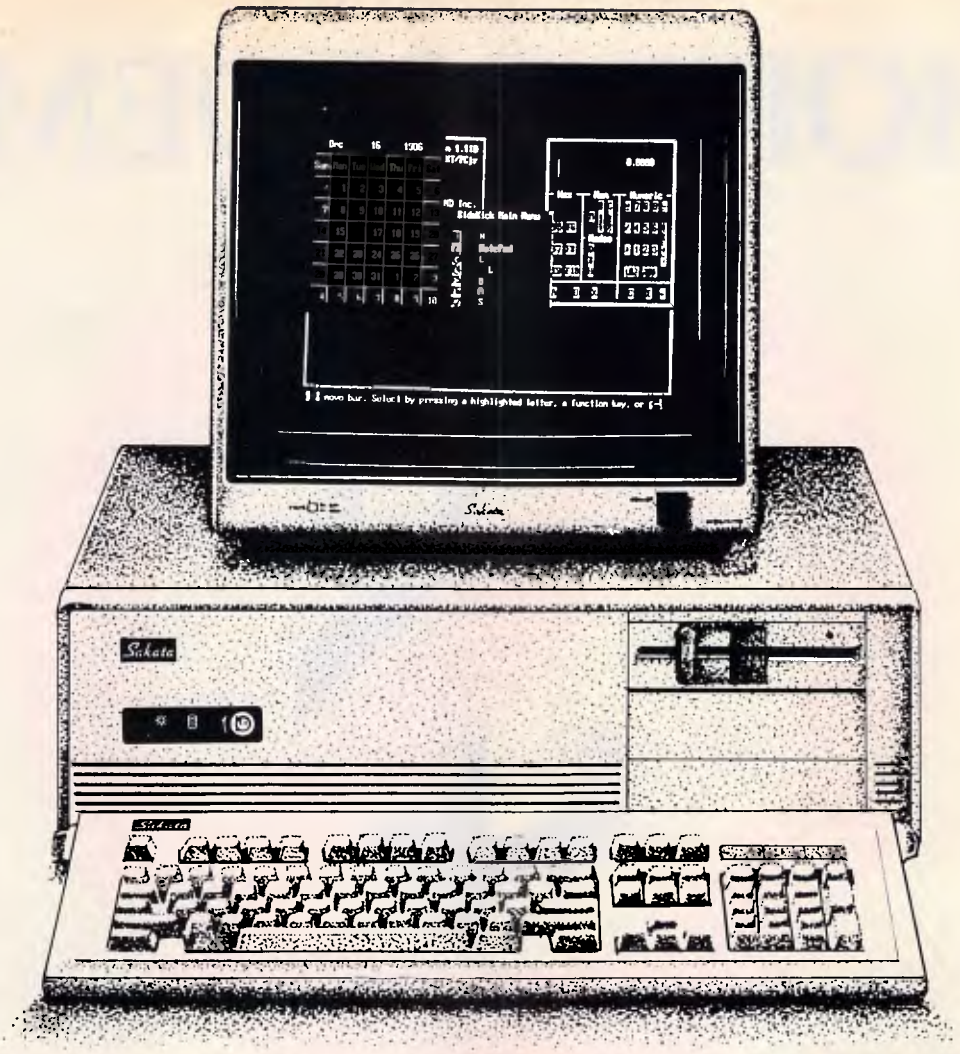
Word easily handles documents up to 250 pages long. To create longer documents, it's possible to link documents together. Word treats a series of linked documents as one, and automatically generates tables of contents and in-



Word's formula generator has codes which draw radicals, integrals, summations and boxes. When 'Hide ¶' is chosen, the formula is displayed



The outlining functions are carried out through the use of a special icon bar. The best that can be said about this process is that it's non-instinctual



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dexes for the whole document. The user can print the whole series by directing Word to print the first document.

- **Formulae**

Formulae can be created within Word by using the formula code along with some built-in formula generators. Square roots, integrals, summations, fractions, boxes and formula-sized parentheses and brackets can be generated and can be displayed on-screen.

Other features

Just some of the other features of Word 3.0 include the capability to print mailing labels three across; a convenient calculation function that computes sums, differences, products, quotients, and percentages of highlighted values; line numbering and/or paragraph numbering; sorting; a number of printer defaults that will drive most popular serial printers; and Postscript commands for use with the LaserWriter.

Performance

Generally, Word's performance is fast and surprisingly bug-free for the first release of a program of this complexity. The overall design is a work of genius, with vast word processing power easily accessible from the pull-down menus and the keyboard. Although there were a few minor quirks applying styles from the keyboard and producing the correct formula symbols from the formula generator, when I changed over to the system provided by Microsoft, these disappeared. Strangely, both system files were version 3.2.

Documentation & support

The documentation included a well-indexed reference manual, a tutorial and a quick-reference guide, and was generally very well done. Certainly, the sections explaining outlining and formula construction could be redone to include more examples. Still, Microsoft has set a tough standard with Excel, Works and Word 3.0 documentation.

The program is unprotected and so can be easily installed on a hard disk. A second disk is provided with sample files, printer drivers, an English dictionary, Switcher 5.1 and a set of switcher files. As usual, Microsoft has released a classy package.

Conclusion

"'There is a Thingumbob shouting!' the Bellman said.
'He is shouting like mad, only hark!
He is waving his hands, he is wagging his head,
He has certainly found a Snark!'"
(Lewis Carroll — *The Hunting of the Snark, An Agony in Eight fits.*
London: Macmillan, 1876)

It's really quite difficult to place this program in any kind of perspective as it's the first word processing software to employ the full facilities of the Mac Plus. It's also *by far* the most powerful feature-laden word processor on any machine. If a single program like VisiCalc were responsible for the emergence of the Apple II and the general acceptance of small-business computing, Microsoft's Word 3.0 may be the irresistible force that finally establishes the dominance of the WIMPs interface and brings the raw power of the 32-bit computers to the rest of us. After all, only a very few people in a business or in the home actually use a spreadsheet, while almost everyone has occasion to use a word processor!

For anyone who writes, though, Word 3.0 is reason enough to purchase a Macintosh.

END

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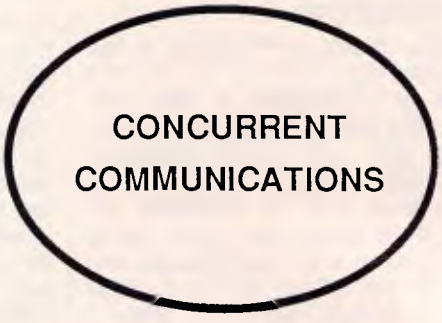

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Lotus Manuscript

Designed specially for creating complex manuals and long documents, Manuscript boasts many impressive features and will be a boon to writers of all persuasions. Robert Schifreen perfects his style.

Manuscript isn't a word processor — the title screen tells you that as soon as you load the program. It's actually a Professional Document Preparation System and, as you spend time with it, you tend to agree that Lotus's description is more appropriate.

Although it can be used quite easily for writing and editing short letters and memos, the product is specifically designed for creating long, complex manuals and technical documents. Assuming you have enough expansion memory, or sufficient space on your hard disk for all the temporary files that get created instead, Manuscript will allow you to have a single document file of around a thousand pages, with things like outlining, inclusion of pictures and formulae, the author's name, choice of typefaces and current version number handled automatically.

Two features not normally found on word processors but indispensable to the writer at which Manuscript is aimed, are 'Print Preview' and 'Document Comparison'. Assuming you have a monitor that can display graphics, the Print Preview system will drive the screen like a printer, displaying a full A4 page of text and letting you see exactly how the finished article will look, with any included graphics shown, to scale, in the correct place. This is similar to the Preview screen found on expensive typesetting systems and can be a godsend.

Compatible graphics files are generally (though not surprisingly) those produced by Lotus's own products, Freelance Plus and 1-2-3.

The Document Comparison will compare the current version of a file with a backup and print the current document with all updates marked by vertical bars in the margin.

Manuscript is fairly easy to use but, because of its complexity and the number of features that normal word processors don't have, it took me almost two weeks of solid use before I felt familiar enough with it to write this review. Having written manuals myself (18 months with a well-known Japanese printer manufacturer), there are certain features I would have liked to see and I knew what I was looking for.

'Two features not normally found on word processors but indispensable to the writer...are "Print Preview" and "Document Comparison".'

Installation

Getting everything set up is easy. Manuscript is designed for use with a hard disk system only and, since the program is not copy-protected, installation involves nothing more than typing COPY A:*.* enough times to transfer everything from the eight floppy disks supplied onto the hard drive. Eight disks is a lot of word processor, taking up 70 files and very nearly 1900k. A third of this space (30 files) is taken up by drivers for various graphics displays and printers, so you can delete the ones that don't apply to you; unfortunately, the manual doesn't mention this. You'll need at least 640k of RAM to use Manuscript properly. Long documents can be dealt with by using lots of temporary disk files, so you won't need 3Mbyte RAM cards. If you have them, though, things go a lot faster.

Having copied the disks, the next job is to assemble the manuals. Each chapter has to be separated, paired with a divider page and clipped into the ring-binder. There are also 36 update pages supplied separately which have to be inserted in the correct place and the old versions removed. There are a dozen or so sheets of brown card that can be thrown away and, by the time everything was ready to use, my rubbish bin looked like I'd just unwrapped a season's supply of shirts from David Jones. It makes you wonder why the manuals were typeset at all, though experience tells me that the people who wrote them probably never saw a final version of the software.

To start the program, the manual said

I should type MS. Seeing that there was a sample file called CNSDRAFT.DOC, I thought I'd be smart and typed MS CNSDRAFT to load the file in one go. 'CANNOT FIND APPLICATION (CNSDRAFT.EXE),' it said, and threw me straight back to MS-DOS. Because Manuscript is so large, everything is handled by separate programs that you call up from an opening menu called the 'Document Manager', in a similar way to WordStar. You can bypass this opening menu by specifying which program you actually have typed was MS MSEDIT CNSDRAFT to load the editor module and then the file.

For this reason, I would like to have seen a complete list of all the files that make up Manuscript and short note about what each one does. I couldn't find one. One file that puzzled me was SPELLDOS.SYS. I thought at first that it might be a device driver that lets you check words as you type, like Lightning. It wasn't, and you can't.

Although the Document Manager is handy, it saves time not to use it. One vital option it contains, though, is SETUP, which you must run at least once. Among other things, it tells Manuscript how you want to deal with virtual memory. If you have an expanded memory board, this is the place you say so. If you haven't, you have to use this option to tell Manuscript how much of your hard disk it can use for its temporary files. The default settings (1024k of disk space) allow for the creation of a document of 100 pages. If you plan to write more than that, you have to increase this by 10k per page *before* you create the document. If you don't, a warning box will appear at an inopportune moment advising you to do drastic things, such as deleting the spelling-checker's dictionary files immediately to avoid losing the current document.

With everything set up you can create or edit a document. Once you have given the file a name, a panel appears on the screen. From here, you can alter the current directory and file name, as well as the name of the template file. The template file holds layout information like fonts and typestyles, ruler settings, and so on. There are also fields to enter a one-line description of the document, the name of the author and the revision number.

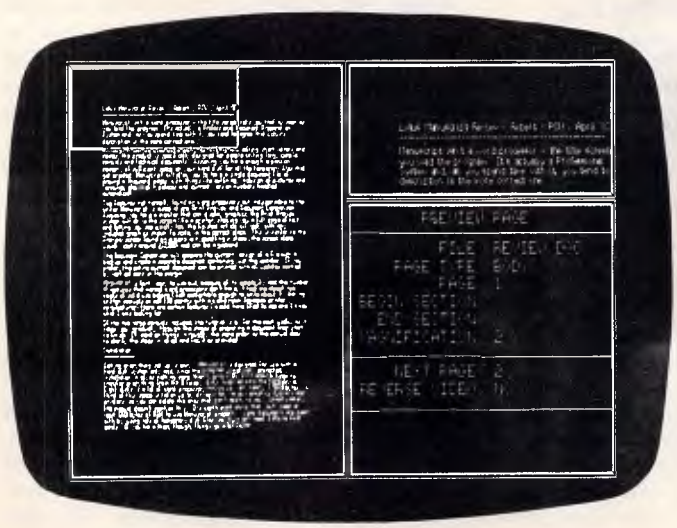
Like other Lotus products, the panels appear in white on a colour monitor and can't be changed to other colours. The revision number starts at 1.000 and is incremented automatically every time you edit the file. This number, as well as the author and description fields, don't automatically appear in the document but can be included in the text by use of backslash commands — the equivalent of WordStar's dot commands. To accept the entries on the panel you press the INS key. Manuscript uses this key everywhere to accept choices from a menu. You'll keep pressing RETURN by mistake for a few days, but you'll adapt eventually. You'll also keep pressing INS to change from insert to overtype mode, and nothing will happen. The correct key for this is Alt-F5, which is far too inconvenient a place for such an often-used key.

One convenient touch is that the name of the document you edit is recorded in a Manuscript data file and automatically appears as the default setting next time you use the program. The current cursor position is saved along with the text in the document file itself, so loading an existing file really is like carrying on where you left off.

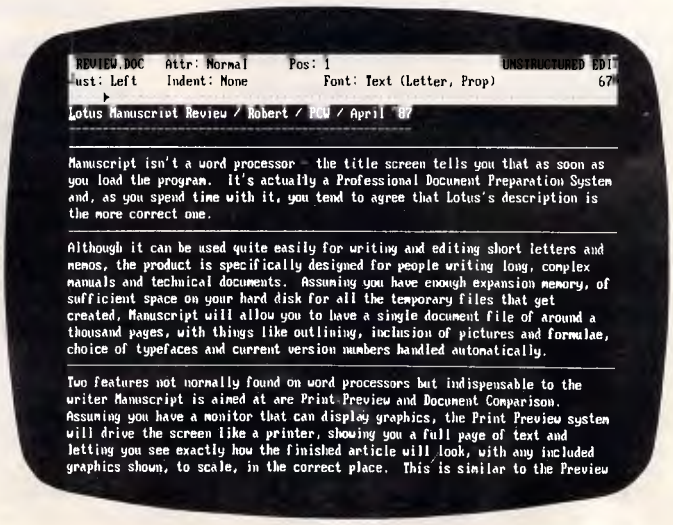
When you load a long document, Manuscript loads all of it into virtual memory. In the case of a very long document (350k, say), the loading process is really just pulling the first few pages into RAM and spooling the rest straight back out again to temporary files on disk or in the expanded RAM. Still, a status box ticks over at the bottom of the screen to show how much has been loaded. Unless you know how long the file is, though, you don't know how long there is to go. On my standard PC with hard disk running at 4.77MHz, my 330k test file took two and a half minutes to load in.

Editing a file

With all options specified, the text screen appears and you start typing. At the top of the screen is a two-line status panel containing the name of the document, current text attributes, the cursor position and whether you are in structured or unstructured mode. Structured mode is Manuscript's outliner. The cursor position is given as a single number that tells you the horizontal position. You get no indica-



The preview screen is one of Manuscript's main selling points. You can see a whole A4 page at a time and zoom in on small areas



Manuscript's status information is normally confined to the top two screen lines. The block separators can be removed but the gaps still remain

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tion of how many lines are in the current document, or how many pages you have entered. You can opt for an extended (three-line) status line that also contains the current font information and the amount of virtual memory being used, but this figure is no guide to the size of the current document. This review (4400 words) took 26k of disk space but 59k of virtual memory. You can get a word count, though, at any time. Also on the standard status line is an indication of whether the document has changed since last being saved. If it has, attempting to quit the system will prompt you to save first. If it hasn't, the MS-DOS prompt will appear that much faster.

The key to creating documents in Manuscript is the 'Block'. Basically, you have to enter text in chunks and, before starting each chunk, you press Ctrl-A to start a new block. This is the case whether you use structured or unstructured mode. Each block is normally a paragraph, though headings, tables, graphics, and so on should also be given a block to themselves. Organising things this way makes it easier to pick typefaces and styles. Normally, a new block inherits the format of the preceding one but you can give individual blocks their own characteristics, such as different margin settings, spacings, and so on.

What I don't like about the block system is that a solid horizontal line appears between each new one. There is an option not to display the line, but there is still a gap on the screen and you often forget why. Also, when paging up and down through a document, the cursor skips over the block dividers so vertical movement is not as smooth as it should be.

The manual advises that you should stick to the use of blocks in order to make full use of Manuscript; in truth, there's no way you can avoid them. If the length of a block exceeds about one screen full of text, everything slows down to a crawl.

As long as blocks are used to separate each paragraph, everything is fine. I tried entering a 30k document all in one block. When I wanted to highlight a portion of the text, the cursor took ten seconds to move down one line, and my hard disk went into a spin.

As long as everything is in blocks, moving the cursor from top to bottom of a 350k document is instantaneous. Also, blocks can be sorted alphabetically, which means that preparing a glossary is easy. Manuscript can read and write IBM DCA files for converting to and from other WP formats — DCA files are turned into one-photograph-per-block format when loaded into Manuscript.

Although you work in these units of text, normal functions referred to as block functions on other word processors are still available. You can copy, delete or move portions of text, and a portion can be a true Manuscript block, a part of a Manuscript block or a larger portion that spans two or more blocks.

Getting help

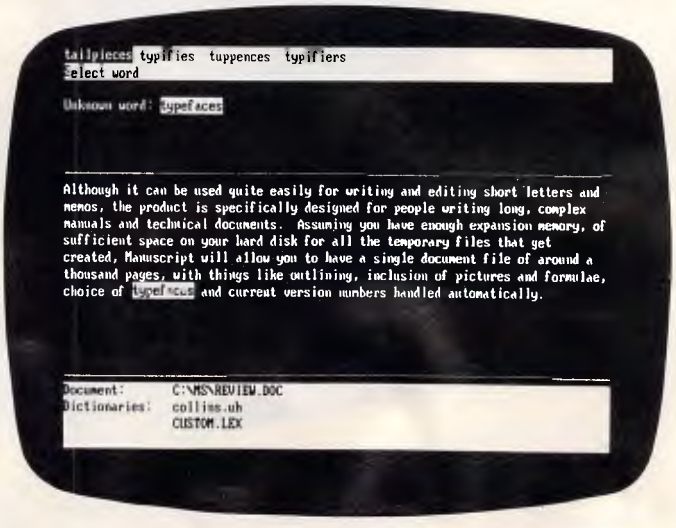
As seems to be becoming a standard among PC software, pressing F1 gives help. It's vaguely context-sensitive, so pressing F1 while in the middle of the spelling-checker will tell you about spelling. The 'help' isn't very helpful, though. You can't type in ATTRIBUTE and get help on that subject. You can look it up in an onscreen help index, but there are only 35 entries and it probably won't be there. Even if it is, you will be told all about what 'attributes' are and which ones you can have, but nothing about how to set them.

With similar inspiration, Lotus includes a list of all the backslash commands, in alphabetical (not subject) order. The one-line descriptions are understandable, but you can't search through them automatically. The first topic I wanted help with had me searching in vain through the screen displays and, eventually, consulting the reference manual. The topic was how to remove the little triangles that get put at the end of every line. Luckily, you can remove them.

Menus and shortcuts

Commands and functions are accessed through single-line menus that appear on the status display. Menus are summoned with either a plain function key or an ALT-ed function key. Two keyboard templates are supplied — one for each type of IBM keyboard. Because the CTRL and SHIFT keys are not used with function keys, there are 20 unused function key combinations and I'd have expected these to

A spelling checker is included but there is no thesaurus. Manuscript doesn't start guessing at words until you say so, though, which slows things down



The opening menu, called the Document Manager, serves a similar purpose to WordStar's main menu. It can be bypassed by selecting options in advance

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be available to the user as programmable macros. The manual didn't mention it anywhere. A useful menu tree is contained in the manual, which I unclipped and kept by the keyboard.

Once you know what options are available from menus, they can be accessed by what Lotus calls 'accelerator keys'. Ctrl-B, for example, turns on bold type until you do a Ctrl-B again. If your monitor can handle it, the text really will appear bold on the screen. Not all the program's options appear in the menu in which I'd expect to find them. The PRINT menu is where you find the PREVIEW and SPELL options.

Backslash commands

WordStar has its dot commands and Manuscript has the backslash variety. Backslash commands are used for two purposes: to tell Manuscript to do something like \pagebreak\or\table\ or \section\; or to substitute a value. For example, putting \date\ in the document will substitute the current date when the document is printed. The same goes for \time\. You can also read in values that identify the current document, like \author\, \revision\, \description\ and so on. If you include a picture in a document (more of which later), you use something like \picture This Graph Shows First Quarter Sales\ to specify an entry which Manuscript will turn into a table of figures if you want it to.

One useful backslash command is \equation\. This lets you specify an equation using normal characters which are turned into mathematical and Greek symbols at print time. The equation is sent as graphics data to the printer. The quadratic formula of

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

can be incorporated into a document with the command \equation x=[-b+ - root[b super 2-4ac]]over [2a]\. The \equation \ command knows around 150 symbols and characters.

Windows

You can split Manuscript's screen horizontally into two windows, and you can edit a different document in each window. Indeed, you *have* to edit a different document in each window as you aren't allowed to edit the same one twice. You can't actually move the windows around, but you can specify how much of the screen each one takes up. A maximum of two windows can be open at a time, whether visible or hidden.

Tables and columns

Preparing a table is fast and painless so long as you stick to the use of blocks. Every row should be a separate block, and columns should be defined using the column facility. The column command will divide the screen into vertical columns and, as you type in a column, words wrap within it. As one column fills up, any parallel columns are extended to match.

With every entry in a table enclosed within a unique area of a certain column and block, the table just about defines itself. All that remains is to mark out the area required and select a border for it. Borders use the IBM box-drawing characters and can be composed of single or double solid lines.

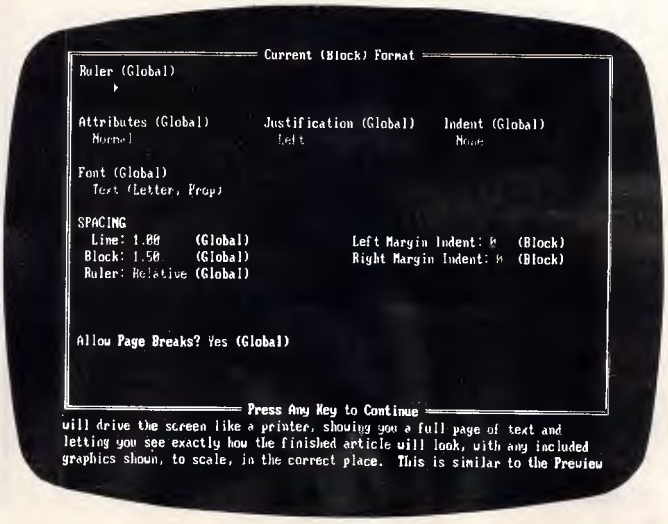
Outlining and structure

When you're editing a document, you can be in either structured or unstructured mode. Structured mode is what Manuscript calls its built-in outlining system. It is useful for compiling reports or technical manuals where each point or section is numbered and structured. Numbering is automatic and can be in decimal, Roman or any style of numbering you desire; the package was quite happy to let me create an outline where the number contained so many levels that it ran off the screen. If you start composing a file in unstructured mode, it's possible to convert it to a structured format quite quickly. The reverse, though, is not allowed unless the structured document contains only one block.

Like any outliner, you can hide all text under a certain level. Pressing ALT with a number hides any text below that level. The most useful number is '1', as pressing ALT-1 hides all the text and displays only the major subject headings in order to give you a quick overview of the document.

Unique format information can be defined for the first five levels of outlining. This allows you to specify different-sized fonts and typestyles for different

The help facility is limited. This single screen is the full extent of the onscreen help index, which won't get you very far



The advantage of dividing text into blocks is that each block, or level of heading, can have unique format and attribute information specified for it

levels of heading. If you have a style sheet that dictates how all your documents are supposed to look, this information can be programmed into a global setting file once and then forgotten.

Compare documents

Manuscript allows you to compare two similar versions of the same document and produces a marked-up copy indicating where changes occur. The two documents are read into memory (real and virtual) and compared; and deleted, inserted and moved text is highlighted. You can produce a document with vertical bars in the margin to indicate updates. Ideally, I'd like to have been able to create a third document containing just the updates, for distribution as an update sheet, but the manual made no mention of how this can be done.

The marked-up document can be printed to disk with all printer control codes included, for printing in background mode with the MS-DOS PRINT command.

Comparing two documents changes neither of the two files.

Spelling-checker

The package contains a spelling-checker but no thesaurus. Although the software and the manual think that you have the American dictionary file called WEBSTER.UH, Australian and UK users get COLLINS.UH and you have to inform the software accordingly. The first time you specify the name of the dictionary file it gets stored in the startup file and everything will go smoothly in future. I'm still working out what the UH extension on the dictionary files stands for.

The spelling-checker can be called up from the Document Manager screen or from within the editor. I chose the latter option and regretted it. To start the spell-checker you select SPELL from the PRINT menu. Before the speller is loaded, you are asked if you want to save the document being edited. I said 'No'. I should have said 'Yes'. The spelling-checker, I found out, is a separate program and works only on saved files. If you say 'No' at the "Save file?" prompt, your current document is lost forever and the spelling-checker works on the old version from disk. This is unacceptable, and the lack of warnings in the manual makes it even more so.

Unknown words are normally highlighted and a menu appears with a default option that lets you accept the word and carry on checking the document. If you want the system to guess what the correct spelling should be, you have to press G. The guessing algorithm works well and 'becuase', 'mising', 'problen' and 'hte' were guessed correctly first time; the last of these usually fools most spell-checking algorithms. 'IBM' isn't in the dictionary and was, interestingly, guessed as 'abeam', suggesting that the system is using phonetic rules somewhere.

My main complaint is that the system won't start guessing at an unknown word until you type 'G'. This makes the process slower than packages that start guessing immediately and abandon the task if you accept the word. I was strongly tempted to leave Manuscript and use a different speller.

If you add a word to the dictionary, that word will appear in future guesses. For example, if you put 'Profound' in and then type 'Profond', the correct spelling of the word will be guessed and appear. Not many other word processors have this feature.

Including graphics

Although there are no built-in facilities for creating graphics images with the Manuscript editor, a number of different format image files can be included at print time and some can be previewed *in situ* onscreen. The \picture\ command inserts a specified file, and the \figure\ command helps Manuscript build a table of figures if you want one.

Compatible graphics files include those created by Lotus's 1-2-3 and Freelance Plus packages. Bitmap files produced by a digitiser can also be used, and files containing Postscript commands can be passed to a suitable laser-printer but not displayed on the preview screen.

Metafiles produced by Lotus's Freelance Plus presentation graphics system can also be used.

The manual doesn't make much of the types of files that can be included as \picture\s. Details are relegated to Appendix E and information is scarce. My attempts at using the facility worked satisfactorily, though.

Print and Preview

Spend half a million dollars on a typesetting system and, if you're lucky, you'll get something called a preview screen. It's a VDU with (almost) the same resolution as the final typeset paper copy and allows you to check the layout of a page, choice of fonts,

and so on, without wasting any of the expensive photographic paper that typesetting uses.

Manuscript is the first word processor that offers a preview facility, though expensive desktop-publishing packages often include it. The preview facility uses the PC's screen and a number of different drivers are included on the disks so that you can take advantage of your particular monitor's capability. I tried the system on a standard colour screen and also an EGA one and both were impressive. The preview facility drives everything in graphics mode; this means that non-graphic monitors can't be used.

Preview shows a whole A4 page at a time and, if the screen can cope, bold and underlining show as well. Fonts are all reproduced properly.

Even on an EGA monitor, normal text won't be completely readable when reduced so much in size, so you can zoom in on a small portion to check minute details. Equations, I found, don't display too well at all, and on my EGA I couldn't read them. There is an option that expands an equation to fill around half a screen. This can then be expanded again to show even more detail. However, I managed to semi-crash the system (only once) by expanding an equation twice and then pressing RETURN a couple of time while the machine was still generating a display. I got an 'INTERNAL ERROR M2 (UNRESOLVEABLE REFERENCE TO CON:RVIDEO)' and ended up back at the document manager screen. I couldn't reproduce the error, so I hope it was a one-off. I *was* using a full release version of the software, though.

Like the spelling-checker, both the Print and Preview are handled by separate programs that work only on saved files. This means that you *have* to answer 'Yes' to the "Save file?" prompt that appears before you print or preview a document that you are editing.

There are two ways to print a document: namely, draft and final print. In draft mode, the printer's fastest font is used. Backslash commands are not interpreted but are printed out as they appear on the screen. Only the draft font is used. A draft print allows you to get the text printed on paper for checking, without wasting time producing graphics, fonts and letter-quality print.

Once the text has been checked and the layout looked at through a preview, you can produce a final print. In this mode, all global and local fonts and typestyles are printed correctly, and backslash commands are acted upon. The printer is automatically put into its best quality typeface. Text is printed in text mode, and the printer is switched into graphics mode to produce graphics and equations.

Printing is not performed in background mode, so you have to wait while the job is printed. You can specify, before starting, which parts of the document are to be printed, and whether the title page, contents list, index, table of figures, and so on, are to be printed as well. You can print a whole document, or just details of the global setting in force.

Conclusion

I like Manuscript. It's not marketed as a general-purpose word processor and I wouldn't want to use it as one. In order to keep the available memory to a maximum for long documents, all the package's functions are in separate modules and loading is slow. However, I've written 500-page manuals for a living before now, and some of Manuscript's features would certainly have been appreciated in that respect.

The package is a mainly text-based, desktop-publishing job. If you have a good quality dot-matrix or laser-printer, camera-ready artwork (ready to be duplicated and bound) can be produced cheaply and quickly using nothing more than a desktop PC and printer. If you intend to eventually have everything typeset, though, many of the facilities provided by the software lose their benefit. Contents and index pages, for example, won't be of use unless the typeset version keeps exactly the same page numbers. And it probably won't.

Also useful for driving laser-printers is that measurements can be specified in centimetres, millimetres, inches or points (72 points to the inch). This means you can specify, in meaningful terms, where various elements of a page go. You also get intelligible error messages when printing, that say something like "invalid picture file, three inches from top of page".

I don't think I'd switch to Manuscript for the work I do now for *APC*, as the program lacks a thesaurus and I don't like being forced to use blocks for everything. But, for producing technical documents and manuals where it's easier not to trust a typesetter to get it right, or if you do the sort of work that would benefit from the preview facility, it would be ideal. Lotus Manuscript release 1 is available from Imagineering and costs $1054.

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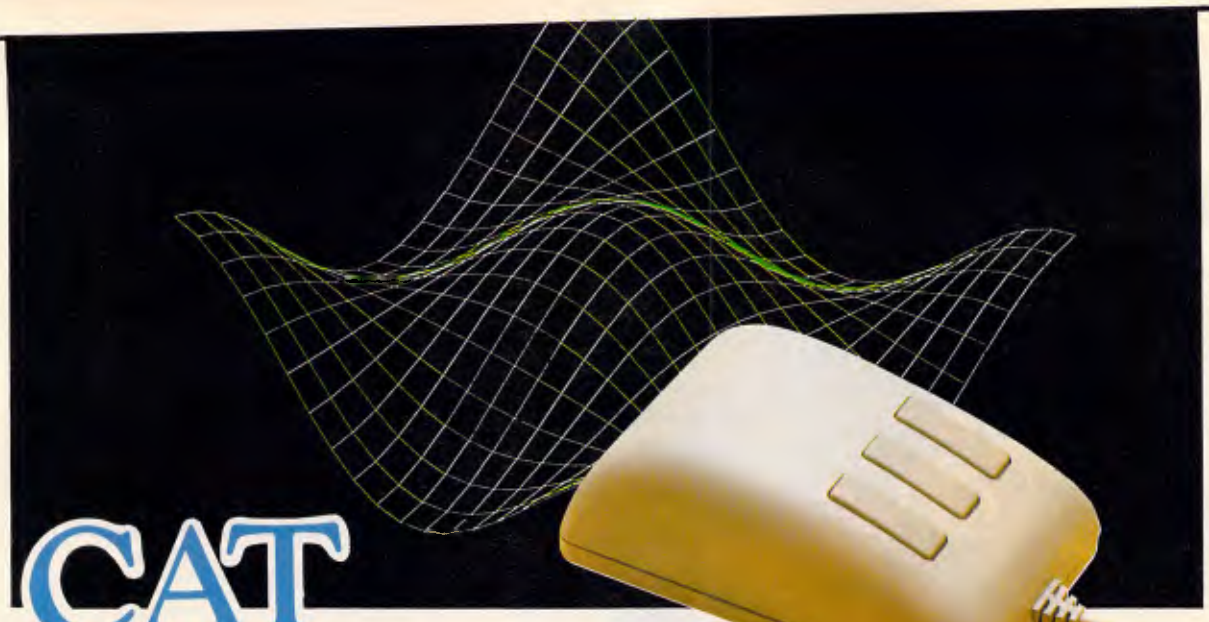

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SCREENTEST

GEOS utilities

Writer's Workshop, geoDex, Desk Pack 1 and Fontpack 1 are four utilities from First Analytical which greatly enhance GEOS, the rather jaded Commodore operating system. Tony Hetherington assesses their rejuvenative qualities.

GEOS (or Graphic Environment Operating System), the Mac-like disk operating system for the Commodore 64, was launched recently by Californian Berkeley Softworks to critical acclaim. The combination of icons and mice became the hallmarks of the Macintosh and were then simulated on the humble C64, but without the Mac's superior 68000-based hardware.

The GEOS disk came complete with: a graphics package, geoPaint; geoWrite, a basic word processor; and a collection of desk accessories such as an alarm clock, a calculator and a notepad that can be used independently or from within geoWrite and geoPaint.

The Mac image was completed by the choice of black on light blue screen colours (even though a Preference Manager program could set any combination) and even a trashcan icon to throw away or erase unwanted files.

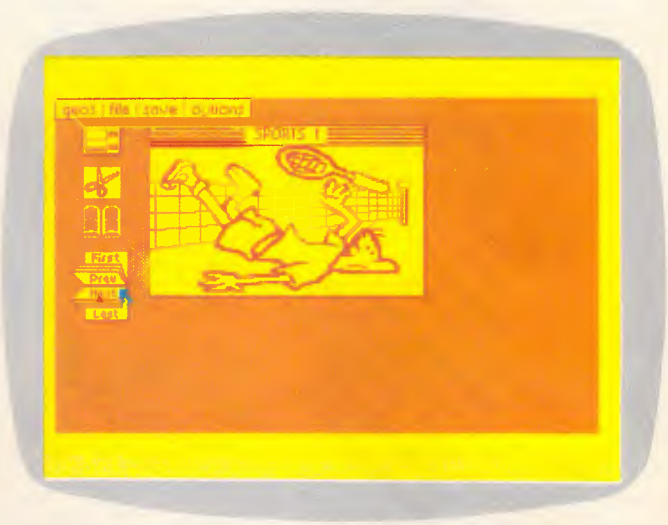
GEOS quickly received Commodore's official endorsement and was bundled with the 64C.

Having used GEOS for several months, I have found that the novelty of icons and pull-down menus has now worn off because the programs themselves aren't up to much.

geoWrite is very pretty, but it is little more than a basic text-handler without any facilities for line-spacing, screen formatting or headers or footers. As a result I left GEOS to one side and returned to less friendly but more practical programs.

Now that is all set to change with the release of four new packages designed to put GEOS to work.

geoDex is a simple cardfile system designed to be used as an electronic address book. geoMerge on the same disk gives a mail-merge facility from geoDex into a geoWrite document



One of the four desk accessories, Graphics Grabber, lets you transport 'clip art' graphics from other graphics packages such as Print Shop or Newsroom, and transfer them to geoPaint and geoWrite

Writer's Workshop contains not only a full word processor but also an intelligent merging program to send individually addressed letters to a mailing list. Fontpack 1 includes 20 new typefaces to improve your printouts. geoDex adds a card index system and Desk Pack 1 adds not only a graphics grabber that can use Print Shop, Print Master and Newsroom pictures, but also an icon editor, a calendar and diary program, and a Blackjack game.

Getting started

Each program is supplied on disk along with full documentation in an attractive box which proudly displays Mac-like screenshots. However, you soon find that you will abandon the boxes, pile the manuals together and put all the disks into the same box as you embark on a remarkable session of backing up masters, installing programs and creating work disks.

Installing a new program is usually just a case of copying the program onto your work disks, but you must first key Writer's Workshop into your GEOS master disk. This is a most effective security system as, once linked, the Workshop cannot be run without the correct master disk. Copying files over to your work disks couldn't be easier: you simply pull the files you need over to the border of the original, swap disks, then enter the files into your work-disks' deskTop (this is the 'front' to GEOS and consists of icons which then load the program, utilities, and so on). Throughout this stage you can rely on clear instructions but it's up to you to decide exactly which programs to have on your work disks. This isn't made any easier by the limits of C64 disk storage, but after a few false starts you should have all the files you need on your work disks and enough space left to use them.

When you've fought your way through the jungle of file copying and setting up, your system GEOS takes over with an impressive array of manual tutorials, onscreen prompts, icons and pull-down menus to guide you through.

Writer's Workshop

Writer's Workshop immediately fills the gap left in the original GEOS by providing geoWrite 2.0, a full and comprehensive word processor.

The original geoWrite was little more than a pull-down, menu-controlled text handler that let you enter and edit text, then print it out in only single-spaced lines. Although you could preview a page (display a graphic version of it) in order that you could see its shape and layout, you couldn't do much to change its format. Paragraph indentations had to be entered manually and there was no facility for headers or footers. The result was limited and only suitable for brief letters.

geoWrite 2.0 not only adds more invaluable features, but also speeds up the whole operation by introducing keyboard-command shortcuts. Pressing the Commodore key together with a second key moves you around the text freely, cuts and pastes copy, searches for words, provides headers and footers, selects pages, and gives the choice of plain, bold, italic, online, underline, subscript and superscript text style. Subscript and superscript are two new text styles which can be written in any font or point size.

The original geoWrite screen featured a top line of pull-down menus, and a line-number bar on which you could set left and right margins and tab

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markers. geoWrite 2.0 adds a paragraph marker to that number bar, plus a third command bar on which you can select either the first instance or all on left, right, centre and full justification; and single, one-and-a-half or double-line spacing.

Among the other new features is an intelligent search and replace function that allows you to search for a whole or part of a word, either the first instance or all on a single or all pages, then replace it with any string of characters.

Finally, you can select a single word for font or style alteration simply by double-clicking it; format paragraphs individually; print all or part of a document in draft (rough), high and near-letter quality; and define a header and a footer that contains text and graphics, and even the date and page number.

The result is a powerful word processor that is comparable to any on the market. However, the problem with using any new word processor is that all your old but still important documents were written on other word processors and stored on a variety of disks. You then find that you have to use a whole selection of different word processors, selecting the one that's best for that particular job. Thanks to its Text Grabber utility which is also supplied on the Writer's Workshop disk, geoWrite 2.0 has become the 'universal' word processor capable of reading and writing any C64 word processor file.

Using the Text Grabber couldn't be easier, and is simply a matter of following onscreen prompts which ask you to select whether your document is either an EasyScript, SpeedScript or PaperClip file. If it isn't one of these, simply select the forth 'Generic' option and the Text Grabber will do the rest. Conversion is automatic and only takes a few seconds, and you even have the chance to convert the whole disk so that it can be run from the GEOS desktop.

Conversion for the listed programs is now complete, but other programs processed through the generic option are still usable although they have no formatting instructions. I tried the Text Grabber on a VizaWrite file and soon had it converted, copied over to a GEOS work disk and edited in the format commands in only a few minutes. I could then alter fonts and styles, and even add geoPaint graphics.

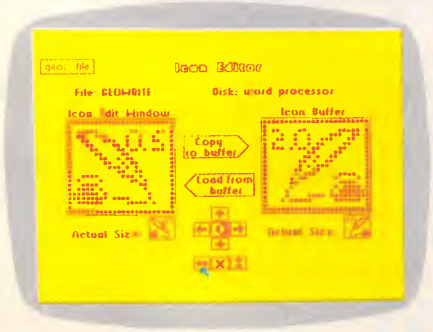
A utility called geoLaser is also included on the disk but as this is only for preparing documents for printing on a laser printer or uploading them to the American network, Quantum Link, it's beyond the scope of this review and should be left to those with either a laser printer or an extremely large phone bill.

Alongside geoWrite 2.0, the Text Grabber and geoLaser programs is the impressive geoMerge program. It's not unusual for a word processor to be accompanied by a mail-merge program, but geoMerge can not only send form letters individually addressed to people on a mailing list, but can also send messages using its IF and IF ELSE commands.

As with standard mail-merge programs, letters can include bracketed words (<<label>>) which represent names and addresses held on a separate file. In geoWrite 2.0 this is a separate document with records separated by an asterisk. When a print is required, the letters are printed with the brackets replaced by details from the appropriate record. For single letters, this information can be entered manually by following keyboard prompts.

geoMerge takes this format one stage further with its facility to contain IF and IF ELSE conditions in the original letter. The IF command can be used to

The calendar desk accessory is actually a personal diary system from 1900 until the year 9999. Each date on the calendar can be expanded to a time and appointment page in an electronic diary



The icon editor lets you take existing icons and customise them or create new icons from scratch

No desk accessory set is complete without a game; the one with Desk Pack 1 is Blackjack

It is possible to flick through the pages of a window (in this case the diary) by clicking on the corners

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test the condition of a bracketed value (is it TRUE or FALSE?) and only prints a sandwiched phrase if it's true. The IF ELSE command extends this further by printing one phrase if the condition is true and another if it's false. These IF and IF ELSE commands can be nested to form a bewildering array of options. Therefore, using the same carefully planned original, you can demand or accept payment from a customer, ask for or refuse future work and wish them a happy Christmas or Easter. geoMerge obtains the necessary information either from the user through screen prompts or from additional entries in the address file.

geoDex

geoDex is the GEOS electronic card index system which, as a geoDex card file can be used by geoMerge as an address file, also contains a copy of geoMerge. Double-clicking the geoDex icon loads in the program which appears as an angled card file. A blank record with spaces for name, address and phone number lies in front of a full pack complete with indexing letter tabs arranged at the top of the pack. Selecting a letter brings that card to the front, and so on, with an asterisk ending a file and a NEW card to create new records. Entering the information you need to store couldn't be easier, as it's simply typed from the keyboard with the Return key swapping the cursor between records. You can subdivide your records by splitting them into one of three groups, which is ideal for setting geoMerge conditions.

A line of icons down the side of the cards accesses a series of additional options which allow you to delete records, print some or all of the records either as address labels or just a list of phone numbers, search for a record, view a single group, enter geoMerge or, if you have the required modem, use geoDex to autodial any phone number.

Desk Pack 1

This bundle of software contains three invaluable utilities and a game. The Graphics Grabber is by far the most spectacular utility as it not only extends the usefulness of GEOS but also adds tremendous flexibility to the popular trio of Print Shop, Print Master and Newsroom.

The problem with these so-called 'productivity' programs is that they're very limited in position of graphics, and even size and position of text. For example, Newsroom has only three typefaces and three sizes of print. By using the Graphics Grabber GEOS can 'steal' any Newsroom, Print Master or Print Shop graphic and file it away in a photo scrap (for a single picture) or a photo album. Once stored, these graphics can be altered in geoPaint and incorporated into geoWrite.

Fontpack 1 includes 20 new fonts for geoWrite and geoPaint

Under full icon control you are free to swap between disks, examine any graphics and store them in any album which can be created as required, and even flip through (forwards and backwards) collections of pictures loaded in simúltaneously from Newsroom.

The simple utility means that you can use the graphics from these programs, add text in GEOS's fonts and point sizes, and finish off with a geoPaint border and background. The result will be without equal.

A simple icon editor is included so that you can complete the customisation of your work disk when you've renamed it, and set the screen colours using the master disk's Preference Manager. Now you can change the image pixel by pixel, invert, scroll, or completely redesign any of GEOS's icons.

Apart from its obvious aesthetic purposes, this utility has a more serious application and can be used to convert non-GEOS programs and files to the GEOS format. These files appear on the GEOS desktop as large Commodore symbols (C=) and up until now have been unusable. Now they can be converted, given a GEOS file header and a custom-designed icon so that they can be copied to a work disk, and run by a simple double click (this represents LOAD "*",8,1).

If the icon editor organises non-GEOS files, then the Calender utility will organise *you*. Loading the program reveals the familiar monthly calendar format with a square for every day. A pull-down menu is available to select a specific month from any of the 9999 years that are available if the default date (current date set in Preference Manager) isn't required.

Any important dates can be marked by clicking on them; this not only flags them with an asterisk, but also creates and opens a page in a datebook. This is the same size as a page in the deskTop notebook and can be used to store appointments and reminders. If you aren't sure when you have appointments and you don't want to scroll through every month, simply click the question-mark icon at the bottom of the screen to reveal a list of dates that you have flagged. Click any of these and you'll go straight into the right entry in the datebook.

The final program supplied in Desk Pack 1 is a change from the file-handling utilities, and gives you the chance to enjoy another Macintosh tradition and relax with a game of Las Vegas Blackjack.

Fontpack 1

Twenty new fonts are included on this disk to add extra printing styles to geoWrite and geoPaint printouts. Unfortunately, GEOS can only handle seven fonts (plus the system BSW font) at any one time, although more can be present on a work disk. To use these new fonts you must copy them over, one at a time, to your work disk and arrange them so the seven you require appear first in the deskTop. To bring in a new selection, you must rearrange the fonts on the deskTop.

The fonts (some of which, incidentally, are named after parts of Berkeley, California) are restricted to certain point sizes. For example, Superb can only be used in headings as it's restricted to only 24pt letters. Some examples of these fonts and typesizes are shown alongside.

GEOS updates

To confuse new users (and some reviewers) the reverse side of all four disks contains updated versions of existing GEOS programs and a few new utilities and printer drivers.

DeskTop 1.3 is probably the most useful utility and can easily overwrite and replace your existing deskTop. Apart from speeding up disk access, it also allows geoWrite 2.0-style single-key commands to open and close disk

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files (this saves a lot of time) and select an input device. New input devices supported include the Koala Pad and Commodore 1350 and 1351 mice. The GEOS updates also include geoWrite 1.3 which is basically the original geoWrite with additional keyboard shortcuts; an improved text-handling routine for geoPaint; and a more extensive collection of printer drivers to ensure that GEOS works with your printer.

The good news for GEOS users is that there's more to come, with two more applications, more fontpacks and even an entire 80-column C128 version. The new applications will fill the gaps by providing a full database program to replace geoDex, logically called geoFile; and the inevitable spreadsheet program, geoCalc, featuring 28,000 cells, split-screen displays of two separate sections of the spreadsheet, and advanced calculations to nine places of accuracy.

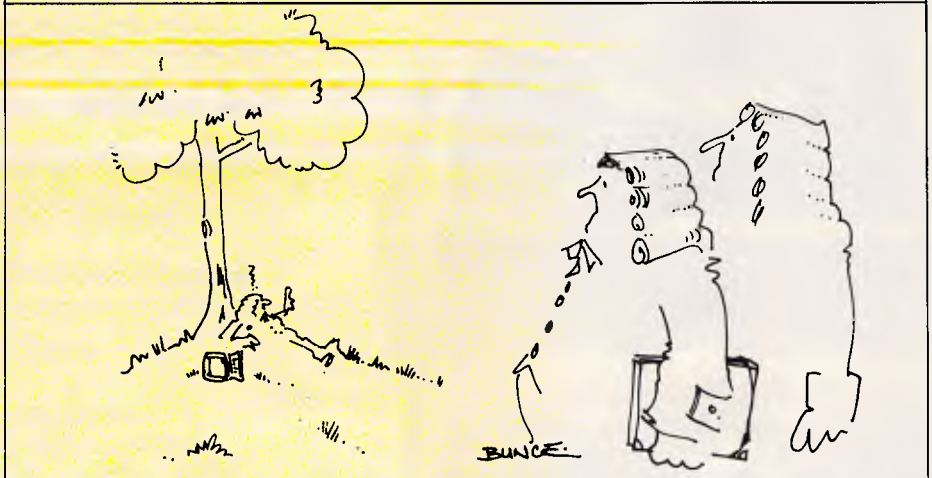
Documentation

The manuals that are supplied with these utilities packs are the best I've ever seen. Clear and concise instructions guide you safely through the potential minefield of installation and creating work disks. Tutorials featuring clear, working examples and screenshots take you through the important stages of each program, leaving you confident to carry on. And each manual is clearly indexed so that you can find things quickly, and is provided in an A5 booklet format ready-punched to fit in a ring file. The only exception is the Fontpack 1 manual which has been printed entirely by geoWrite (the others have been typeset), and shows the fonts' actual appearance.

Support

Customers support is carried out by Commodore's customer service division, as well as online telephone support. There are no plans to Australianise the American nature of the programs which only causes minor irritation at times, such as the zip codes in the geoDex files.

The alarm-clock problem isn't immediately obvious but is caused because the alarm-clock utiltiy was written for American C64s which run at a different speed to other versions, so one minute of real time is only 50 seconds to your GEOS clock!



Prices

Writer's Workshop, $99.95 Provides GEOS with a real word processor (geoWrite 2.0) and, thanks to a Text Grabber, can read and convert any C64 word processor document. Also includes the geoMerge mail-merge program and GEOS update files.

Desk Pack 1, $99.95 Four new GEOS programs featuring the Graphics Grabber utility which can 'steal' Print Master, Print Shop and Newsroom graphics for use in geoWrite and geoPaint; an icon editor, calendar and datebook deskTop accessory; and a game of Blackjack (plus GEOS update files).

geoDex, $69.95 geoDex electronic index file program that can print out labels and phone numbers, and can auto-dial them if you have a modem. Disk also includes geoMerge and GEOS update files.

Fontpack 1, $69.95 Twenty new fonts to be used with geoWrite and geoPaint.

geoCable, $69.95 Provides a disk, with some laser modules, and a cable to give parallel output.

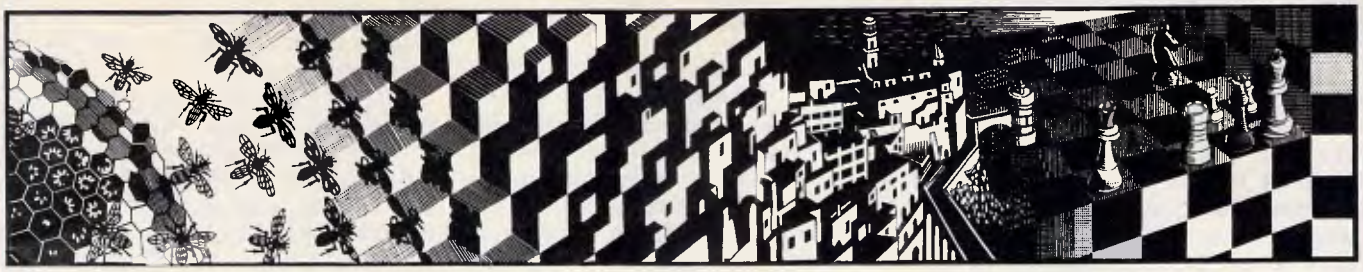
Conclusion

GEOS, the Mac-like disk operating system that gave a new lease of life to the tired C64, has been given a boost by these new utility packs that transform it from a pretty but useless gimmick into a working system.

The opportunity to convert all your disks to GEOS format and run them from the icons of the deskTop will ensure that GEOS will become *the* C64 operating system. Technically the system still defies the limitations and sluggishness of the infamous 1541 disk drive, and provides a continuing future for this durable machine.

END

GEOS utilities are available from all authorised Commodore dealers.



See how far you get as a futuristic detective with no clues at all, or as a German commandant. Stephen Applebaum and Carlos Domingo Martinez review the best of this month's games.

Just your imagination

TITLE: Portal
COMPUTER: Commodore 64/128
SUPPLIER: Imagineering
PRICE: $59

Of all the games I have played over the past few years, none has posed such a challenge to my imagination as Activision's apocalyptic Portal; an eclectic detective yarn awash with savage and symbolic imagery that takes its subject matter from genres as diverse as science fiction, Greek Mythology, psychology and philosophy.

On a superficial level, Portal is a kind of Hacker for grown-ups. But to look at it in such a simplistic fashion would be to do both the game and its creators a great injustice.

It is difficult to make any hard and fast judgment about what exactly Portal's writers are trying to say, as the game's plot throws up so many different ideas. At times its characters appear to yearn for an escape from the technology with which they have surrounded themselves, hence the allusions to Greek Mythology; but at other times they revel in it. Whatever the meaning, Portal certainly provides food for thought.

In a way, Portal's construction is reminiscent of Kubrick's *2001: A Space Odyssey*. The analogy is given, not to throw light on the plot, but to indicate the awe in which the program's authors hold the technology they have created in their highly stylised vision of the Earth, some 30 years from now.

Where Kubrick used slow pan shots and Strauss waltzes to enhance his fantastic models and communicate his sense of wonder at the future, so Portal's writers have, at the risk of being accused of self-indulgence, employed long discriptive passages to breathe life into their creations. Science-fiction buffs will enjoy these prosaics, although I doubt whether Portal will appeal to the shoot-'em-up contingent.

Portal is a futuristic detective story. And, being such, it would be careless of me to give too much away since that would preclude any pleasure readers might derive from unravelling its mysteries for themselves. What follows should not be looked upon as a source of clues, but only as an indication of the nature of the game's workings.

When Portal has been loaded, the computer becomes a nominal Worldnet terminal. (You won't have heard of Worldnet: it's a fictitious network that is supposed to have entry points dotted all over the globe). Displayed on the terminal screen is a window containing a number of squares marked with different motifs; these are data-gathering agents called AIs. By scrolling the window's contents either vertically or horizontally, each AI can be accessed in turn to reveal the files stored in its database.

Like Hacker (which I hate to mention in connection with Portal but it's the closest thing of its kind), the player enters the scene not knowing what to do or even what the aim of the game is. The only way to learn is to extract data from the various AIs.

Inside an AI called Central Processing are a number of messages left by Ezekial Fortune. He, it would appear, was one of the first people to notice that all was not well with the world, and that strange and inexplicable phenomena were occuring in Antarctica. Although others must have harboured fears similar to Fortune's, he was the only one to couch them via Worldnet.

Fortune's first message tells of the discovery of a new viral disease in Christchurch; his later ones are filled with cryptic references to a Field and a Migration. He knew next to nothing about what these terms meant, but he had uncovered the name Peter Devore with whom he felt they were connected in some way. And most sinister of all, people were disappearing: even Fortune's last message ends in mid-sen-

tence, implying that he, too, has suffered the fate he was trying to warn others about.

Using the facilities of Worldnet, the player, who picks up the story years after Fortune and the rest of mankind vanished, must discover why everyone suddenly left the Earth and where, if anywhere, they went. Although apparently alone in this seemingly impossible search for knowledge, the player actually has a helper in the form of HOMER, Worldnet's leading AI.

HOMER is an acronym derived from Heuristic Overview of Matrix Expansion and Reconstruction. Like its human namesake, HOMER's function is to teach. It does this by accepting data from the other AIs and consolidating it to form a story. As HOMER receives more information, the story becomes less patchy and the player can slowly build up a picture of what has happened.

As the game proceeds, the AIs churn out more information about specific characters and historical events. It becomes clear that Peter Devore played a prominent role in instigating the Migration; for it was his accidental discovery of the Portal, the doorway to the Realm, that allowed the Migration to take place. But what exactly are the Portal and the Realm in the first place?

Questions such as these can only be answered after a great deal of investigation. The amount of data making up the progarm is immense and almost fills all six sides of three 5¼in disks, so there are many more questions that have to be satisfied first.

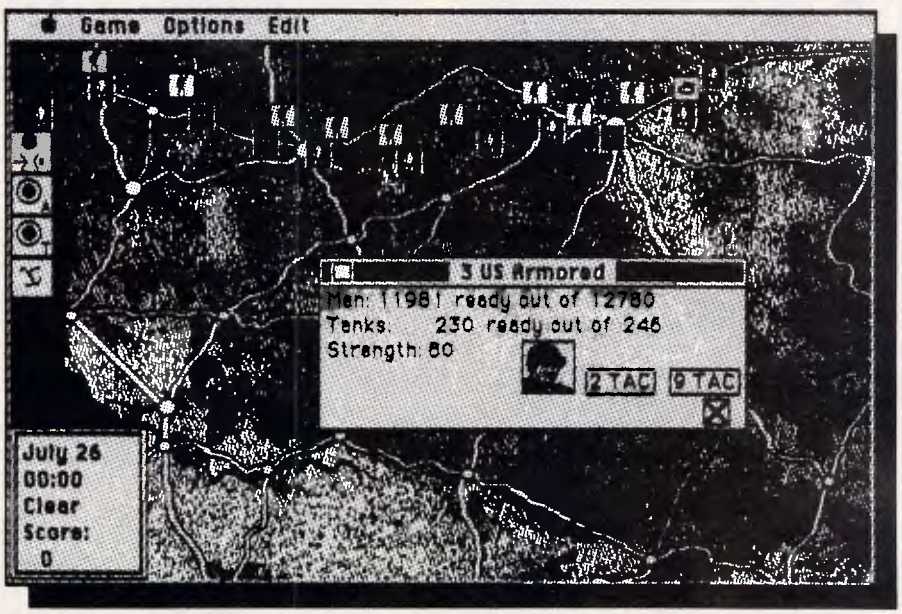
Portal is one to the most inventive games available for any home micro; it is also a program for the brain, not the trigger finger, which is certainly a refreshing thought.

A lot of work has gone into characterising Portal's major figures, which in itself brings the game to life. HOMER, the star of the show, is like a friendly old teacher who is always offering counsel to his young pupil. His character, in particular, is so well constructed that I was reluctant to switch off the computer after play, as it seemed as if I was saying goodbye to an old friend whom I would never see again.

Portal is a brilliant odyssey of the imagination, presided over by one of the most believable characters to inhabit a computer game. It would be madness for anyone owning a Commodore 64 or a 128 to overlook this exciting program.

War games

TITLE: Patton vs. Rommel
COMPUTER: Macintosh
SUPPLIER: ECP
PRICE: $79.95



Once upon a time military board games used carboard-chip armies moved around a printed battlefield. Though interesting, those games were cumbersome to play. They cried out for computerisation. Now their direct descendant, Patton vs. Rommel, designed by Chris Crawford, proves that, when fought on the Macintosh, war can be altogether less hellish.

Patton vs. Rommel recreates Operation Cobra, the post D-Day offensive designed to break through the German lines. You can command either the Allied or Axis forces against the computer or match wits against another player. Scoring, based on territory gained or lost, the number of towns controlled, and the casualties incurred, decides the winner.

Played on a map of the Normandy peninsula, the game uses icons depicting Allied and German divisions. A menu at the left of the screen changes these icons to show the type of unit, the direction it is 'facing', its degree of battle weariness and its available strength. Clicking on an icon opens a Statistics window, displaying the unit's current condition.

Three levels of play are available. Beginners give orders by simply pointing and clicking at locations on the map. At the intermediate and advanced levels, more precise orders (for both the movement of the unit and style of attack or defence) are issued inside the Stat window. Sequences of up to 32 commands can be specified. During combat, either commander (Rommel or Patton) may amend the orders of any unit within a certain radius. At the expert level, individual units may be edited and the conditions of battle changed — options that can completely alter the play. Games in progress or such altered scenarios may be saved for future recall. In battle, the icons move, flashing as they fire or take hits. However, if exciting graphics are important to you, look elsewhere. In deference to the sensibilities of others in the same room, the sound effects may be turned off. Dialogs offering a critique of your tactics appear at the conclusion of each day's fighting. I found them tiresome after a while. This feature may also be toggled off.

Game play is very straightforward, but don't expect to *blitzkrieg* your way through Europe right away. All the complexities of warfare, including the effects of weather, terrain, time and the condition of troops and equipment, have been coded into the program. Mastering these variables takes time and practice.

In a triumph of marketing over accuracy, Patton vs. Rommel is based on a campaign in which neither was present, a fact that is duly noted in the concise, complete manual. However, the game reflects the theory and practice of warfare embodied by these men. War game enthusiasts should find themselves challenged and entertained.

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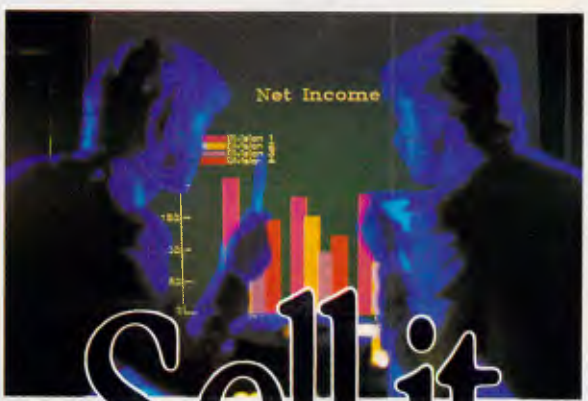

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Defending Amstrad LocoScript

It seems unfortunately commonplace for LocoScript, the word processor thrown in free with the Amstrad PCW 8256 and 1512, to be mildly rubbished by the computer press, with a special dig reserved for the manual. Diane Haymer, in her Screentest review of Protext (an 'alternative' to LocoScript) in April *APC*, is no exception, and while not excessively unkind to LocoScript nevertheless does not accord it its proper due.

She starts with a general, rather sour, comment to the effect that LocoScript's dreamlike quality — whatever *that* is — soon tarnishes slightly for those used to more sophisticated software. Maybe — but most LocoScript users will be first-timers rather than sophisticates, and anyway I personally find LocoScript easier and nicer to use than WordStar, Word or Word Perfect, albeit more limited.

And yes, I admit that LocoScript is rather slow, particularly when scrolling through the file being edited, or prior to exiting. This is odd, for presumably Locomotive Software could correct it if it tried. After all, when selecting for printing only the last few pages of a long document, LocoScript (version 1.2) gets there pretty quickly!

Also on the debit side, LocoScript's Find and Find & Replace (the latter is called Exchange) rather surprisingly can't find control characters like the embedded Emphasis or Style commands (as, for example, those for italics on or off). Moreover, it doesn't count words, and you can't format a disk from within LocoScript itself.

On the other hand, it quite happily inserts one document into another (though the format of the inserted text takes on the characteristics of that text already there), and prints in the background while editing in the foreground.

Back on the minus side, LocoScript is always in 'insert' mode, with no 'overtype' facility at all, and it has no column mode that would allow text to be inserted alongside (or, contrarywise, deleted from alongside) some already there.

Perhaps the best feature of LocoScript is the superb way it caters both for the tyro and for the expert. At one extreme the function keys invoke pull-down menus, from which the inexperienced user can select the required item with the cursor and Enter keys while at the other almost all the layout, emphasis, style and line operations can be switched on and off at touch-typing speeds with the special '+' and '-' keys.

This adaptability is a real delight, but unfortunately is often ignored by the reviewer. Indeed, Diane herself seems to have fallen into this very trap (if trap it be) when she talks, erroneously, about the 'greatest difference' [between LocoScript and Protext] being the 'replacement of menus [in LocoScript] with a series of "stored commands" [in Protext] that are embedded in the text.' The truth is that, unlike Protext, LocoScript gives it to you both ways, to use at your choice.

J Hooper

Amstrad has had great success with its PCW machines, drawing many people away from typewriters to word processing. However, the fact that LocoScript comes with the PCW machines doesn't necessarily mean that it is the best word processor for all purposes, merely that it is a good beginning.

It is interesting to note that even a die-hard LocoScript fan like J Hooper spent much of his letter criticising LocoScript. Diane Haymer wrote as someone who had used both packages, and it was that experience which informed her review.

APC *would be interested in hearing from other readers who have tried both products.*

Political debate

Last February I considered taking out a subscription to *APC*. I didn't because I was extremely irritated by a comment made by one of your correspondents.

Being a reasonable sort of person I decided to give you a second chance, and to my delight the March issue of your (excellent) magazine was of the expected high standard.

My hastily filled-in subscription form was nearly on its way to the letter box when I noticed in the April issue another piece of run-of-the-mill wisdom in the form of a review by Stephen Applebaum of a piece of software called 'SDI' ('Screenplay'). As stated before, I'm fairly tolerant — but if there's one thing that really annoys me it's being given a quick, unwanted piece of someone else's political mind. Please, don't

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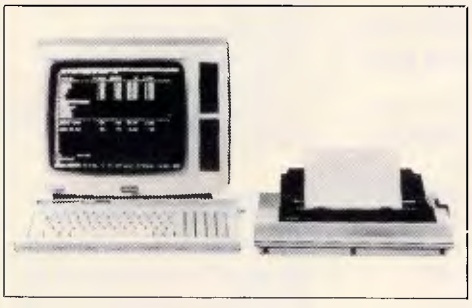

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let your great magazine be tarnished by politics. Apart from that, absolutely no criticisms . . .
G Heinig

It's amazing how people who argue for the staus quo never consider themselves political, whereas those who question and challenge are.
Isn't it a political act for MindScape to publish a game based on Reagan's Star Wars 'defence' policy?

If the cap fits

I have just finished reading Angie Brew's review of Degas Elite and Art Director in the March issue. I have been studying such packages for some months now in the hope of breaking into the already crowded computer graphics market. I would like to offer some opinions.

- Congratulations on having an artist review art packages! Too often I have read reviews by journalists who miss major flaws which an artist would spot immediately. An example is a lightpen which I bought having read a glowing review (not in *APC*). The reviewer failed to mention that the palette colours could not be changed from within the program!
- Having congratulated you on the idea, I must say that Angie Brew does not seem to be a good choice. I can't comment on her talents as an artist with pen and paper, but she is a rotten computer artist. I can only think it is due (as she says herself) to her inexperience with the packages.
- Miss Brew says she had to adapt her style too much to the computer. I find this a very strange statement. Would she expect to use watercolour techniques on an oil painting? Different mediums require different techniques and *some* adaptation in an artist's style. A mouse is not a pen, and to expect to use it in exactly the same way is foolish. As

can be seen from the screenshots, most of Miss Brew's drawing was done in freehand mode. Even with the slow-draw facility, this will only produce very jagged lines.

- Miss Brew implies that computer graphics packages are strictly for the amateur, or at best they can be used for rough working drawings by professional artists. Perhaps she changed her mind when she saw the Screenplay section in the February issue and saw the shots of the Defender of the Crown graphics which are neither rough nor, I suspect, produced by an amateur. I know they were taken on an Amiga with four times the screen resolution, but even the lower resolution of an ST can be used to produce excellent pictures. As with any form of art, computer graphics have advantages and disadvantages, and if you want to be any good at it you have to practise.

P McKinley

Telecom topics

I read with interest an item in Newsprint in the February issue of *APC*. In this item a member of your staff (unnamed) criticises Telecom for the proposed changes to charges for data calls.

The Australian telephony network is optimised for voice traffic, and as such is dimensioned and costed based on the average telephone call duration of approximately three minutes.

Any increase to the average call duration due to a change in demand patterns by our customers will mean a redimensioning of the telephony network, (that is, increased numbers of inter- exchange junctions).

With the current system of untimed local calls, the increased cost of providing this capacity is not reflected in the call charge revenues. Therefore Telecom must look to methods of recouping this cost.

One *proposed* solution is the introduction of timed local calls for data traffic. Unfortunately this idea has severe limitations and, personally, I see it as unlikely that timed local calls for data will be proceeded with.

The other major proposal is, of course, timed local calls for all customers. While this seems at first to be a blatant case of Telecom profiteering, just consider the following.

Telecom loses massive amounts of money providing the untimed local call in all but the most heavily trafficed business districts. In all other areas, including suburban Sydney and Melbourne, local calls are cross-subsidised by the large (approximately $900m) profits in the STD network.

If a timed local call were introduced, the cross-subsidisation in many areas would no longer be needed, allowing us to substantially reduce charges for longer distance calls.

This would bring the charging of telephone calls closer to the ideal situation of 'user pays', which is a trend in all forms of government enterprise in Australia.

Of course, our current policy of using part of the profit from high traffic areas to subsidise services in rural and remote areas would continue as a social obligation to our country customers.

It is also interesting to note that Telecom Australia is one of the few telecommunication administrations in the world that does not already charge at timed rates for local calls, (including AT&T in the US where only calls to the same exchange avoid toll charges).

While I agree with the belief that increasing call charges indiscriminately is totally unfair, attempting to put more of the burden of the cost of provision of the telephony network onto those who generate the traffic makes good sense.

Of course, those of us who continue to make telephone calls of the average three minute duration will incur no extra charges.

I must stress that the introduction of timed local calls in the Australian network is only a proposal, and even though I personally favour the idea, it may well be that the Communications Minister of the day doesn't see it that way.

In the meantime, enjoy your cheap dial-up data lines, and keep an open mind about your National Communications Carrier.

R Coster
Switching Development and Support
Telecom HQ Parramatta

Brick bats

Unfortunately, my first letter to *APC* is with a complaint.

The complaint deals with the March issue and the way it was packaged. I do not buy every issue of *APC*, but buy issues which contain articles specific to me. In this issue it was the Macintosh II/SE, the PC'87 preview and the Verbatim sample disk of Viatel. My complaint deals with the sample disk.

The packaging was most unsatisfactory and did not explain that the disk was in IBM format only; it was only when I got inside the magazine that I discovered this. Perhaps in future, you could label the disk with the format it is in, thus preventing any inconvenience. A most misleading package.

Now, onto a lighter note. I would like to congratulate you on a fine magazine and I hope to see more articles on the Apple II family in future.

Concerning the *Australian Personal Computer* Show: I would like to congratulate you and Australian Exhibition Services for a consistently fine exhibition and I look forward to PC'88.

T Allen

Yes, we should have indicated the diskette was for IBM PCs only. This was mentioned on the contents page, but of course because of the plastic bag in which each issue was enclosed, this could not be read before purchase.

Genetically speaking

I have been an avid reader of *APC* for several years, and there has not been one that I have not read from cover to cover.

I don't claim to have understood everything, but I still get pleasure from the more esoteric columns such as Numbers Count, and discourses on exotic programming languages.

But have you noticed that the practical stuff for mere home computer owners is pretty thin on the ground?

Much of the software reviewed on your pages costs more than my entire (modest but adequate) system.

And much of the hardware costs more than the extensions I plan for my, (modest but adequate) family home.

Every time I see another database program reviewed, I wince — what proportion of your readers really needs to handle the amount of information those monsters are capable of?

I would love to have a Macintosh or an IBM PC/AT or an Amiga, but I don't and I probably never will, and that means your excellent magazine is for me, and I suspect most readers, all theory and dreams.

My first dip each month is into the Program File section, where I can find the fruits of the labours of programmers like myself.

Owen Linderholm, bless him, is always on the lookout for something different, and I have spent many happy hours playing with the ideas his con-

tributors come up with.

But I must take issue with David Wilson's program 'Darwin's Lens', in the February issue, which purports to demonstrate a process (admittedly simple) of natural selection — it doesn't at all.

What it does is simply start with given conditions, and step incrementally through to the given end conditions.

My assertion is best demonstrated by applying the rules of Wilson's program to one cell of the seven in the array — increment or decrement the starting value, test which yields a result closest to the expected one, and make this the start point for the next iteration.

It should be clear that the program will automatically home in on the desired result — evolution is not like that. Applying the rules to the entire array rather than one cell at a time just makes the program dither a little, instead of getting straight to the point.

A better simulation would involve two parents, rather than one in each generation, whose probability of mating and producing improved offspring was related to the efficiency of the lens — they could see each other better!

Then random variations in the litter would lead to further changes. This scheme would prove more 'realistic' than the one-step changes in Wilson's program.

So, now I'm off to spend more happy hours playing with an idea sparked off in your fine magazine.

F Connell

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. . . continued from page 126

```
                mov dx,es:[di]                  ;get CRTC address
                mov addr_6845,dx                ;save it
;
;Get and save the address of the DOS BUSY_FLAG.
;
                mov ah,34h                      ;function 34h
                int 21h                         ;get address
                mov dos_segment,es              ;save segment
                mov busy_flag,bx                ;save offset
;
;Save and replace all required interrupt vectors.
;
                mov ah,35h                      ;get interrupt 9 vector
                mov al,9
                int 21h
                mov old9h,bx                    ;save it
                mov old9h[2],es
                mov ah,25h                      ;point it to KEYBOARD routine
                lea dx,keyboard
                int 21h
                mov ah,35h                      ;get interrupt 1Ch vector
                mov al,1Ch
                int 21h
                mov old1ch,bx                   ;save it
                mov old1ch[2],es
                mov ah,25h                      ;then point it to TIMER
                lea dx,timer
                int 21h
                mov ah,35h                      ;get interrupt 13h vector
                mov al,13h
                int 21h
                mov old13h,bx                   ;save it
                mov old13h[2],es
                mov ah,25h                      ;point it to BDISK
                lea dx,bdisk
                int 21h
                mov ah,35h                      ;get interrupt 28h vector
                mov al,28h
                int 21h
                mov old28h,bx                   ;save it
                mov old28h[2],es
                mov ah,25h                      ;point it to BACKPROC
                lea dx,backproc
                int 21h
;
;Terminate but remain resident in memory.
;
                mov dx,offset initialize+6216 ;point DX to end of resident code
                int 27h                         ;terminate-but-stay-resident
initialize      endp
;
code            ends
                end begin
```

```
100 REM -- BASIC PROGRAM TO CREATE XDIR.COM
110 OPEN "XDIR.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO  181
150     LINESUM = 0
160     FOR J = 1 TO 8
170         READ BYTE
180         CHECKSUM = CHECKSUM + BYTE
190         LINESUM = LINESUM + BYTE
200         IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210         PUT #1
220     NEXT J
230     READ LINECHECK
240     IF LINECHECK <> LINESUM THEN PRINT "Error in Line";280 + 10 * I
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 134603 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA    233,   236,     4,    67,   111,   112,   121,   114,   998
300 DATA    105,   103,   104,   116,    32,    49,    57,    56,   622
310 DATA     54,    32,    98,   105,   102,   102,    45,    68,   598
320 DATA     97,   118,   105,   115,    32,    80,   117,    98,   762
330 DATA    108,   105,   115,   104,   105,   110,   103,    32,   782
340 DATA     67,   111,    46,    26,    92,    42,    46,    42,   472
350 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
360 DATA      2,     0,   184,     0,    79,    15,     0,     0,   280
370 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
380 DATA      0,     7,     6,     0,     0,     0,     0,     0,    13
390 DATA      0,    64,     0,   239,     5,   239,    11,     0,   558
400 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
410 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
420 DATA      0,     0,     0,     0,     0,     0,     0,    44,    44
430 DATA     40,    45,    41,    42,    46,    30,    78,   111,   433
440 DATA     32,    70,   105,   108,   101,   115,    32,    70,   633
450 DATA    111,   117,   110,   100,     0,   251,    80,   228,   997
460 DATA     96,    60,    52,   117,    27,   180,     2,   205,   739
470 DATA     22,   168,     8,   116,    19,   232,    40,     2,   607
480 DATA     88,    46,   128,    62,    53,     1,     0,   117,   495
490 DATA      6,    46,   198,     6,    55,     1,     1,   207,   520
500 DATA     88,    46,   255,    46,    87,     1,   156,    46,   725
510 DATA    255,    30,    91,     1,    46,   128,    62,    55,   668
520 DATA      1,     0,   116,    41,     6,    87,    46,   142,   439
530 DATA      6,    49,     1,    46,   139,    62,    51,     1,   355
540 DATA     38,   128,    61,     0,    95,     7,   117,    21,   467
550 DATA     46,   128,    62,    54,     1,     0,   117,    13,   421
560 DATA    176,    32,   230,    32,    46,   198,     6,    55,   775
570 DATA      1,     0,   232,    52,     0,   207,    46,   254,   792
580 DATA      6,    54,     1,   156,    46,   255,    30,    95,   643
590 DATA      1,    46,   254,    14,    54,     1,   207,   156,   733
600 DATA     46,   255,    30,    99,     1,    46,   128,    62,   667
```

Figure 2: The Basic program for creating XDIR.COM.

moved from the position it was in when interrupted and will not be returned when the resident program passes control back to the application. XDIR intercepts interrupt 13h, maintains an internal flag (labelled FLAG_13h in the source code) that reflects its status at any point in time, and doesn't let the window pop up if a BIOS disk service is in process.

Finally the end of the initialisation phase is reached, and XDIR executes an interrupt 27h to terminate but stay resident. An extra 6216 bytes are reserved beyond the end of the resident code to provide room for saving the screen contents before opening the window and for the text of the filenames read in from the disk. The DTA and pathname buffer are located in the 256-byte Program Segment Prefix, which is no longer needed after the program becomes resident. The net result is the sacrifice of a small portion of your computer's usable RAM but the gain of a very powerful and economical new utility.

Most memory-resident utilities, once installed, check every keypress looking for their specific trigger combination. In this respect, XDIR is no different: it intercepts the interrupt 9 that's generated every time a key is pressed or released and, if it detects a touch of the period key, immediately queries the system to see if the Alt key is also being held down. What it does when it finds the trigger keys depressed, however, is quite different from what a typical resident program does.

XDIR can't blindly take control of the computer and open the directory window ready for input; instead, it must make sure that it didn't interrupt a DOS service routine or a BIOS disk service. (If it did, it must wait until later to pop up.) Further, if the DOS Busy Flag is set, the routine must take advantage of an interrupt 28h if one is generated before the flag is cleared. It sounds somewhat formidable, but it really isn't. The XDIR keyboard handler doesn't even try to open the window, but merely sets an internal flag called REQUEST_FLAG from 0 to 1 and promptly exits.

XDIR employs a pair of custom interrupt handlers for the express purpose of checking the REQUEST_FLAG and, if possible, opening the directory window. The first is the procedure labelled TIMER, which is invoked 18 times every second at each tick of the time-of-day clock. TIMER checks the REQUEST_FLAG and exits through an IRET if it's clear. But if the flag is set to 1, TIMER checks the DOS Busy Flag

```
610 DATA     55,    1,    0,  116,    9,   46,  198,    6,  431
620 DATA     55,    1,    0,  232,   11,    0,  207,  251,  757
630 DATA     46,  198,    6,   72,    1,    1,  176,    0,  500
640 DATA    207,   46,  198,    6,   53,    1,    1,  251,  763
650 DATA     80,   83,   81,   82,   86,   87,   30,    6,  535
660 DATA     14,   31,   14,    7,  180,   15,  205,   16,  482
670 DATA     60,    2,  116,   22,   60,    3,  116,   18,  397
680 DATA     60,    7,  116,   14,  198,    6,   53,    1,  455
690 DATA      0,    7,   31,   95,   94,   90,   89,   91,  497
700 DATA     88,  195,  136,   62,   59,    1,  180,    3,  724
710 DATA    205,   16,  137,   14,   64,    1,  232,  131,  800
720 DATA      1,  163,   66,    1,  252,  128,   62,   56,  729
730 DATA      1,    1,  117,    3,  232,   60,    1,  232,  647
740 DATA    218,    0,  232,  153,    1,  128,   62,   56,  850
750 DATA      1,    1,  117,    3,  232,   59,    1,  232,  646
760 DATA     50,    2,  139,   62,   79,    1,  186,   10,  529
770 DATA      2,  177,   59,  232,  203,    1,   60,   27,  761
780 DATA    117,    3,  233,  134,    0,   81,  180,    1,  749
790 DATA    181,   32,  205,   16,   89,  186,   45,    1,  755
800 DATA     10,  201,  116,   20,  128,  125,  255,   92,  947
810 DATA    117,    1,   79,  141,   54,   44,    1,  185,  622
820 DATA      5,    0,  243,  164,  139,   22,   79,    1,  653
830 DATA    232,   70,    2,  198,    6,   70,    1,    0,  579
840 DATA     11,  201,  117,   21,  186,   33,    7,  141,  717
850 DATA     54,  118,    1,  232,  221,    2,  232,   46,  906
860 DATA      1,  232,   14,    3,  232,  250,    2,  235,  969
870 DATA    169,  232,  132,    2,  232,   32,    1,   60,  860
880 DATA      0,  116,   12,   60,   27,  117,  245,  232,  809
890 DATA    248,    2,  232,  228,    2,  235,  147,  128, 1222
900 DATA    252,   81,  117,   18,  160,   70,    1,   58,  757
910 DATA      6,   69,    1,  116,  223,  254,    6,   70,  745
920 DATA      1,  232,  205,    2,  235,  211,  128,  252, 1266
930 DATA     73,  117,  209,  128,   62,   70,    1,    0,  660
940 DATA    116,  202,  254,   14,   70,    1,  232,  184, 1073
950 DATA      2,  235,  190,  232,  195,    1,  128,   62, 1045
960 DATA     56,    1,    1,  117,    3,  232,  131,    0,  541
970 DATA    232,   78,    0,  128,   62,   56,    1,    1,  558
980 DATA    117,    3,  232,  133,    0,  180,    2,  138,  805
990 DATA     62,   59,    1,  139,   22,   66,    1,  205,  555
1000 DATA    16,  180,    1,  139,   14,   64,    1,  205,  620
1010 DATA    16,  233,  248,  254,  186,    8,    2,  138, 1085
1020 DATA    30,   59,    1,   50,  255,  232,   63,    0,  690
1030 DATA   137,   62,   62,    1,  139,  247,   30,  142,  820
1040 DATA    30,   57,    1,   46,  139,   62,   83,    1,  419
1050 DATA   185,   12,    0,   81,  185,   64,    0,  243,  770
1060 DATA   165,   89,  131,  198,   32,  226,  244,   31, 1116
1070 DATA   195,    6,  139,   62,   62,    1,  142,    6,  613
1080 DATA    57,    1,  139,   54,   83,    1,  185,   12,  532
1090 DATA     0,   81,  185,   64,    0,  243,  165,   89,  827
1100 DATA   131,  199,   32,  226,  244,    7,  195,  176, 1210
1110 DATA   160,  246,  230,  208,  226,   50,  246,    3, 1369
1120 DATA   194,  139,  248,  184,    8,   16,  247,  227, 1255
1130 DATA     3,  248,  195,  186,  218,    3,  236,  168, 1257
1140 DATA     8,  116,  251,  131,  234,    2,  176,   37,  955
1150 DATA   238,  195,  180,   15,  205,   16,  141,   30, 1020
1160 DATA   111,    1,  215,  186,  216,    3,  238,  195, 1165
1170 DATA   228,   97,  138,  224,   12,  128,  230,   97, 1154
1180 DATA   138,  196,  230,   97,  250,  176,   32,  230, 1349
1190 DATA    32,  251,  195,  180,    1,  139,   14,   73,  885
1200 DATA     1,  205,   16,  195,  139,   22,   75,    1,  654
1210 DATA   176,   14,  238,   66,  236,  138,  224,   74, 1166
1220 DATA   176,   15,  238,   66,  236,   37,  255,    7, 1030
1230 DATA   179,   80,  246,  243,  134,  224,  195,  180, 1481
1240 DATA     1,  205,   22,  117,    4,  205,   40,  235,  829
1250 DATA   246,  180,    0,  205,   22,  195,    6,  142,  996
1260 DATA     6,   57,    1,  139,   62,   62,    1,  176,  504
1270 DATA   218,  138,   38,   60,    1,  171,  185,   62,  873
1280 DATA     0,  176,   32,  243,  171,  176,  191,  171, 1160
1290 DATA   131,  199,   32,  185,   10,    0,   81,  176,  814
1300 DATA   179,  138,   38,   68,    1,   80,  171,  185,  852
1310 DATA    62,    0,  176,   32,  138,   38,   61,    1,  508
1320 DATA   243,  171,   88,  171,  131,  199,   32,   89, 1124
1330 DATA   226,  228,  176,  192,  171,  185,   62,    0, 1240
1340 DATA   176,  196,  243,  171,  176,  217,  171,    7, 1357
1350 DATA   195,  136,   14,   68,    1,  180,    2,  138,  734
1360 DATA    62,   59,    1,  205,   16,  232,  115,  255,  945
1370 DATA    50,  201,  232,  146,  255,   60,   13,  116, 1073
1380 DATA    66,   60,   27,  116,   62,   60,    8,  116,  515
1390 DATA    32,   60,   32,  114,  237,   58,   14,   68,  615
1400 DATA     1,  116,  231,   80,   81,  180,   10,  185,  884
1410 DATA     1,    0,  205,   16,  254,  194,  180,    2,  852
1420 DATA   205,   16,   89,   88,  170,  254,  193,  235, 1250
1430 DATA   209,   10,  201,  116,  205,   81,  254,  202, 1278
1440 DATA   180,    2,  205,   16,  180,   10,  176,   32,  801
1450 DATA   185,    1,    0,  205,   16,   89,  254,  201,  951
1460 DATA    79,  235,  183,  195,    6,  180,   47,  205, 1130
1470 DATA    33,  140,    6,  103,    1,  137,   30,  105,  555
1480 DATA     1,  188,   26,  139,   22,   81,    1,  205,  655
1490 DATA    33,  180,   53,  176,   36,  205,   33,  140,  856
1500 DATA     6,  107,    1,  137,   30,  109,    1,  180,  571
1510 DATA    37,  141,   22,   15,    2,  205,   33,    7,  462
1520 DATA   195,  180,   37,  176,   36,  139,   22,  109,  894
1530 DATA     1,   30,   46,  142,   30,  107,    1,  285,  562
1540 DATA    33,  180,   26,   46,  139,   22,  105,    1,  552
1550 DATA    46,  142,   30,  103,    1,  205,   33,   31,  591
1560 DATA   195,  198,    6,   72,    1,    0,  180,   78,  730
1570 DATA   139,   14,   77,    1,  205,   33,  185,    0,  654
1580 DATA     0,  114,   61,  128,   62,   72,    1,    0,  438
1590 DATA   117,   54,   65,  139,   62,   85,    1,  232,  755
1600 DATA    47,    0,  180,   79,  205,   33,  114,   17,  675
1610 DATA   128,   62,   72,    1,    0,  117,   10,  232,  622
1620 DATA    31,    0,   65,  129,  249,  104,    1,  117,  696
1630 DATA   233,  131,  239,   13,   71,   38,  128,   61,  914
1640 DATA     0,  117,  249,   38,  254,   13,  139,  193, 1003
1650 DATA    72,  179,   40,  246,  243,  162,   69,    1, 1012
1660 DATA   195,  139,   54,   81,    1,  131,  198,   30,  829
1670 DATA    81,  185,   13,    0,  243,  164,   89,  195,  970
1680 DATA   198,    6,   71,    1,    0,  184,    8,    2,  470
1690 DATA   138,   30,   70,    1,   50,  255,  247,  227, 1018
1700 DATA   139,  240,    3,   54,   85,    1,  186,   10,  718
1710 DATA     3,  185,   10,    0,   81,  232,   15,    0,  526
1720 DATA   254,  198,  178,   10,   89,  128,   62,   71,  990
1730 DATA     1,    0,  117,    2,  226,  238,  195,  185,  964
1740 DATA     4,    0,   81,   86,   82,  232,   19,    0,  504
1750 DATA    90,  128,  194,   16,   94,  131,  198,   13,  864
```

and FLAG_13H, which indicates whether or not a BIOS disk service is in progress. If both are clear, TIMER calls the DIRECTORY procedure. DIRECTORY is the subroutine that actually opens the window, accepts input, displays directory listings, and closes the window on exit. If either flag is set, however, TIMER simply ends without doing anything, content to try again the next time it's called if REQUEST_FLAG is still set.

The second routine complements the duties of the first. BACKPROC (for BACKground and PROCess) receives control any time an interrupt 28h is generated and, like the TIMER routine, checks to see if the directory window has been requested by looking at REQUEST_FLAG. If the flag is nonzero, BACKPROC examines FLAG_13H and calls DIRECTORY if FLAG_13H is clear. If FLAG_13H isn't clear, an IRET is executed to end the interrupt. You can see how TIMER and BACKPROC coordinate their responsibilities: each routine checks the same REQUEST_FLAG and the first one that can answer a request to open the window does so, but only after clearing REQUEST_FLAG so that the other won't try to duplicate the action.

The interrupt 28h handler doesn't have to check the DOS Busy Flag because, as was outlined at the beginning, most DOS function calls greater than number 0Ch can be safely called from within a 28h handling routine. Note here an interesting point: the DIRECTORY routine can be called from either an interrupt 1Ch or an interrupt 28h handler. We really don't care which one does it as long as the window pops up on the screen with minimal delay. The 28h routine can use only functions 0Ch and greater. The TIMER routine could safely use all DOS services because if it invokes the DIRECTORY subroutine, the Busy Flag must be clear. But since DIRECTORY doesn't know which handler will actually deliver control to it (and it could be different each time), it takes a conservative approach and avoids low-numbered DOS function calls altogether.

The DIRECTORY routine itself is the backbone of XDIR. When it is given control by either the TIMER or BACKPROC routine, it immediately sets the PROGRAM_STATUS flag to 1 to avoid any subsequent press of the Alt-period combination. An STI instruction is executed to restore interrupts. Then it checks to make sure that the PC isn't presently in a graphics mode or a 40-column text mode. (Making the

```
1760 DATA    89,   128,    62,    71,     1,     0,   117,     2,   470
1770 DATA   226,   232,   195,   180,     2,   138,    62,    59,  1094
1780 DATA     1,   205,    16,   185,     1,     0,   172,    10,   590
1790 DATA   192,   116,    21,    60,   255,   116,    12,   180,   952
1800 DATA    10,   205,    16,   180,     2,   254,   194,   205,  1066
1810 DATA    16,   235,   235,   198,     6,    71,     1,     1,   763
1820 DATA   195,   180,     6,   176,     0,   185,    10,     3,   755
1830 DATA   180,    69,    12,   138,    62,    61,     1,   205,   734
1840 DATA    16,   195,   180,     2,   186,    10,     2,   138,   729
1850 DATA    62,    59,     1,   205,    16,   180,    10,   176,   709
1860 DATA    32,   185,    60,     0,   205,    16,   195,   180,   873
1870 DATA    18,   179,    16,   205,    16,   128,   251,    16,   829
1880 DATA   116,     7,    10,   255,   117,    19,   235,    39,   798
1890 DATA   144,   254,    14,    56,     1,   180,    15,   205,   869
1900 DATA    16,    60,     7,   117,    26,   254,    14,    56,   550
1910 DATA     1,   129,    46,    57,     1,     0,     8,   198,   440
1920 DATA     6,    60,     1,   112,   198,     6,    61,     1,   445
1930 DATA     7,   199,     6,    73,     1,    13,    12,   232,   543
1940 DATA   169,   253,   184,    64,     0,   142,   192,   191,  1195
1950 DATA    99,     0,    38,   139,    21,   137,    22,    75,   531
1960 DATA     1,   180,    52,   205,    33,   140,     6,    49,   666
```


program work in video modes other than 80-column text modes would add significantly to the amount of overhead.)

A pair of video parameters has to be obtained and saved so they can be restored when the DIRECTORY routine is finished. The cursor mode is defined by the starting and ending scan lines that form the cursor and are reported directly by interrupt 10h, service 3. The same function call returns the cursor position as well, but that leads to a problem that crops up all too often and merits closer inspection.

Custom video drivers

A handful of programs (for example, Lotus's 1-2-3) bypass the BIOS video services built into the computer and instead uses custom routines written especially for the IBM family of video adaptors. They do this because BIOS routines are somewhat slow. These custom video drivers make life hard for a memory-resident routine designed to interrupt them without any destructive side effects because they typically don't keep the BIOS informed of details like the cursor's whereabouts. They move the cursor by writing directly to the video adaptor's CRT Controller (CRTC) rather than by invoking built-in routines that do the same. The result is that the video interrupt will erroneously report the cursor position to a routine making a request. This creates a sticky situation, one that can't always be overcome. But fortunately, at least when it comes to finding the correct cursor address, there is a solution.

The solution lies in obtaining the cursor address from the CRTC rather than from the BIOS. The routine CURSOR_ADDRESS in the XDIR source code does just that. Both the Color/Graphics Adaptor (CGA) and the Monochrome Display Adaptor (MDA) employ the Motorola 6845 CRTC, a small chip that allows a raster scan display to be driven in a variety of modes through a set of 18 internal and accessible registers. The EGA uses a custom CRTC that has some degree of compatibility with the 6845. In each of those adaptors, the cursor address is stored in the form of a 16-bit video buffer address (similar to the PC's text mode character cell addressing scheme, but without the attribute bytes) that's held in registers 14 and 15 of the CRTC's internal array. Once the port address of the CRTC is obtained (that's why it was stored during initialisation), the CRTC Address Register and Data Register can be

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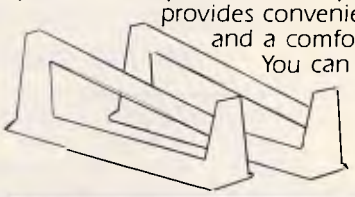

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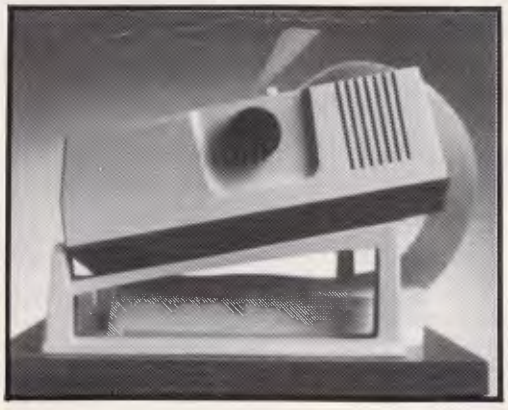

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```
1970 DATA     1,   137,    30,    51,     1,   180,    53,   176,   629
1980 DATA     9,   205,    33,   137,    30,    87,     1,   140,   642
1990 DATA     6,    89,     1,   180,    37,   141,    22,   133,   609
2000 DATA     1,   205,    33,   180,    53,   176,    28,   205,   881
2010 DATA    33,   137,    30,    91,     1,   140,     6,    93,   531
2020 DATA     1,   180,    37,   141,    22,   174,     1,   205,   761
2030 DATA    33,   180,    53,   176,    19,   205,    33,   137,   836
2040 DATA    30,    95,     1,   140,     6,    97,     1,   180,   550
2050 DATA    37,   141,    22,   230,     1,   205,    33,   180,   849
2060 DATA    53,   176,    40,   205,    33,   137,    30,    99,   773
2070 DATA     1,   140,     6,   101,     1,   180,    37,   141,   607
2080 DATA    22,   247,     1,   205,    33,   186,    55,    30,   779
2090 DATA   205,    39,     0,     0,     0,     0,     0,     0,   244
```

Figure 2: The Basic program for creating XDIR.COM.

manipulated to divulge the cursor address. CURSOR_ADDRESS illustrates the mechanics of the process and the transformation of the buffer address to row and column format.

With vital cursor information stored away, DIRECTORY turns its attention to popping the directory window onto the screen. First the routine

'Learning how to deploy non-reentrant DOS routines from inside a resident utilitiy is no picnic because there is precious little material on the subject.'

SAVE_SCREEN is called to save the screen contents, then OPEN_WINDOW writes the character/attribute pairs that define the window to video memory. The video signal is disabled before the writing process begins if a CGA is being used and enabled again upon completion.

Next, IOSET is called upon to save the DTA address and interrupt 24h vector and to replace each with pointers to locations within XDIR. Both tasks are crucial to a resident program that accesses the disk if it's to be certain not to interfere with the application it interrupted.

When the window first makes its appearance on-screen, a flashing cursor sits poised on the top line awaiting input of a path string. The routine READLN is called to handle the receiving of input, and comes complete with its own routines to write characters and perform backspaces. Why create a custom input routine when DOS function 0Ah offers the same service? Because DOS functions numbered 0Ch and lower can't be used. Using it would be perfectly fine if the DIRECTORY routine were invoked from the TIMER module, but using 0Ah from within an interrupt 28h handler would be disastrous.

With an ASCIIZ string in hand describing the path to the directory to be searched, DOS functions 4Eh and 4Fh are used to read the directory information. Both functions are well documented in the DOS *Technical Reference* and other texts. If the path string ends with a backslash character, XDIR appends the string *.* so that all filenames found will be reported. If it doesn't end with a backslash, the string *.* is added. If nothing were entered on the

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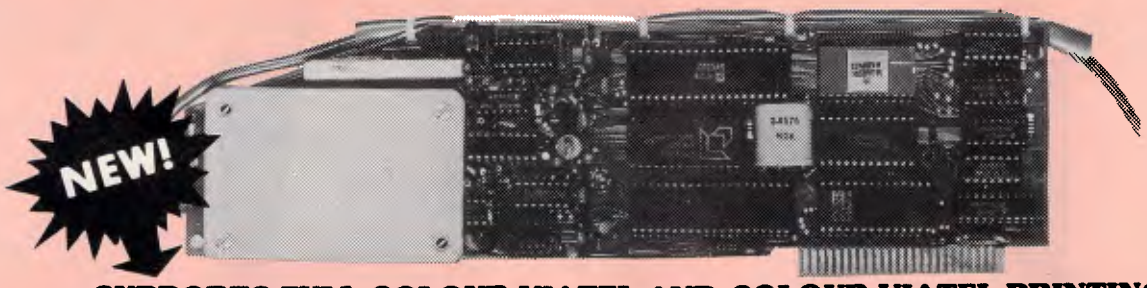

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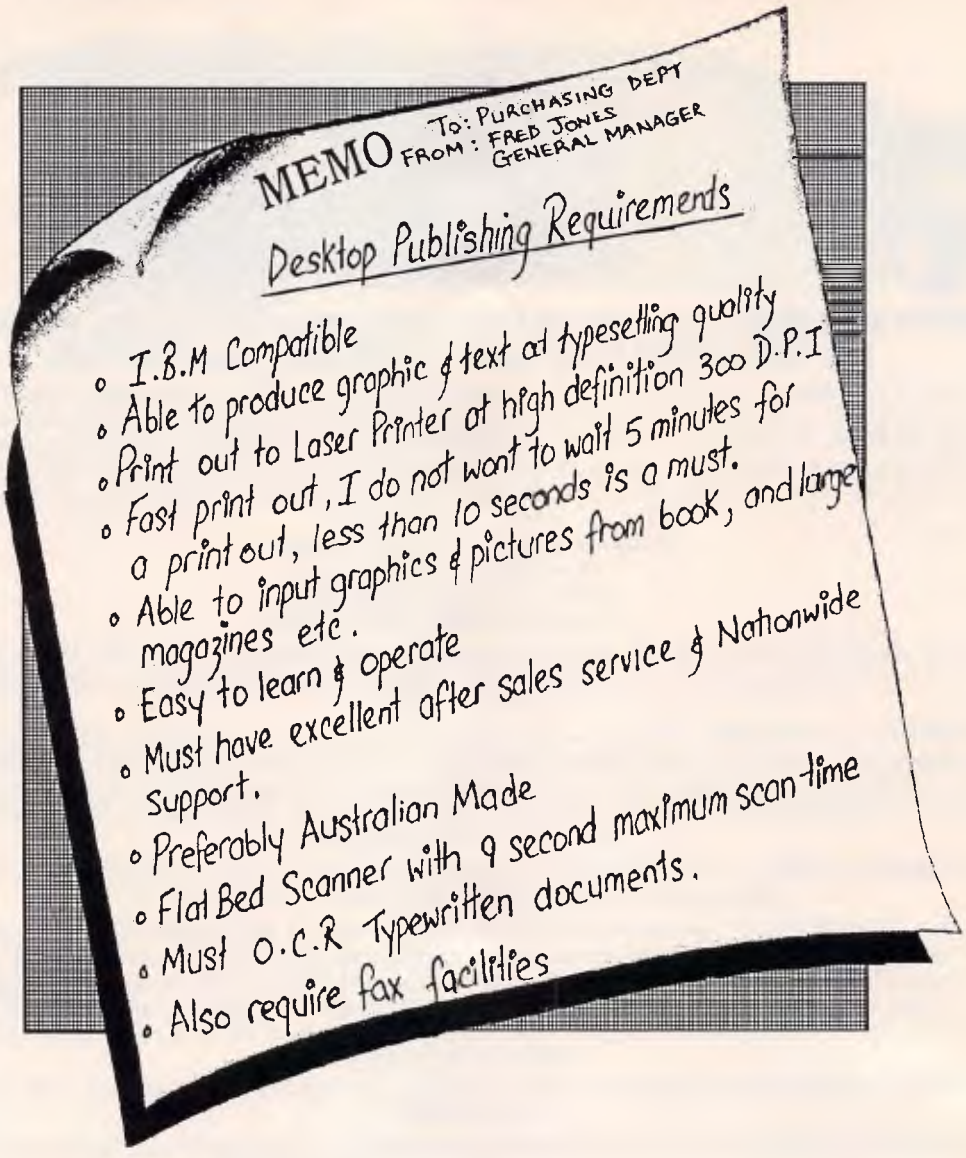

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input line, the global designator *.* is used so that the current directory is targeted. A search attribute of 0 is specified so that subdirectories, hidden and system files, and volume labels will be ignored. And rather than let the filenames scroll by, XDIR buffers up to 360 names so that the list can be examined backward and forward with the PgUp and PgDn keys.

After the first page of directory text is printed in the window, XDIR sits back and waits for a press of the Esc, PgUp, or PgDn key telling it what action to take next. Under normal circumstances BIOS interrupt 16h is used to trap a keypress. But these aren't normal circumstances. Any time XDIR solicits a keypress, it calls the GETKEY procedure instead of explicitly using the BIOS service. GETKEY does essentially the same thing as interrupt 16h and even employs it, but it also does something quite unique: it generates interrupt 28h over and over while it waits. The reason? For complete compatibility with other resident utilities like SideKick.

Keeping compatible

To see why, try this short experiment. If you use another memory-resident utility, install it into memory, and afterwards load SideKick. From the DOS command line, pop up SideKick followed by the other program. Both should work quite nicely. But then exit from both and, still from the DOS prompt, pop up the secondary utility followed by SideKick. You may get a strange result. The other TSR will successfully come up, but SideKick may only respond with a series of audible chirps. That's SideKick's signal that it can't pop up. The reason is that the other TSR interrupted the execution of DOS function 0Ah, so SideKick looks at the DOS Busy Flag and realises it can't take control until the flag clears or an interrupt 28h comes along. But the flag won't clear until the other TSR hands control back to DOS, and if the other TSR doesn't generate an interrupt 28h, SideKick is helpless. SideKick might come up if this exact scenario were duplicated from within a running applications program rather than from the DOS command line, because chances are about even then that the other TSR wouldn't have interrupted a DOS service in progress.

The situation is remedied by having XDIR generate its own interrupt 28h calls while it waits for a keypress. That way, a program like SideKick can pop up at any time, even if XDIR itself were

address 018Ah to the scan code of the primary key you want to assign to bring up the window. Its present value is 52, the scan code for the period key. If you want to use Ctrl rather than Alt as the secondary key, change the byte at 0192h from 8 to 4.

As written, XDIR will display only normal filenames when it searches directories. Subdirectories, hidden files, system files, and volume labels are ignored. If that doesn't satsify your needs, change the byte at offset 014Dh in the .COM file (it's currently set to 0 and labelled SEARCH_ATTR in the source code) to the search attribute value you want, as outlined in the documentation for DOS function 4Eh. The following table lists each file type and the corresponding attribute value:

Hidden	2
System	4
Subdirectory	16

Setting the search attribute byte to 16, for example, will tell XDIR to display subdirectory names as well as filenames. The values listed above are additive, so setting the byte to 18 would result in hidden files, subdirectories, and normal files being listed. The DOS *Technical Reference* mentions a volume label bit in addition to the rest. Don't set it. A search that includes volume labels as a target will automatically ignore everything else.

If you have a colour system and don't like the program's default colour scheme (a red border with white text printed against a black background), this, too, is easy to modify. Change the byte at 013Ch to the desired border attribute and the byte at 013Dh to the new text attribute. They appear in the source listing as the bytes BORDER_ATTR and TEXT_ATTR. All of this has no effect in monochrome.

In closing

The PC-DOS operating system provides applications programmers with some of the most sophisticated coding tools available. Its built-in routines are nothing short of crucial for a program that must communicate with disk media. Learning how to deploy non-reentrant DOS routines from inside a resident utiltiy is no picnic because there is precious little material on the subject, yet it's one of the more useful skills a programmer can learn. It's as if that knowledge were a deep dark secret that can't be trusted in the hands of the average user. Microsoft continues to foster that notion by withholding documentation on DOS function 34h and a host of other useful services. In reality, there's nothing hard about it. Just follow a few simple rules and it's a cookbook process.

I hope this article sheds some light on an interesting but elusive subject. Utilities like XDIR are fascinating and deserve their own little niche in your library. With major software companies like Borland and Microsoft collaborating on establishing standards for the structure and behavior of memory-resident programs the days of utilities that won't work with each other and can't be uninstalled from memory should be nearing an end. But even with the acceptance of new interfaces like Windows, don't write gems like SideKick off too soon. Just as there will always be room for improvement in any operating system, there will always be programmers waiting to plug the holes.

END

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invoked from an interrupt 28h. It's one of the little touches that makes a program special, and it's a must if it's to claim true compatibility with other utilities on the market.

When the Esc key is pressed to close the window, several things occur. First, the original DTA address and the interrupt 24h vector are restored. Then the contents of the screen that were saved before the window was opened are written back to video memory. This effectively closes the window and reveals what lay beneath it. Finally, the cursor is set back to its original location and unblanked, and the DIRECTORY routine ends by returning to the interrupt handler that called it. The handler in turn transfers control back to the program interrupted by the Alt-period keypress.

The only remaining item of interest is the critical error handler XDIR employs. The routine IOERR gets control when a critical error is detected. The most common such error is trying to read from an empty drive or damaged disk. The XDIR procedure GET_DIR is the one that calls functions 4Eh and 4Fh to read the directory information, and is thus the one whose malfunction might result in an interrupt 24h. While a whole volume could be devoted to writing critical error handlers, IOERR is a very simple one that does its job in only a few lines of code.

When the operating system vectors to an interrupt 24h handler, a wealth of information is available to it describing what happened to cause the crisis. In addition, the stack contains the return address of the error routine, the register values at the time interrupt 21h was called, and the return address of the 21h code itself. IOERR simply sets an external flag called ERROR_FLAG to 1 indicating an error has occurred, sets AL to 0 telling DOS to ignore the error, and passes control back to the operating system with an IRET. Control winds its way back to the instruction within XDIR (in the GET_DIR routine) that follows the interrupt 21h call that went bad. GET_DIR sees that ERROR_FLAG is set and exits back to the main body of XDIR with CX set to 0, indicating that no files were found, and XDIR prints the "No files found" message.

Versions of DOS 3.0 and later provide a cleaner way to do the same thing. If AL is set to 3 when the user error handler ends with an IRET, DOS fails the system call currently in progress. The traditional options, and the only ones available through DOS 2.10, are to abort the program, retry the operation, or ignore the critical error altogether. If DOS 3.x were a unanimous standard, XDIR's error handler could simply exit with AL set to 3 and not have to set an external flag. But it's not. Something of a double standard exists between 3.x and 2.x, so the programmer has to a write code that will work on either.

Modifying the program

No program is perfect for everyone. That simple axiom probably applies doubly where a resident utility is concerned, since it must walk a tightrope to avoid interfering with other programs like itself. The good news is that small modifications are easy to make when they're backed with the proper documentation. Armed with DEBUG, you can tailor XDIR for your own needs.

XDIR is brought to life by a press of Alt-period. If that conflicts with a piece of software you want to use, here's what to do: change the byte at offset

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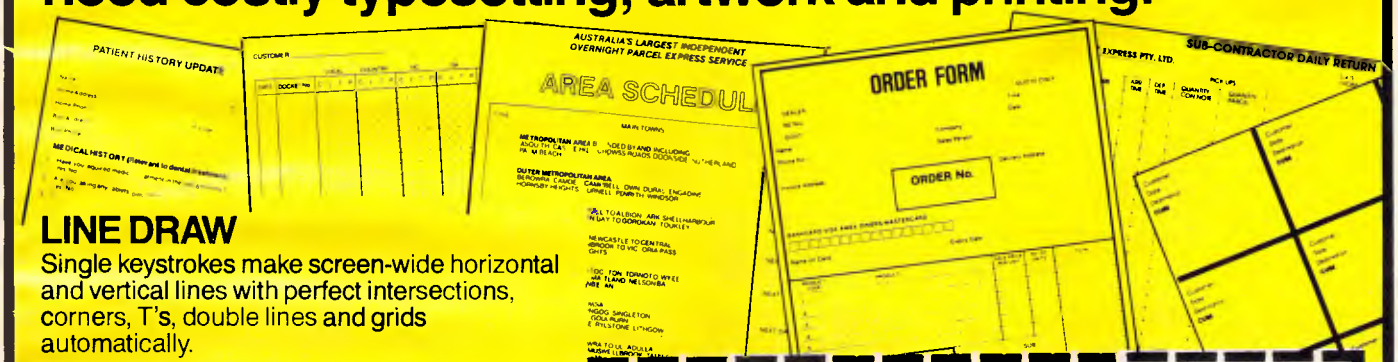

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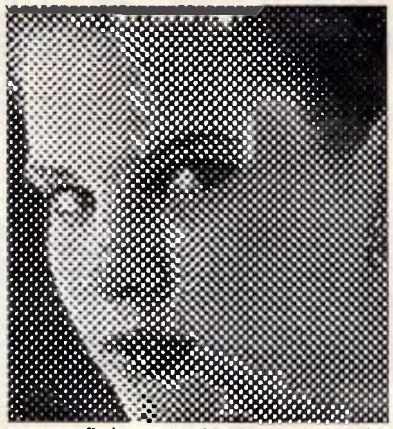

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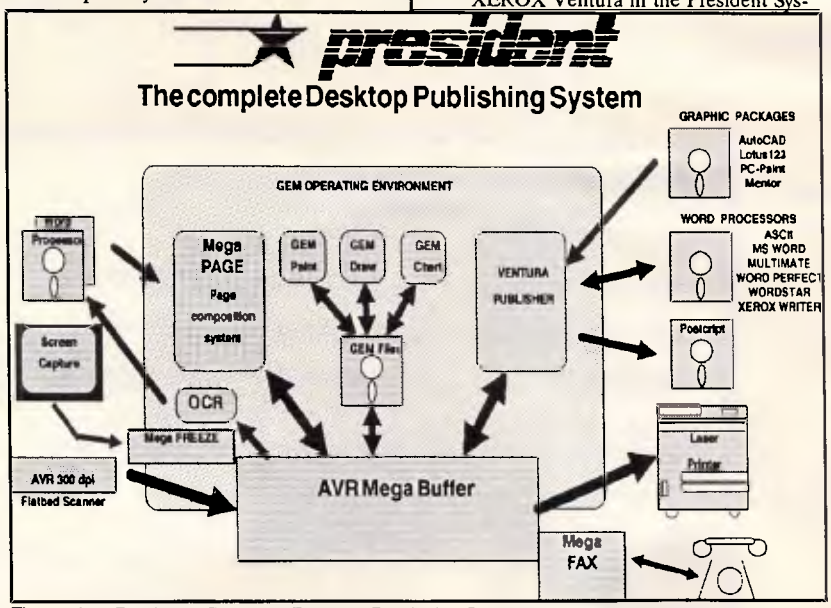

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TJ'S WORKSHOP

There has been a steady stream of letters bemoaning the fact that APC ceased its column 'TJ's Workshop'. So, being a magazine to unfailingly acquiesce to its readers desires . . . here it is: TJ's, back again. Send in your thoughts and most importantly, suggestions, on the newTJ's. And if you have a hint or tip for your micro, send that in too. APC will pay between $100 and $200 for each tip published. Write to is TJ's Workshop, 2nd Floor, 215 Clarence Street, Sydney 2000.

Ultimate ERRORLEVEL routine

The YESNO script in Fig 1 improves the standard ERRORLEVEL batch file branching program on IBM PC-compatibles in five ways:

It accepts both uppercase and lowercase responses and then makes the appropriate conversions. If a user enters a key other than Y,y,N, or n, the program beeps and the cursor remains where it is. If the user presses Ctrl-Break or Ctrl-C, the program exits normally without changing the current ERRORLEVEL setting. The program prints a prompt on-screen, so the batch file doesn't have to. In addition, it makes it extremely simple for programmers to change the on-screen prompt.

Incidentally, DEBUG script files should really end with a .DEB extension rather than .SCR, since .SCR is widely used by graphics programs to designate screen files and screen dumps.

Adam Baruch

```
n yesno.com
a
mov dx,132    ;move offset of string to DX
mov ah,9      ;output character string
int 21        ;do it
mov ah,8      ;character output without echo
int 21        ;do it
and al,df     ;tu+rn response to upper case
push ax       ;put AX onto stack
cmp al,4e     ;compare response to "N"
jz 11f        ;if N jump to N errorlevel setter
cmp al,59     ;compare response to "Y"
jz 123        ;if Y jump to Y errorlevel setter
mov dl,7      ;otherwise set up beep with CHR$(7)
mov ah,2      ;character output
int 21        ;do it
pop ax        ;remove AX from stack
jmp 107       ;and go back to beginning
mov bl,0      ;set errorlevel to 0 = N
jmp 125       ;and jump around Y
mov bl,1      ;set errorlevel to 1 = Y
pop ax        ;remove AX from stack
mov dl,al     ;get ready to display response
mov ah,6      ;direct console I/O (display)
int 21        ;do it
mov al,bl     ;move errorlevel to AL
mov ah,4c     ;terminate with return code
int 21        ;do it
db "Enter Yes or No: $"

rcx
44
w
q
```

Fig 1: YESNO script to create YESNO.COM. Type this in using a pure-ASCII word processor or the DOS COPY CON command. Be sure to leave a blank line before rcx and hit the Enter key at the end of each line, especially the last one. Then put it and a copy of DEBUG.COM (Version 2.0 or later) on your disk and type DEBUG<YESNO. AY (or y) returns an ERRORLEVEL of 1, and N (or n) an ERRORLEVEL of O

If you want to change the message from 'Enter Yes or No:', make the change in the last line (starting with the db). Then adjust the hex number 44 at the end of the script between rcx and w accordingly. If you make the message bigger, increase the 44; if you make it smaller, decrease the 44. Remember it's a hex number, not a decimal one, so that if your new prompt is five characters shorter, the new hex number is 3f, not 39. And remember to put a final $ at the end of your new prompt. A sample batch file to exploit this program would be:

```
echo off
yesno
if errorlevel == 1 goto yes
echo -- you said no
goto end
:yes
echo -- you said yes
:end
```

Changing the extension on scripts to .DEB does make some sense, except that these script files aren't really meant to last longer than it takes to create a .COM file with no typos. You don't need any extension unless you plan to archive them.

DOS Turbo

I often find it annoying that you can't run MS-DOS programs — especially DELETE, COPY, and APPEND — from the Turbo Pascal editor. I have written the short programs shown in Figs 2, 3, and 4 to duplicate these utilities, which I keep on my Turbo disk.

To use one of these programs, you read it into the top of your current program file with Ctrl-KR (^KR). You can then run it without having to comment out your file because the compiler ignores everything after an 'END'. And since the small program arrives already marked as a block, you can quickly delete it with Ctrl-KY (^KY). This is much faster than saving your file, exiting to MS-DOS, performing the MS-DOS function, re-entering Turbo, and reloading your program.

David Johns

The program to DELETE a file (Fig 2) will work on any file, but those

programs to COPY or APPEND one file to another (Figs 3 and 4) work only on text files. I've constructed my own program to copy any file, whether it is text or not, which is shown as Fig 5.

Turbo 3.01A has a minor bug in its append procedure. If you try to append to a totally empty file, your program will crash. The procedure OpenForAppend is a workaround to protect you from this sort of crash.

The file copy program that is listed in Fig 5 demonstrates two Turbo features for untyped files that are not in the manual, though they are described in the READ.ME file. First, Reset and Rewrite can take an optional second parameter that defines the block size for BlockRead and BlockWrite. Second, BlockRead and BlockWrite can take an optional fourth parameter that returns the actual number of blocks read or written. Setting the block size down to 1 byte, as this program does, will not slow down the execution as long as you read many blocks each time. In this case, the program is set to ask for 16,384 bytes with each BlockRead, but will BlockWrite only the actual number of bytes read.

ST

Mac column sort

Macintosh users will be aware that the spreadsheet in Microsoft Works can sort rows, but there is no direct way to sort columns. A column sort can be performed by first selecting and copying the range of columns you want to sort. Then paste this selection into a new spreadsheet using PASTE WITH OPTIONS instead of the standard PASTE. Choose BOTH FORMULAS AND VALUES and TRANSPOSE and click OK. Then reselect the range (that is now in a row) and use the SORT command from the Edit menu. Once the sort is completed, cut the data and then paste it back into the original range, once more, using the PASTE WITH OPTIONS command with BOTH FORMULAS AND VALUES and TRANSPOSE options selected.

C Caldwell

Incorporating Excel

While working with a spreadsheet in Excel, hold down the Shift key before dragging down the Edit menu, and 'COPY PICTURE' will appear as a menu option. Choose 'COPY PICTURE' to copy a PICT representation of your data to the Clipboard. When you enter MacDraw or other object-oriented drawing program, and paste the PICT data taken from Excel, you will have full editing control over every portion of the picture. Each item, text and lines, can be individually edited.

```
PROGRAM Delete;
VAR
  FileVar : FILE;
  Name    : STRING[255];
BEGIN
  Write('Delete file: '); ReadLn(name);
  Assign(FileVar, Name);
  Erase(FileVar);
END.
```

Fig 2 A program to delete any file without leaving the Turbo editor

```
PROGRAM Copy;
VAR
  Source, Dest : Text;
  Name, Line   : STRING[255];
BEGIN
  Write('Copy from TEXT file: '); ReadLn(Name);
  Assign(Source, Name);
  Write('                  To: '); ReadLn(Name);
  Assign(Dest, Name);
  Reset(Source); Rewrite(Dest);
  WHILE NOT EoF(Source) DO
    BEGIN
      ReadLn(Source, Line);
      WriteLn(Dest, Line);
    END;
  Close(Source); Close(Dest);
END.
```

Fig 3 A program to copy a text file without leaving the Turbo editor

```
PROGRAM Append;
TYPE
  string255 = STRING[255];
VAR
  Source, Dest : Text;
  Name, Line   : string255;

  PROCEDURE OpenForAppend(VAR F : Text; Fname : string255);
  BEGIN
    Assign(F, Fname);
    {$I-} Reset(F); {$I+}
    IF IOResult <> 0 THEN Rewrite(F)
    ELSE
      IF EoF(F) THEN
        BEGIN Close(F); Rewrite(F) END
      ELSE
        BEGIN Close(F); Append(F) END;
  END;

BEGIN
  Write('Append from TEXT file: '); ReadLn(Name);
  Assign(Source, Name);
  Write('                    To: '); ReadLn(Name);
  Assign(Dest, Name);
  Reset(Source);
  OpenForAppend(Dest, Name);
  WHILE NOT EoF(Source) DO
    BEGIN
      ReadLn(Source, Line);
      WriteLn(Dest, Line);
    END;
  Close(Source); Close(Dest);
END.
```

(Figure 3 ends)

Fig 4 A program to append a text file without leaving the Turbo editor

XON/XOFF printer driver

By using the XON/XOFF software handshaking method shown in Listing 1, IBM PCs and compatibles can support peripherals that have serial interfaces. While PCs support parallel printers with ease, there are times when driving serial peripherals would be desirable. Many popular printers, such as the Hewlett-Packard Laser Jet, use serial (or RS-232) interfaces. Be-

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```
PROGRAM CopyAnyFile;
VAR
  Source, Dest : FILE;
  Name         : STRING[64];
  Buffer       : ARRAY[1..16384] OF Byte;
  RecsRead     : Integer;
BEGIN
  Write('COPY from : '); ReadLn(Name);
  Assign(Source, Name);
  Write('       To : '); ReadLn(Name);
  Assign(Dest, Name);
  (* Note 2nd parameter in Reset and Rewrite of UNtyped files *)
  Reset(Source, 1);  Rewrite(Dest, 1);
  WHILE NOT EoF(Source) DO
    BEGIN
      (* Note 4th parameter in BlockRead *)
      BlockRead(Source, Buffer, 16384, RecsRead);
      BlockWrite(Dest, Buffer, RecsRead);
    END;
  Close(Source); Close(Dest);
END.
```

Fig 5 This program will copy any file without leaving the Turbo editor

cause most printers can print characters at only a fraction of the rate that a PC can send them, a printer must exchange some handshaking, or control signals, to control the rate at which characters are sent by the PC. This control can be done through either hardware of software.

The hardware method involves connecting a special wire between the printer and the PC. When the printer is ready to accept data, it asserts a logic 1 on this wire. When the printer is unable to accept data, it asserts a logic 0. The PC must then check the status of this signal before sending data. This simple method of flow control has several drawbacks. First, it requires an additional wire in the interface cable. Second, the printer cannot return any additional status data (paper out, device off-line, and so on) unless additional wires are connected between the PC and the printer.

The software method involves having the printer send special flow control characters to the PC to notify it of status conditions. When the printer is able to accept data it will send a special character, called an XON character — CHR(17). When the printer is unable to accept data, an EOFF character — CHR(19) — is sent by the printer to the PC. Other characters may be sent to notify the PC of special conditions.

The PC may be configured with either serial or parallel ports; however, the PC's software drivers support only the hardware method of handshaking. The program below provides a software driver that allows the PC to use a serial printer that uses XON/XOFF software handshaking.

The program 'steals' the special BIOS printer interrupt vector reserved for printer functions. This vector is located in low memory at address 0000:005CH and is normally set to point to the printer driver code located in the system ROM. The program redirects this vector to point to its own code for driving the serial port using XON/XOFF handshaking. Once the XON program is loaded, it directs all printer output to the serial port. A serial printer then can be used as if it is a standard parallel interface printer.

D Gienger

SideKick alert

If you haven't yet heard (although it's been widely documented), there's an easily repaired divide overflow bug when you run the SideKick calculator on an IBM PC/AT or other 80286 machine; dividing 93500 by 31167 should give you a result of 3, but may actually show up as 2.4.

If you experience this, use DEBUG to patch your SK.COM. Make sure DEBUG.COM and a copy — not your

```
; Use DOS MODE to redirect LPT1: to COM1: and set up the BAUD rate etc
rom_ptr_vec     equ     17h*4           ; rom vector location
com             equ     03f8h           ; com1=3f8, com2=2f8
code            segment public      'CODE'
                assume  cs:code,ds:code
                org     0100h
start           proc    far             ; patch in the new code
                cli                     ; disable interrupts
                sub     ax,ax           ; set es segment
                mov     es,ax           ; copy vector
                mov     ax,c#           ; reset ptr vector
                mov     es:word ptr[rom_ptr_vec+2],ax
                mov     ax,offset ptr_int
                mov     es:word ptr[rom_ptr_vec],ax
                sti                     ; reenable interrupts
                mov     dx,offset last_byte  ; call dos to exit
                int     27h             ; and stay resident
                db      '(c) 1986, Dean P Gienger'
start           endp
ptrint          proc    far             ; we get here from int 17h
ptr_int:        sti                     ; enable interrupts
                cmp     ah,0            ; is this an output req?
                je      ptr_out         ; yes
                cmp     ah,1            ; is it an init req?
                je      ptr_init        ; yes
ptr_stat:       push    dx              ; it must be a status req
                mov     dx,com+5        ; get status
                in      al,dx
                and     al,20h
                je      ptr_busy        ; port is busy
                mov     dx,com
                in      al,dx           ; is there an xoff ?
                and     al,7fh
                cmp     al,19           ; xoff is ^S ( 19 )
                je      ptr_busy        ; yes, it is busy
                mov     ah,80h          ; else return not busy
                pop     dx
                iret
ptr_busy:       mov     ah,00h          ; return busy status
                pop     dx
                iret
ptr_out:        push    ax              ; print character & save
ptr_wait:       mov     ah,2            ; wait till printer free
                int     17h             ; ready?
                and     ah,80h
                jz      ptr_wait        ; no
                pop     ax              ; yes, get char from stk
                push    dx
                mov     dx,com          ; send character
                out     dx,al
                pop     dx
                mov     ah,2            ; return status
                int     17h
                iret
ptr_init:       mov     ax,27           ; initialize the printer
                int     17h             ; send ESC E
                mov     ax,45h          ; to init printer
                int     17h
                mov     ah,2            ; return status
                int     17h
                iret
last_byte:
ptrint          endp
code            ends
```

Listing 1: XON.ASM

president

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original — of SK.COM are in the same directory or are properly PATHed to, and type:

DEBUG SK.COM

Then, when you see the DEBUG "-" hyphen prompt, type:

S 100 L9A00 2 FE C8

DEBUG should respond with two four-digit hex numbers separated by a colon, something like 2F8A:70B8. Ignore the leftmost four, but enter the rightmost four in the place of the xxxx below:

E xxxx 2 B0 63

(You'd type E 7OB8 2 BO 63, for example, if DEBUG reported 2F8A:7OB8.)

Finally, type W and then hit Enter to write the patch, and then type Q and hit Enter to quit DEBUG. You'll have to reboot your system to load the patched copy.

PS

Apple IIc boot

I own an Apple IIc with an external Disk IIc, a UniDisk 3.5, and a 512k RAM card. Since the new IIc ROM does not let you use the PR#7 command to boot a disk from the external 5¼-inch disk drive, I had problems with my internal disk drive and decided to try to boot AppleWorks from my external disk drive.

On comparing the listing of the old IIc ROM and the new ROM, I noticed that the only thing keeping me from booting from the external disk drive was the code from $C700 to $C709. By changing the code at $C707 to 4C 0B C6 (which is the code listed at DODRV2), you can boot AppleWorks from the external disk drive.

From Basic type CALL—151, and you will see an asterisk indicating that you are in the monitor. Enter the following modified $C700 routine at location $300 and then type 300G to run the program, which will boot the external disk drive:

```
] CALL —151
* 300 : FF
* 301 : A9 E0
* 303 : A0 01
* 305 : A2 60
* 307 : 4C 0B C6
* 300G
```

I have booted several other ProDOS disks in this manner and all seem to work fine so far. Of course, this method still does not allow a DOS 3.3 disk to boot from the external disk drive.

J Yoder

MiniFinder

On Mac disks that have the MiniFinder installed, you can hold down the Option key while quitting an application (or upon booting a disk) to bypass the MiniFinder and go directly to the Finder.

S Armitage

Software sampler

MacPaint and MacDraw are present on the Software Sampler disk that comes with each new Macintosh, however the Print and Save options have been disabled on these programs. If you are unable to part with your graphic creation, you can cut your artwork, open the Scrapbook DA and paste the graphic into the Scrapbook. Later, you can either purchase the particular program and move the graphic back into the program, or if you are using a word processor, you can move the Scrapbook file onto the word processing disk and then paste the graphic into a document.

B Dugan

Missing Turbo functions

One irksome omission in Turbo Pascal for the IBM PC is the lack of the standard Pascal routines get(f) and f^ (file pointer). Many Pascal programs use these routines, and converting such programs to Turbo can be quite difficult. The listing in Fig 6 is my solution to this problem.

File_ptr is a function of type char. It calls EOF, which forces a read of one character from the file into the character buffer, to see if the next character is a ^Z. The Turbo file pointer does not move, but the character buffer now holds the next character, just like a standard Pascal file pointer. File_ptr simply returns the contents of this buffer.

The type text_info matches the first four bytes of a Turbo text file variable. The fourth byte is the character buffer. Defining a variable of type text_info at the same absolute location as the text variable f makes it very easy to ensure you always get the right byte.

B Fortune

```
PROGRAM File_Pointer;
VAR
  T : text;
  Name : string[64];

  FUNCTION File_Ptr(VAR F : text):char;
  TYPE
    text_info = RECORD
                  handle : integer;
                  flags  : byte;
                  char_buffer : char;
                END;
  VAR
    pseudo : text_info absolute F;
  BEGIN
    IF EoF(F) THEN BEGIN WriteLN(#7,'Reading past EOF!'); Halt; END;
    File_Ptr := pseudo.char_buffer;
  END;

  PROCEDURE get(VAR F : text);
  VAR CH : char;
  BEGIN
    IF Eoln(F) THEN readLn(F) ELSE read(F,CH);
  END;

BEGIN
  Write('Enter the file name: '); ReadLn(Name);
  assign(T, Name); reset(T);
  WHILE NOT EoF(T) DO
    BEGIN
      IF Eoln(T) THEN writeLn
        ELSE Write(File_Ptr(T));  (* "write t^;" in standard Pascal *)
      Get(T);
    END;
END.
```

Fig 6 An implementation of 'get' and file pointer for Turbo Pascal

The two routines shown in Fig 6 will be a boon to anyone who must convert to Turbo Pascal from standard Pascal. Turbo Pascal packs a lot of information into the File Interface Block.

I've added a small program of my own (shown in Fig 7) that demonstrates some of the other goodies that can be found in the File Interface Block.

The file handle is there, as is the complete path name under which the file was opened. And a 'flags' byte tells whether the file in question is a true disk file or is instead an MS-DOS device. The flags byte also tells you if

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```
PROGRAM file_info; (* FILEINFO.PAS *)
TYPE
  Flag_Set = SET OF (b0, b1, b2, b3, b4, Char_Waiting, Out_Okay, In_Okay);
  fancy_FIB = RECORD
                handle : Integer;
                F : RECORD
                      CASE Boolean OF
                        True  : (ftype : Byte);
                        False : (flags : flag_set);
                      END;
                chBuff : Char;
                B_Offs : Integer;
                B_Size : Integer;
                B_Ptr  : Integer;
                B_End  : Integer;
                path   : ARRAY[0..63] OF Char;
              END;
VAR
  TF1 : Text;
  TF2 : Text[321];      {<-- specifies a file buffer of 321 bytes }
  TF3 : Text;

  PROCEDURE File_Report(VAR F);
  VAR
    FIB : Fancy_FIB ABSOLUTE F;
    N : Byte;
  BEGIN
    WITH FIB DO
      BEGIN
        CASE (F.ftype AND $F) OF
          0 : BEGIN
                Write('Disk file: ');
                IF (Out_Okay IN F.Flags) OR (In_Okay IN F.Flags) THEN
                  BEGIN
                    Write('Handle is ', handle);
                    Write('  BUFFER starts at ', B_Offs);
                    Write(', size is ', B_size);
                    WriteLn(', pointer is at ', B_Ptr);
                    IF Char_Waiting IN F.Flags THEN
                      Write('CHAR waiting is "',chBuff,'"')
                    ELSE Write('    NO char waiting');
                  END
                ELSE

                   Write('The file is not yet open.');
              END;
            1 : Write('      CON: device');
            2 : Write('      KBD: device');
            3 : Write('      LST: device');
            4 : Write('      AUX: device');
            5 : Write('      USR: device');
          END;
          IF Out_Okay IN F.flags THEN Write('    Open for output.');
          IF IN_Okay IN F.flags THEN Write('    Open for input.');
          WriteLn; WriteLn;
          END;
      END;

    BEGIN
      ClrScr;
      Assign(TF1, 'FILEINFO.PAS');
      WriteLn('==================== REPORT on an un-opened file');
      File_Report(TF1);

      Reset(TF1);
      WriteLn('==================== REPORT on an opened file');
      File_Report(TF1);

      Assign(TF2, 'FILEINFO.PAS');
      Reset(TF2); IF EoF(TF2) THEN ;
      WriteLn('==================== REPORT after a dummy call to "EoF"');
      File_Report(TF2);

      Assign(TF3, 'SomeDumb.fil');
      Rewrite(TF3);
      WriteLn('==================== REPORT on a newly created file');
      File_Report(TF3);

      WriteLn('==================== REPORTS on I/O devices');
      File_Report(Lst);
      File_Report(Kbd);
      File_Report(Output);
    END.
```

Fig 7 More information from the File Information Block of a Turbo text file

the file is open for input, output, or both.

NR

Sound sampler

The program shown below allows you to alter the pitch of an audio signal by playing it back through the Ensoniq chip on an Apple IIGS. By changing the pitch, you can disguise your voice!

The program controlling the Ensoniq chip is written in machine code and is contained in DATA statements within the Basic program listing. The Basic program POKEs in the machine code and executes the machine code with the appropriate parameters set. The call in line 50 sets the number of oscillators, which oscillator, the frequency, and the volume. The call in line 60 makes the machine code program start continuously sampling sound until you press the space bar; then the program continues to line 70 and makes the oscillators quiet. The sound samples are stored directly into the Ensoniq waveform RAM in a one-page (256 byte) waveform table. The Ensoniq DOC plays back the data at its own constant frequency while the machine code program is storing new waveform data into the same buffer. We simply request the Ensoniq chip to play back the waveform data at a different frequency.

Program Description

Line 10: Sets the slot number of your digitizer (if you are not using a digitizer, do not change line 10)

Line 20: POKEs in the machine code

Line 30: Verifies that the machine-code DATA statements were typed in correctly

Line 40: Initializes the parameters that are passed to the machine code

Line 50: Calls the machine code to start the oscillators

Line 60: Calls the machine code to begin continuously sampling sound

Line 70: Calls the machine code to make the oscillators quiet

Line 80: Allows you to enter a new frequency value (larger numbers correspond to higher frequencies)

```
5    REM //GS Ensoniq sound sampler by
     Roland Gustafsson
10   SS = 2: POKE 0,SS * 16
20   SO = 768: FOR A = SO TO SO + 190:
     READ B: POKE A,B:
     C = C + B: NEXT
30   READ A: IF A <  > C THEN  PRINT
     "Error in DATA statements!": END
40   NO = 31:OS = 0:FQ = 451:VL = 240:SR
     = 2
50   CALL SO,NO,OS,FQ,VL
60   CALL SO + 3,SR
70   FOR A = 0 TO 31: CALL SO,31,A,0,0:
     NEXT
80   PRINT : PRINT "Current frequency = "
     FQ
90   INPUT "New frequency ? (1-9999) ";FQ
100  GOTO 50
1000 DATA 76,6,3,76,118,3,175,202,0,225
1010 DATA 9,64,141,60,192,160,0,140,63
1020 DATA 192,140,62,192,169,128,141,61
1030 DATA 192,200,208,245,175,202,0,225
1040 DATA 141,60,192,32,76,231,169,225
1050 DATA 141,62,192,138,10,141,61,192
1060 DATA 32,76,231,134,58,32,190,222
1070 DATA 32,103,221,32,82,231,72,169
1080 DATA 169,0,32,109,3,250,169,32,32
1090 DATA 109,3,32,76,231,169,64,32,109
1100 DATA 3,169,128,162,0,32,109,3,169
1110 DATA 160,32,109,3,169,192,32,109,3
1120 DATA 32,183,0,208,154,96,5,58,141
1130 DATA 62,192,142,61,192,96,165,[illegible]
1140 DATA 128,141,154,3,32,76,231,142
1150 DATA 146,3,160,0,175,202,0,225,141
1160 DATA 60,192,169,226,141,62,192,162
1170 DATA 2,202,208,253,173,61,192,141
1180 DATA 160,192,208,2,9,1,170,175,202
1190 DATA 0,225,3,64,141,60,192,169,0
1200 DATA 141,61,192,140,62,192,142,61
1210 DATA 192,200,44,0,192,16,201,44,16
1220 DATA [illegible]
```

Basic listing for 'Sound sampler'

Line 100: Loops back to try new frequency
Line 1000-1220: Machine-language program in DATA statements
Description of Variables (Range)
NO = number of oscillators to activate, minus 1 (0-31)
OS = which oscillator to use (0-31)
FQ = value used for Ensoniq frequency register (0-65535)
VL = volume (0-255)
SR = sample rate (2-255)

Try this: Make your voice play back in three-part harmony. Duplicate line 50, creating lines 51 and 52, but change the oscillator, frequency, and volume variables.

R Gustafsson.

END

Getting it in

There are several ways in which you can input sound into your system: either buy a sound digitizer; or build your own for about $27. To build your own you'll need a Tandy intercom (part number 43-221) and an 8 way connector socket from Jaycar Electronics (in Sydney, Melbourne or Brisbane), Cat. number HM3220. Strip the ends off the intercom's communications twin pair wire, then use the connector to attach the stripped ends to pins one and two of the sound expansion connector on the lower right hand side of the Apple IIGS motherboard

WARNING: The IIGS's polarity can be reversed if the wires to pins 1 and 2 are incorrect. To restore correct polarity to the IIGS, remove the memory card, reboot the system, turn the computer off, and replace the memory card.

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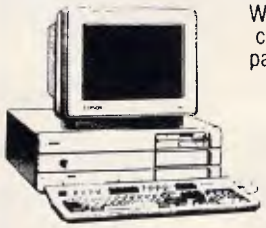

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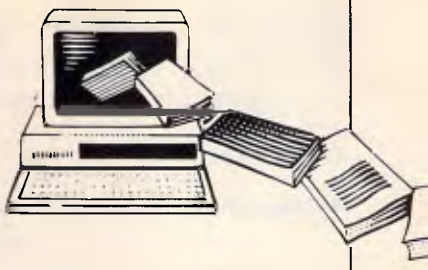
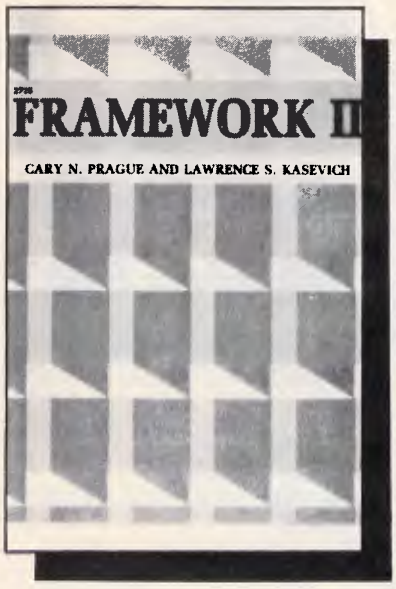
Under the spotlight this month come guides to Framework II, Lotus 1-2-3, business graphics and on a lighter note — Flight Simulator.





Framework II
Authors: Cary N Prague and Lawrence S Kasevich
Publisher: Tab Books Inc (Nelson)
Price: $42.90

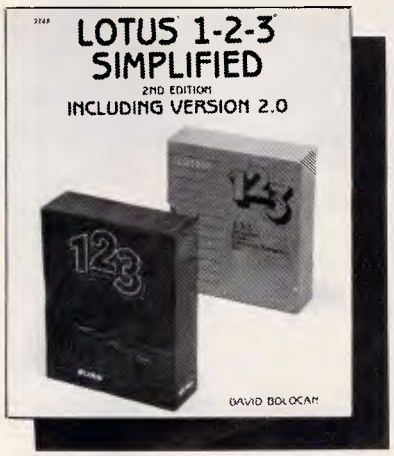
'Its power of combining functions puts it ahead of every other software package that claims to be integrated'.
That's pretty hot stuff for page one! Capture your reader's attention immediately — you know the sort of thing. The authors certainly hit a powerful punch with 'The Framework II Philisophy'. Not only will Framework II cope with word processing, database management, spreadsheets, graphics and communications, but it also has its own programming language, FRED, and a concept called 'outlining': that is, files become 'frames'; frames that hold other frames become 'containing frames'; and containing frames become 'outlines'. The latter two functions are certainly the icing on the cake, and just like any other deserving treat they are kept to the end (of the book in this case). It's as if the authors have whetted your appetite in Chapers 1 & 2, realised that they've gone too far too soon *'using Framework II for thought processing'* and decided to come back down to earth to discuss word processing, spreadsheets and databases.

Word processing definitely comes off the best of the three. In Chapter 3 it is described as *'probably the heart of the program'*. In comparison, spreadsheet and database management (Chapters 4 & 5) get a raw deal. Although described in adequate detail, these chapters didn't have the continuity and flow of the other sections.

However, all is improved for Chapter 6, 'Graphics'. I agree wholeheartedly with the authors' statement: *'Charts of all types can help you express your thoughts more clearly. They can lend meaning in an otherwise meaningless stream of numbers and words.'* The clear diagrams and graphs used throughout *Framework II* can only bear witness to this — all the images were captured from within Framework II, an excellent recommendation for the package.

Chapter 7 on 'Outlining' was absorbing and thought-provoking, but I was more than a little disappointed with FRED in Chapter 8. I would like to have seen more examples of its use, ranging from the simple to the complex, as it is undoubtedly a powerful language. The remaining chapters deal with communication programs creating a customised environment for Framework II and Advanced Framework II.

Framework II is a meaty, well-written book which covers a lot of ground. If the Framework II software is as good as this book claims, then it must be a hard package to beat.
Lorna Kyle



Lotus 1-2-3 Simplified (Including Version 2.0)
Author: David Bolocan
Publisher: Tab Books Inc (Nelson)
Price: $28.90

Anything 'simplified' incurs the great danger of either being written for a complete idiot or coming across as incredibly condescending. Add to that the extra dimension of trying to combine into one a reference/tutorial/readable text book and you are just asking for the impossible: I've struggled through many a 'user-friendly' instruction manual only to find myself more frustrated and perplexed at the end than I was at the beginning. So David Bolocan's *Lotus 1-2-3 Simplified* came as a welcome surprise. Gone is all the mysterious jargon and clinical presentation often associated with software manuals. His style is very chatty and informal, interspersed with snatches of humour; for example, a warning on the use of the DOS ERASE command; *'If you delete any important company files, you will have to change your name and move to a monastery in Tibet.'*

The twenty-two chapters are individually well-structured and comprehensive. For the novice 1-2-3 user Chapters 1-9 disclose what Lotus 1-2-3 can do for you and cover the basic concepts of a spreadsheet, a disk operating system, certain essential commands and how to print and manipulate worksheets. The more experienced user, however, could plunge straight into Chapter 14, 'Programming with Macros', or wrap themselves in the delights of Boolean algebra (TRUE or FALSE I hear you cry) in Chapter 13.

The book is action-packed with diagrams and illustrations; in fact there are so many diagrams in Chapter 10, 'Creating Graphs with 1-2-3', that the text lags three or four pages behind the figure references. A minor inconvenience.

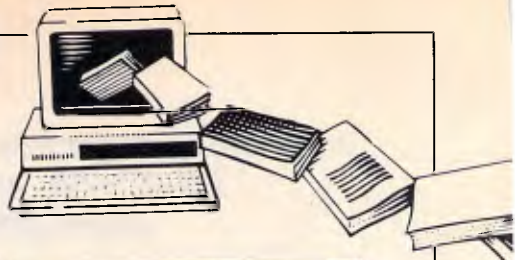
David Bolocan presents an honest, warts-and-all, view of Lotus 1-2-3. If you've been feeling guilty about not using your 1-2-3 to its full potential simply because you haven't had the time to read its accompanying manual,

then dip into this book and try again. Regardless of what version of 1-2-3 you may have, *'Lotus 1-2-3 Simplified'* is a helpful and valuable aid to any Lotus user.
Lorna Kyle

Business Graphics on the IBM PC
Author: Corey Sandler
Publisher: Addison-Wesley Publishing Company
Price: $32.95

This book begins with a brief, non-specialist introduction to the statistics and mathematics of graph creation. This is very well written and a useful guide to the appropriate time to use some of the more esoteric graphs: for example, this is the first book to clearly explain when you should use a logarithmic scale on an axis. It then describes the hardware required to create business graphics, starting with the choice of machine but concentrating on the vast range of output devices available. Printers, laser printers, Polaroid cameras, plotters and video displays are all described in detail before the author moves on to consider actual products available.The largest portion of the book is dedicated to a discussion of currently available software. Although Corey Sandler does concentrate on his particular favourites, he does consider most of the popular packages (including GEM) and admits his own bias towards the more statistically capable packages.

On the whole *Business Graphics on the IBM PC* is an excellent read, although the rapidly moving nature of the software market means that the product reviews will soon be out of date. This book, used in conjunction with the latest magazine reviews, would act as a good starting point for anyone wanting to use their machine for the creation of business graphics.
Graham Wood



Flight Simulator Co-Pilot
Author: Charles Gulick
Publisher: Microsoft Press (Penguin)
Price: $16.95

Charles Gulick is an expert flying instructor for the Microsoft and Sub-Logic flight simulators. He has been flying both of them regularly ever since they were available and his enthusiasm for them is infectious. Even the easiest, most mundane flights become adventures inside and outside the aircraft.

This book is designed to be as much as possible like having a real instructor or co-pilot by your side. You should read it while you fly.

Flight Simulator Co-Pilot is divided into three sections.

The first section is basic flying training, learning to fly steady, climb, bank, descend and land. The second section takes you on trips around the interesting locations in Flight Simulator and teaches instrument-controlled flying at the same time. The final section gives some of the most interesting trips to be found in the Flight Simulator world and shows you a few interesting manoeuvres. All the locations are described as they are in real life and Charles Gulick gives details of local history and points of interest.

Before I read this book, I had always found Flight Simulator boring: too slow, too hard to control accurately and no fun. Charles Gulick has taken away all the drudgery. He teaches you to fly quickly and painlessly and then proceeds to make it all fun.
Helen Brew

END

Clearing the line

This month Steve Withers and Peter Tootill tackle the subject of error-free data transmission.

Transferring information of some sort between computers is a very popular pastime these days — or should I say it is very common. It can be very unpopular with those who have to move significant amounts regularly, who are often faced with a choice between slow data rates (for example, V21 300 bits/sec) and reasonable freedom from re-transmissions due to errors, or higher speeds, but a much higher incidence of errors. Even at 300 bits/sec there is a good chance of noise on the phone line affecting the information being tansferred. So, if it is important to avoid errors, some sort of error detection and correcting system is required.

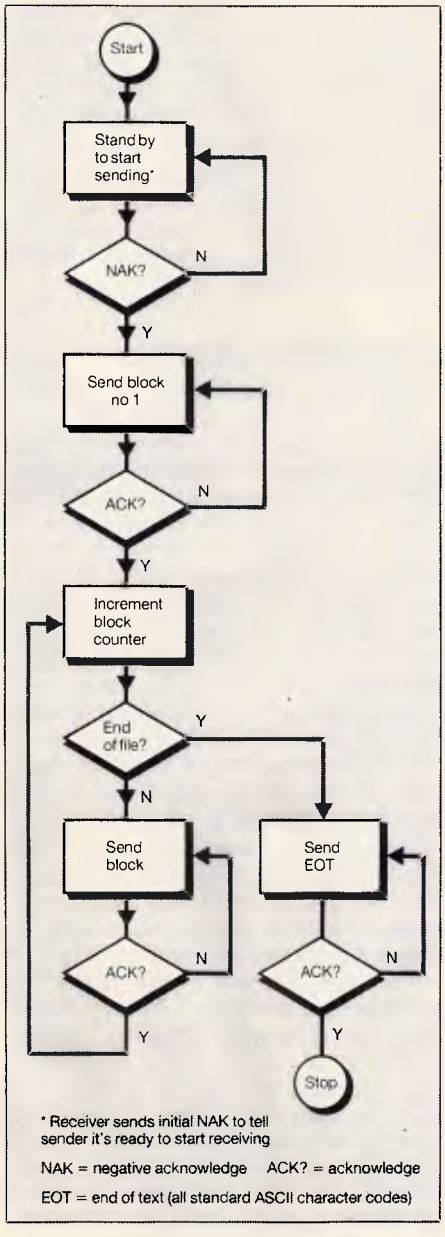
Error correction can be achieved in a number of ways, the most common of which is to send information in blocks and to check each block for errors after it has been sent. If an error has occurred during transmission, the block is repeatedly sent until a good copy is received. Of course, if too many errors occur, most systems will abort.

The way that the block is checked for errors varies. The most common methods treat the string of ASCII codes that represent the characters like numbers and perform an arithmetic calculation on them.

The simplest way is to calculate the checksum of the data by adding up the numbers. The total is then transmitted along with the data itself. When the receiving computer gets the data, it adds the numbers again and checks that the total agrees with the total sent with the data. If the numbers don't agree, an error has occurred.

Another more complex method uses something called a CRC (cyclic redundancy check). CRC is a more accurate test for data errors.

So far so good; we have covered the basic principles involved in achieving error-free file transfer — they are simple. The complications arise in how the data is sent (what size of block, for example), how the calculations are performed and what happens in various circumstances during the transfer: the software at both ends must obviously be in harmony if the process is to work.



How Xmodem works (flowchart)

The description of the above process is called a 'protocol' and the protocol standard for transferring, say, a file between two computers will have to cover such things as block size, calculation of check data, methods of acknowledging a correctly received block, what to do to request retransmission if an error is detected, whether the file name should be included in the transmission, and so on. The description of a protocol can be quite extensive — the one I have for Zmodem is nearly forty pages long!

You will probably come across the letters ARQ in connection with error-checking data transfer. ARQ stands for Automatic Repeat on reQuest and is usually associated with error-correcting modems, rather than file-transfer software.

The advantage of ARQ is that everything passing between the two systems is checked including, for example, logging on and entering a password, which means you should not notice the effects of line noise at all.

The main problem with ARQ modems is the lack of an internationally accepted standard protocol at present, with various manufacturers implementing different schemes. The CCITT — the international body controlling this area — is presently considering the topic, but the whole area has become much more important with the higher speed modems that are now in regular use, especially if long-distance phone calls are involved.

Using ARQ modems can be a bit dis-

concerting as the data tends to move in fits and starts as the blocks of data are sent and checked. On a bad line the process can be very intrusive — but it's still better than coping with the line noise were ARQ is not being used.

Which way the CCITT will go, I don't know. Hayes, which has set the standard in modem control languages, is pushing for a variant of the X25 protocols used in packet networks. This is on the basis that it is widely understood by manufacturers and software houses and could be adapted to dial-up modems relatively easily. I understand that the CCITT is not likely to decide before 1988 and even then it will take a while before products start to appear based on whatever standard it produces.

In the meantime, the MNP system seems to be the clear leader in the US. This technology has been available to Australian users for some time in the form of the 'Shuttle Error Free' from Shuttle Datacom Pty Ltd. This unit adds MNP functionality to non-ARQ modems, connecting between the modem and the terminal or computer. Complete ARQ modems are also available in this country.

Next month I'll discuss file-transfer protocols.

Telecom approvals

Last month I mentioned that Telecom has started to insist that BBS's cannot be operated without approval. When sysops seek such approval, they are required to agree to certain conditions. Some are reasonable (eg., "Equipment to be connected to the network is to be Telecom Authorised"), but one is outrageous: "The operator agrees to comply with any notice or direction given by Telecom from time to time in relation to this approval." This is so open-ended, I'm suprised Telecom expects anyone to agree to it.

One sysop sought legal advice, and was told to change that clause to make it clear that he will only be bound by such directions as Telecom is legally empowered to make.

Sysops must also agree to the classification of their systems as business services, a ruling that I discussed at length last month.

The joys of dealing with a monopoly.

Smilies

The following smilies have appeared in various places, most recently in the March 1987 DECUS Australian newsletter.

:-o	wow!	colon,minus,lowercase-o
:-c	real unhappy	colon,minus,lowercase-c
:-ll	grim	colon,minus,double-bar
:-C	totally unbelieving	colon,minus,uppercase-C
:-v	speaking	colon,minus,lowercase-v
:-V	shouting	colon,minus,uppercase-V
:-,	smirk	colon,minus,comma
:-w	speak with forked tongue	colon,minus,lowercase-w
:-r	sticking tongue out	colon,minus,lowercase-r
'-)	wink	open-quote,minus,closebracket
:-T	keeping a straight face	colon,minus,uppercase-T
;-)	sardonic incredulity	semicolon,minus,closebracket
:-D	said with a smile	colon,minus,uppercase-D
%-}	drunk with laughter	percent,minus,close brace
:-x	kiss,kiss	colon,minus,lowercase-x

If you haven't seen such things before, the idea is to use them to add inflection to an electronic mail message. When you speak to someone, there are all sorts of overtones that you pick up without really being aware of them. E-mail messages tend to be terse, and the reader can take a statement the wrong way. The use of an appropriate smilie can help avoid misunderstandings.

Information express

In the March issue, I suggested that Information Express's charges are considerably higher than Viatel's. Jim Farrer, the company's marketing manager points out that it is much cheaper to send a telex through Information Express than Viatel (70 cents compared with $2.03 at the lowest rates). A small proportion of the difference is due to the fact that Information Express allows uploading at 1200baud with a consequential saving in connect time, but the bulk comes from a far lower charge for the transmission of the telex itself.

The problem is in the $15/month minimum charge for connect time. If you send more than one telex per week, you could save money by subscribing to Information Express, and you could also be attracted by the full international telex service. Occasional users of telex are probably better off with Viatel.

Information Express caters mainly for business and professional users, while Viatel has a broader attraction. When you look at 'conventional' electronic mail, it's most important to pick a service that attracts the type of user that you want to communicate with — cost is a secondary (but still important) consideration. You might choose Telememo, Viatel, Information Express, or some other system, but your selection should not be on the cost alone.

Irangate

It has been reported that electronic mail played a part in the investigation into the 'Irangate' scandal. Although one of the officials involved is said to have shredded hard-copy versions of messages relating to the scandal, investigators were able to recover the text from the computer system.

Supercom

I recently received a flyer for a new comms program for IBM PCs and compatibles. Supercom is an Australian product, and claims to incorporate "the best of Crosstalk, Gateway, and Carbon Copy". It provides emulations of 40 terminals, videotex, and a 'remote control' mode that will work with Lotus 1-2-3 and other programs that write directly to the screen. Although I haven't seen the program itself, the specification is impressive and I believe the price is reasonable.

System news

I hear that many Fido sysops have switched to a new BBS program called Opus. Apparently it works just like Fido, but incorporates a number of features that users had called for — Tom Jennings was reluctant to make the changes, so a group of people stepped into the gap and wrote a whole new program. The group takes a firm line on the free distribution of its software: absolutely no charges can be made whatsoever. You can't even make it available for downloading from a system that's restricted to members of a club. A donation to AIDS research is solicited from Opus sysops — a very topical suggestion.

This month there are nine new systems, more than enough to make up

for those that have gone off-line. In the 'Updates' section, please take particular note of the corrected number for Computer Connection.

This month's information providers were Hamish Bowly, Richard Budge, Anthony Callahan, Peter Jetson, and Larry Lewis.

New systems

NSW

Amstrad (02) 981 2966. M. Riccey Schmahl. V21, V22, V23.
Sendata (02) 438 4060. P. Stephen Beeby. 24 hours daily. V21, V22, V22bis, V23. Voice: (02) 438 4255.
Dungeons and Modems (02) 636 9027. MV.
Playground (02) 53 9688. MV. Brett Selwood.
Zenith (02) 477 7509. Tony Callahan. 24 hours daily.

Vic

AmigaLink (03) 792 3918. Bohdan Ferens. 24 hours daily. V21, V22, V23. A FidoNet system.
Sendata (03) 568 0794. P. Richard Budge. 24 hours daily. V21, V22, V22bis, V23. Voice: (02) 568 6299.

WA

Streamline (09) 387 8097. Ismael Yahya. 6pm-1.30am, 3.30am-9am daily. V21,V22, V22bis, V23.
Apple Board (09) 378 3258. Mazi Maniei. V21, V22, V22bis, V23.

Updates

NSW

Blackboard Off-line.
Computer Connection (02) 57 2463. M. Hamish Bowly. 24 hours daily.
Metebeelus Off-line.
TABA-Prophet (02) 628 7030. MV. Larry Lewis. 24 hours daily. V21, V22, V22bis. Previously listed as Prophet.
Texpac Off-line.
Zeta (02) 627 4177. MV. Nick Andrew. 24 hours weekdays, 7pm-7am weekends. V21, V22, V22bis, V23, Bell 103 and 212.

ACT

Fatcat Off-line.
Gateway Off-line.

Vic

PC Domain (03) 789 8918. Daryl Clayton. 24 hours daily. V21, V22, V22bis, V23. FidoNet 630/309.

Qld

Mackay High (079) 514 815. P. 4pm-7.30am weekdays, 24 hours weekends.

SA

Multiple (08) 255 5116. MV. Danny Vosso. 9pm-9am daily. V21, V22, V22bis, V23.

END

Mike Mudge looks at W-Sequences, an introduction to an endless source of unsolved problems in number theory.

This problem area was first suggested to me by Philip Newton Webb, some eight years ago. At that time Philip had already spent seven years investigating a subset of the problems, and must be among the most experienced researchers into the properties of W-Sequences.

This topic provides a fascinating area for empirical number theory, a limitless supply of unsolved problems defined by an absolute minimum of mathematical symbolism, and I strongly recommend it as a natural entry point for new readers in this field.

The definition of a W-Sequence

Consider five positive integers a,b,c,d_1, and d_2 satisfying 2<=a<=b, c>=0, d_1,d_2 ≠ 0.

The sequence W(a,b,c,d_1,d_2) is defined by the following rules:

(i) The first term $W_1 = c$.

(ii) The even terms $W_{2n} = aW_n + d_1$.

(iii) The odd terms (other than the first defined at (i) above)

$W_{2n+1} = bW_n + d_2$.

(iv) The sequence calculated as above is then rearranged so that the terms are in increasing numerical order; thus, in general, the subscript n will no longer be in numerical order. Note: If $d_1=d_2=1$ we write W(a,b,c), and if further c=1 we abbreviate the notation to W(a,b).

Further, it should be observed that if $d_1=d_2$ then the value of a equal to b is excluded; we then have 2<=a<b. Without this restriction, it is easy to see that $W_{2n}=W_{2n+1}$ and everything becomes rather trivial.

An example of a W-Sequence

If a=3, b=5, c=2 and $d_1=d_2=1$, then W(3,5,2) is generated as follows:

$W_1=c=2$; $W_2=3W_1+1=7$;

$W_3=5W_1+1=11$; $W_4=3W_2+1=22$;

$W_5=5W_2+1=36$; $W_6=3W_3+1=34$;

$W_7=5W_3+1=56$; $W_8=3W_4+1=67$

then rearranging we obtain: 2, 7, 11, 22, 34, 36, 56, 67, 103, 109, 111, 169, 171, 181 as far as W_{14}.

Junction points of a W-Sequence

For certain W-Sequences — that is, for certain choices of a,b,c,d_1 and d_2 — there exist *junction points* denoted by Z where $Z=W_m=W_n$ and the two subscripts m and n are not equal. For example, in W(2,6) we find: $W_1=1$, $W_2=3$, $W_3=7$, $W_4=7$; thus $Z_1=7$ is the first junction point.

In W(2,5) we find that

$W_7=W_{16}=31=Z_1$.

In W(2,3) we find that

$W_{11}=W_{16}=31=Z_1$

$W_{51}=W_{80}=175=Z_2$

...

$W_{35291}=W_{202832}=1640335=Z_{101}$

Problems

(a) What are the terms of a W-Sequence? Test cases: evaluate W(2,3), W(2,3,2,), W(6,9), W(3,4,1) and W(3,4,2) between 1 and 10^6. Count the number of terms in each and further show sub-totals for each 10000.

(b) Given n, evaluate W_n for a specified W-Sequence.

(c) What are the junction points, if any, for a specified W-Sequence? Test cases: evaluate junction points in W(2,3), W(2,3,2), W(2,3,c) where c is to be input.

(d) What are the values of a,b,c,d_1 and d_2 for which there exists at least one junction point?

Hints

(i) Apart from the value of $c=W_1$ itself, all terms in W(2,3,c) can only leave remainders 1,3,4,5 when divided by 6.

Apart from the value of $c=W_1$ and possibly W_2,W_3 and W_4, every term in W(6,9,c) leaves remainder 7,10,37 or 43 when divided by 54, except in the case where c is a multiple of 18 when the remainder 1 also occurs on division by 54.

Readers are encouraged to send their thoughts, together with complete or partial attempts at the solutions to the above problems, to Mike Mudge, c/- *APC*, 2nd Floor, 215 Clarence Street, Sydney 2000 to arrive 15 June 1987.

It would be appreciated if such submissions contained a brief summary of results; together with thoughts relating to W-Sequences in a form suitable for future publication in *APC*. These submissions will be judged using suitably vague 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 stamped, addressed envelope is provided.

Mike Mudge welcomes correspondence on any subject within the areas of number theory and other computational mathematics. Particularly welcome are suggestions, either general or particular, for future Numbers Count articles; all letters will be answered in due course.

Review: Back to basics

This invitation to go 'Back to basics' produced an excellent response; the transposition of 64 to yield 46 in the sixth line of Devi's Number being unfortunate, but not troublesome.

Submissions divided broadly into two classes: those who used string-handling software and those who used the generally much slower array-handling software.

The winner has been chosen from the second category and is Ettrick Thomson.

It should be mentioned that Ettrick's programs were by no means the most efficient submitted, but some feel for his approach may be obtained from the following extract: '...printouts use old-style numerals which, like lower-case letters, have ascenders and descenders. As with lower-case letters, these help in avoiding confusion between certain numerals and certain numeral/letter combinations...It would be a pity if the USA influence led to a disappearance of old-style numerals, especially in work on large integers.'

Mention must be made of the submission from Alan Thomas of Tasmania who refers readers to his paper of January 1980 in *APC*, vol 1, no 8, page 64, detailing Monster Multiplier based upon The Trachtenberg Speed System of Basic Mathematics.

END

USER GROUPS UPDATE

Below is a list of updates and additions to the full User Group Index published in the January issue of APC. The next full listing will appear in the June issue of APC.

NSW

The Sydney Commodore User Group, (Sydcom) now meets at Ryde Catering College, Blaxland Road, Ryde. Meetings start at 7.30pm on the second Wednesday of each month. For more details write to Sydcom, Box 1542 GPO, Sydney, 2000; RCOM BBS (02) 667 1930.

The Australian Amiga User Association operates a 24 hour multi-mode (V21,V22,V23) Bulletin Board (047) 588006, which is accessible to subscribing members with limited access to visitors. This BBS features full facilities for private and public messages, Association news and the exchange of public domain software.

For further information contact the Australian Amiga User Association, c/- Penrith PO, Penrith NSW 2750.

Qld

The dBase User Group caters for all users of dBase II, dBase III and dBase III Plus. The group meets every second Wednesday at Deloitte, Haskins and Sells offices, 6th floor, 307 Queen Street, Brisbane, commencing at 5.30pm.

For more information contact Alan Scott at the Princess Alexandra Hospital, Ipswich Road, Woolloongabba, Brisbane Qld 4102.

ACT

The Canberra NEC Users Group meets on the first Tuesday of each month in the seminar room A or D, HC Coombes Building, ANU Campus.

For more details write to the President, Mr. Brian Embury, Canberra NEC Users Group, PO Box 173, Belconnen ACT 2616.

END

END ZONE

DIARY DATA

Readers are strongly advised to check details with exhibition organisers before making travel arrangements to avoid wasted journeys due to cancellations, printers' errors, etc.

Dallas, Texas	APL '87 Contact: APL '87 Registrar 440 Northlake Shopping Centre Suite #210, Dallas, Texas US 75238	May 10-14, 1987
Perth	Ausgraph '87 Contact: Conference Secretariat PO Box 29, Parkville Vic 3052 (03) 387 9955	May 11-15, 1987
Melbourne	PC87-The Ninth Australian Personal Computer Show also incorporating Office Technology '87 and Communications '87 Australian Exhibition Services Suite 3.3, 424 St Kilda Road Melbourne Vic 3004 (03) 267 4500	May 31-June 3, 1987
Atlanta	The Seventh Annual Comdex/Spring at the Georgia World Congress Centre in Atlanta Contact: (02) 959 5555	June 1-4, 1987
Chicago	NCC'87 Contact: American Federation of InformationProcessing Societies 1899 Preston White Drive. Reston, Virginia 2209 (703) 620 8955	June 15-18, 1987
Melbourne **Sydney** **Auckland** **Perth**	Comnet '87 Contact: Stephen Moore, Karen Rickwood (02) 439 5133	July 1-2, 1987 July 6-7, 1987 July, 9-10, 1987 July 15-16, 1987
Sydney	Macworld Expo '87 Contact: Stephen Moore, Karen Rickwood (02) 439 5133	August 3-6, 1987

LAZING AROUND

No prizes, no answers for this one. Which letter in the alphabet comes next in the series: t, e, l, h, b . . . ?

Prize puzzle

Seven applicants were interviewed for the position of private secretary to the chairman of the company. Each applicant was awarded marks out of 100 for shorthand and typing respectively. By coincidence, the final ranking was in exact reverse alphabetical order.

(1) George came 4th in both tests.
(2) Erica was 2nd in shorthand.
(3) Freda scored 80 marks altogether.
(4) Arthur came 6th in typing.
(5) Diane scored 22 for typing.
(6) Claudine scored 30 for shorthand.
(7)Someone scored for typing the same as Erica scored for shorthand.
(8) Brian was 5th for shorthand, and scored 40 for typing.

What were each applicant's marks?

Answers on postcards, please, or back of envelopes only, to reach *APC*, Lazing Around May 1987, 2nd Floor, 215 Clarence Street, Sydney 2000, no later than 30 May 1987.

February prize puzzle

Although many solutions were possible for this problem, we accepted any that matched the requirements. Several entries were disqualified since they didn't satisfy the boundary length criterion.

The winning card, drawn at random, came from Mr Tim Tucak of Swanbourne, WA. Congratulations, your prize is on its way. Meanwhile, to all the not-quite-lucky-enough ones, keep puzzling — it could be your turn next.

Mr Tucak's winning solution is given below.

END

A	C	E	E	E
A	C	C	C	E
A	B	B	C	E
A	B	D	D	D
A	B	B	D	D

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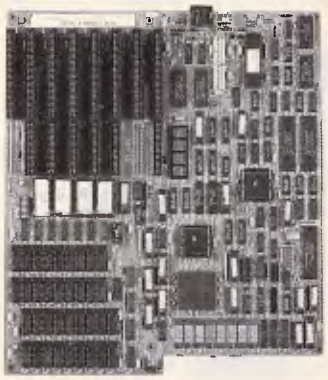

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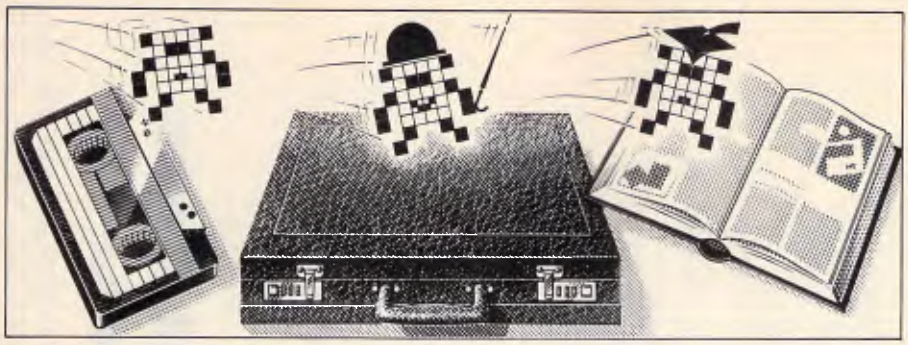

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- ***Toolkit/utilities***
- ***Educational/Computer Aided Learning***

Owen Linderholm selects the best of readers' programs. For details on submitting your own, see the box below.

APC is interested in programs written in any of the major programming languages from all home and small business micros. When submitting programs please include a cassette or disk version of your program, brief but comprehensive documentation, and a listing on plain white paper — typed if you have no printer.

Please ensure that the software itself, the documentation and the listing are all marked with your name, address program title, machine (along with any minimum requirements) and — if possible — a daytime phone number.

Check through the previous Program Files to see the kind of programs we prefer. As a rough guide, original ideas are always welcome, as are good implementations of utilities and applications. Obviously the programs should be well-written, easy to understand, and preferably not too long (remember that other readers have to type them in).

All programs should be fully debugged and your own original, unpublished work. We prefer to receive programs with a maximum 80-column width printed in emphasised typeface.

We will try to return submissions if they are accompanied by a stamped, self addressed envelope of the appropriate size, but please keep a copy of everything. Programs are paid for at the rate of $20 per page of published listing.

Send your contributions to APC Programs, 77 Glenhuntly Rd, Elwood 3184.

This month's programming technique is clean input and validation, which deals with such topics as careful entry of strings and numbers, and checking that values entered by the user fall within the desired range. It is fairly easy to write a standard set of routines that can subsequently be used in all your programs as standard input routines.

Text input essentially falls into two categories — numerical and string. Longer text input in the form of files shouldn't really be done in this way, but entered into a text editor. The file can then be loaded by the program.

The technique used here is to read all input as character strings. If the input is intended to be numerical it is then converted to a number; this allows the program to check that each entered character is numeric as it is typed in. Letters and punctuation marks are simply not accepted; the purpose of which is to prevent novice users or erratic typists making mistakes, as well as discourage malicious users from entering bad data.

Fig 1

```
140 IF (GET AND 95)=89 PRINT "Y":start=3 ELSE PRINT "N":start=1
255 osbyte=&FFF4
312             LDA #&B4
313             LDX #&00
314             LDY #&FF
315             JSR osbyte          \find start of text
316             TXA
317             CLC
318             ADC #start
319             STA addhi
390             LDA #&7A
400             SEC
405             SBC addhi           \set no of 256-byte pages
410             TAX
```

Another advantage of this method is that it allows the programmer to include routines which help the user easily edit invalid entries. For example, if a typing mistake has been made, then the program could redisplay the previous entry with the mistake and allow the user to just correct the error rather than retyping it.

Commercial programs use this type of technique all the time, but user programs often don't do any checking. When a mistake is made, the interpreter or compiler issues an unfriendly standard error message such as 'Redo from start'.

I have written a simple set of routines to provide basic input validation. They can check that input is longer or

shorter than specified lengths; they can check that numbers are not too high or too low, and print error messages; they can also do minimal editing. Their major advantage is that they are easy to modify and expand.

The routines are all very short, and have been written in a modular way so that they can easily be re-written and only the relevant parts in a particular program need be used.

A full MBasic listing is given for a program to repeatedly read in names and telephone numbers. The names must be between 3 and 20 characters long and the numbers between 7 and 15. I had intended to include Modula-2 routines as well but this proved to be a mammoth task, so from now on I shall concentrate on Basic but try to include information to help in translating the programs.

Possible extensions to this kind of routine include displaying the possible field size as underlined characters or blobs, or full editing of input strings including deletion from the centre, and so on. Other changes could allow for better presentation, up to and including pop-up windows or menus.

Blunders

There is a correction to the BBC Wordwise Recovery program (February issue) to allow it to work with the BBC Master. The lines given in Fig 1 should be typed over the previous program.

```
1000 REM/This is an example program for entering names and
1010 REM/telephone numbers.
     REM/Variables used in the program:
     REM/SPX,SPY - start position x and y, screen co-ords of the
     REM/          start of the input field
     REM/NM$ - name string
     REM/NR$ - number string
     REM/IC$ - input character
     REM/MNL,MXL - minimum and maximum string length
     REM/DS$ - display string
     REM/DL - display string length
     REM/FAIL - failure flag for numeric check
     REM/DONE - flag to check for enter key
     REM/DEL - flag to check for delete key
     REM/LONG - flag to check for string too long
     REM/SHORT - flag to check for string too short
     REM/EPX,EPY - start co-ords for error message
     REM/EM$ - error message
     REM/MXV,MNV - maximum and minimum values for numeric entries
     REM/RT$,DL$,NL$ - string constants for the enter and delete
     REM/              keys and an empty string
1020 GOSUB 3300
1030 GOSUB 1100:GOTO 1030

     REM/Main control routine. Clear screen and print message.
     REM/Get name and repeat for number. Then print out what was
     REM/entered and wait for the space bar to be pressed.
1100 CLS:PRINT:PRINT
1110 PRINT"Enter name:";
1120 SPX=3:SPY=13:LOCATE SPX,SPY
1130 GOSUB 1200
1140 PRINT:PRINT:PRINT"Enter no. ";
1150 SPX=5:SPY=12:LOCATE SPX,SPY
1160 GOSUB 1300
1170 PRINT:PRINT:PRINT"Name is ";NM$:PRINT"Number is ";NR$
1180 PRINT"Press SPACE";:IC$=INPUT$(1)
1190 RETURN

     REM/Input name routine. Set min and max length and call
     REM/overall input routine. Set name string to input string
     REM/and return.
1200 MNL=3:MXL=20:DS$="":DL=0:GOSUB 3400
1210 NM$=DS$:RETURN

     REM/Input number routine. As for input name except set
     REM/number string to input string.
1300 MNL=7:MXL=15:DS$="":DL=0:GOSUB 3400
1310 NR$=DS$:RETURN

     REM/Input character routine. Read character from keyboard
     REM/(waits for first key to be pressed and returns this as
     REM/a one character string).
2000 IC$=INPUT$(1):RETURN
     REM/Check numeric routine. Check that input character is a
     REM/number. If not set FAIL flag.
2100 FAIL=0:IF (IC$<"0" OR IC$>"9")THEN IC$="":FAIL=1
2110 RETURN

     REM/Check done routine. If input char was RETURN key then set
     REM/DONE flag.
2200 DONE=0:IF IC$=RT$ THEN DONE=1
2210 RETURN

     REM/Check delete routine. If input char was backspace key then
     REM/set DEL flag.
2300 DEL=0:IF IC$=DL$ THEN IC$="":DEL=1
2310 RETURN

     REM/Display input routine. Move cursor to start of input field
     REM/and print enough spaces to blank the field. Then move back
     REM/to start and print input string so far.
2400 LOCATE SPX,SPY
2410 FOR X=1 TO DL+1:PRINT" ";:NEXT X
2420 LOCATE SPX,SPY:PRINT DS$;:RETURN

     REM/Delete char routine. If there is anything to delete then
     REM/remove the last character from the input string and adjust
     REM/the length to be correct.
2500 IF DL>0 THEN DS$=LEFT$(DS$,DL-1):DL=DL-1
2510 RETURN

     REM/Add char routine. Add the input char to the end of the input
     REM/string
2600 DS$=DS$+IC$:DL=DL+1:RETURN

     REM/Check long routine. If string is too long then delete last
     REM/character, redisplay it, display error message and set
     REM/LONG flag.
2700 LONG=1:IF DL>MXL THEN GOSUB 2500:GOSUB 2400:
     EM$="Entry too long":GOSUB 2900:LONG=1
2710 RETURN

     REM/Check short routine. If string too short then display error
     REM/message and set SHORT flag.
2800 SHORT=0:IF DL<MNL THEN EM$="Entry too short":GOSUB 2900:SHORT=1
2810 RETURN

     REM/Display error routine. Move cursor to error message field
     REM/and display error string.
2900 LOCATE EPX,EPY:GDSUB 3300:PRINT EM$;:RETURN

     REM/Check high routine. If input value too high, then display
     REM/error message. Only here as an example - unused.
3000 IF IV>MXV THEN EM$="Entry too high":GOSUB 2900:RETURN
     REM/Check low routine. If input value too low, then display
     REM/error message. Only here as an example - unused.
3100 IF IV<MNV THEN EM$="Entry too low":GOSUB 2900:RETURN

     REM/Beep routine. Beeps twice.
3200 BEEP:BEEP:RETURN

     REM/Initialisation. Set constant values to the correct ones.
     REM/EPX,EPY are the co-ordinates for the start of the error
     REM/message field;RT$ represents a carriage return;DL$ the
     REM/backspace key and NL$ a null string.
3300 EPX=20:EPY=2:RT$=CHR$(13):DL$=CHR$(8):NL$="":RETURN

     REM/Standard input routine. It reads a character. Checks if
     REM/it is delete and deals with it if it is. Otherwise it
     REM/checks if it is a RETURN. If not it adds the character
     REM/to the string, checks length, displays and repeats.
     REM/Otherwise it checks if it is short and returns.
3400 GOSUB 2000
3410 GOSUB 2300:IF DEL=1 THEN GOSUB 2500:GOTO 3440
3420 GOSUB 2200:IF DONE=1 THEN 3450
3430 GOSUB 2600
3440 GDSUB 2400:GOSUB 2700:GOTO 3400
3450 GOSUB 2800:IF SHORT=1 THEN 3400
3460 RETURN
```

Turbo Pascal Circuit Validation

by Mark Needham

This program allows you to design and test simple logic circuits that comprise AND, NAND, OR, NOR and INVERTER-type gates with up to six different input lines and up to three different output lines. This could be of

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use in school lessons on logic circuits where the actual components are not available, or where it isn't possible to supply the components as they are easily damaged.

To make option selection easy, an arrow is moved around the screen using the cursor keys up, down, left and right. To select an option, move the arrow just underneath the word and press Return.

The master menu has six options:
EXIT — leave the Circuit Validation Program
LOAD — load a pre-saved circuit
SAVE — save the current circuit
CLEAR — clear the current circuit
EDIT — edit the current circuit
PROCESS — calculate for the current circuit the outputs produced by all combinations of inputs

- **Editing the circuit**

The EDIT menu has five options:
RETURN — returns to the Master menu
GATE ADD — add a gate
GATE REMOVE — remove a gate
TRACK ADD — add a track
TRACK REMOVE — remove a track

To add a gate, select the GATE ADD option by moving the arrow to the word ADD on the left of the screen and press Return. The top line will change to display a list of gate types; move the arrow to the gate type you want and press Return. The RETURN option will get you back to the EDIT menu. Now move the arrow around the middle portion of the screen (the grid) to where you want the gate to be placed. If at any time you want to change the gate type, move the arrow to the top row and re-select the gate. The gate type you have chosen will appear on the bottom line of the screen. If you put a gate on top of another gate, the old gate is removed, thus allowing you to modify the circuit without having to redraw it.

Removing a gate is achieved by selecting the REMOVE option, then moving the arrow on top of the gate to be removed and pressing Return. You will be asked to confirm the removal. Any tracks attached to that gate will also be removed.

Adding tracks is slightly more complex. First, select the ADD TRACK option by moving the arrow to the word ADD and pressing Return. You must now select the gate or input connector (A...F) from where the track is to start. Press Return when the arrow is over the required position. Now move the arrow to select the gate or output connector (X...Z) to where the track is to go. Again press Return.

If there are no tracks coming from the selected start gate, a line will appear joining the two gates/connectors. You must now straighten the line if it isn't already straight; this is done by using the cursor keys. To put a corner on the line, press the Space key; to finish, press the Return key. The line must be straight before you finish.

If there's a track coming from the start gate or the chosen connector, a circle will appear. This is a track solder blob that must be moved using the cursor right key along the track to where you want the new track to start from. Press Return to fix the blob, or S to start from the beginning again. When you have fixed the blob, a line will appear which must be straightened as described above.

Removing tracks is similar again: simply select the gate or connector from where the track starts, and then select the gate or connector from where the track ends. You will be asked to confirm the removal of the track.

- **Loading or saving the circuit**

Select the LOAD or SAVE option, then enter the name of the file you want to load or save. A normal MS-DOS filename is required. Press Return alone to abort the load or save.

- **Processing the circuit**

When the circuit has been designed, its output can be generated. This is done by selecting the PROCESS option from the Master menu. The output can go to screen (press 'N') or printe (press 'Y'). Firstly, for each output connector that is connected, its definition is displayed. These definitions are not the standard way logic expressions are displayed — that would require too much code. The minus signs would normally be a horizontal bar over the bracketed expression following them. Following the definitions is every combination of input for those input connectors that are connected to a gate, and the output produced by the circuit for each of the output connectors.

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *6663#

```
const
  MaxBytes = 326; CC = 1; KeyUp = #141; Keydown = #142; KeyLeft = #143;
  KeyRight = #144; Ret = #13; Space = #32; ESC = #27; Bell = #7; FFeed = #12;

  AddComp = 3; RemComp = 4; AddTrak = 6; RemTrak = 7; Erase = 5;
  GateType : set of byte = [2,3,4,5,6,7];
  Join : array[0..5] of char = ('-','-','-','+','+','+');
  LowRange = 65; TopRange = 70;
  Con : array[0..6] of integer = (9,13,5,11,7,15,3);

type
  ShapePtr      = ^ShapeDef;                        { Ptr to shapes on heap }
  ShapeDef      = array[1..MaxBytes] of byte;       { Array for shapes on heap }
  SubLinePtr    = ^SubLineDef;
  SubLineDef    = record
                    SX,SY,EX,EY : integer;          { Info for lines on screen }
                    Ptr : SubLinePtr;
                  end;
  LinePtr       = ^LineDef;
  LineDef       = record                            { Info for tracks }
                    SCol,SRow,ECol,ERow : integer;
                    PutBlob : boolean;              { Start with blob ? }
                    SLPtr : SubLinePtr;
                    LPtr : LinePtr;
                  end;
  GateTypes     = (NONE,ANDGATE,NANDGATE,ORGATE,NORGATE,INVERTER);
  CommandTypes  = (Option,InputLetter,OutPutLetter,Grid,Ziltch);
  Strfield      = string[240];

const MultiInputs : set of GateTypes = [ANDGATE,NANDGATE,ORGATE,NORGATE];
var
  GridFile : Text;
  TempLine,JoinLine,StartLine,WorkLine,LastLine          : LinePtr;
  WSLine,LSLine                                          : SubLinePtr;
  TopHeap,StartData                                      : integer;
  Command                                                : CommandTypes;
  Abort,Value,AddBlob,GoBack,ExitProg,Exit               : boolean;
  CX,CY,StartX,StartY,EndX,EndY,ArrowCol,ArrowRow,
  CommandNum,GateNum,StartCol,StartRow,EndCol,EndRow,
  Mem,T,Eptr,i,FirstCol,LastCol,Column,row,NumInputs,
  NumOutputs,loop,OutDev                                 : integer;
  key,c                                                  : char;
  Skip                                                   : set of byte;
  Ex,Stk,Expr,Fname,CurCircuit                           : strfield;
  GateShape   : array [ANDGATE..INVERTER] of ShapePtr;
  Connections : array[1..8,1..6] of byte;
  State       : array[LowRange..TopRange] of char;
  UseInp      : array[LowRange..TopRange] of boolean;
  UseOut      : array[1..3] of boolean;
  DefOut      : array[1..3] of Strfield;
  GridInfo    : array[1..8,1..6] of GateTypes;
  GateDefs    : array[1..8,1..6] of strfield;

FUNCTION ConvGate(c : GateTypes) : Strfield;
begin
  case c of
  NONE     : ConvGate := '     ';   ANDGATE  : ConvGate := 'AND ';
  NANDGATE : ConvGate := 'NAND';   ORGATE   : ConvGate := 'OR  ';
```

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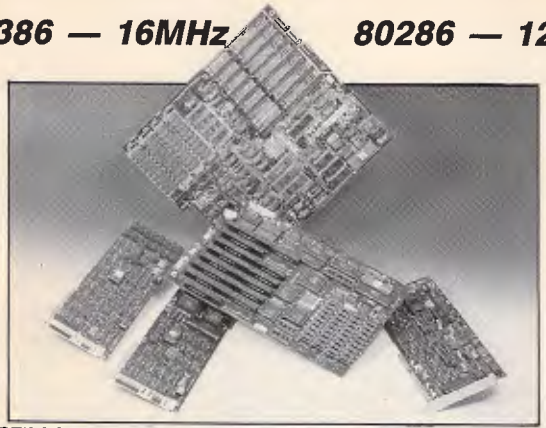

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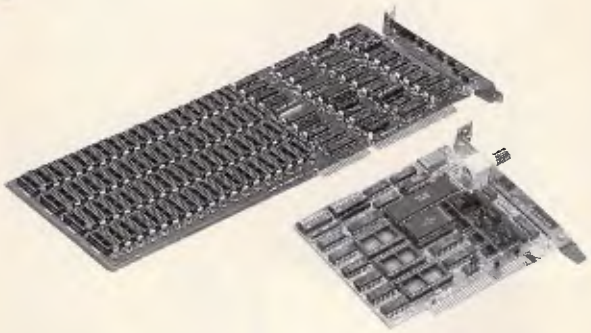

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```
    NORGATE  : ConvGate := 'NOR ';    INVERTER : ConvGate := 'INV '
    end
  end;
  PROCEDURE Beep; begin write(Bell) end;
  PROCEDURE ExitPos; begin ArrowCol := 8; ArrowRow := 1 end;
  PROCEDURE Sp(n : integer); begin for i := 1 to n do write(Space) end;
  PROCEDURE Clr01; begin gotoxy(1,1); Sp(79) end;
  PROCEDURE Clr25; begin gotoxy(1,25); Sp(79) end;
  PROCEDURE InvColour; begin ColorTable(1,0,0,0) end;
  PROCEDURE NormColour; begin ColorTable(0,1,2,3) end;
  FUNCTION ColPos(x : integer) : integer; begin ColPos := 64 + (x-1)* 64; end;
  FUNCTION RowPos(x : integer) : integer; begin RowPos := 24 + (x-1)* 24; end;
  PROCEDURE Blob(x,y,c : integer); begin for i := 1 to 4 do circle(x,y,i,c) end;

  PROCEDURE ArrowHome;
  begin if ArrowRow = 1 then begin ArrowRow := 4; ArrowCol := 1 end end;

  FUNCTION KeyGet: char;
  var KeyPress: char;
  begin
    read(kbd,KeyPress);
    if (KeyPress = ESC) and KeyPressed then begin
      read(kbd,KeyPress);
      case KeyPress of
      #72: KeyPress := KeyUp;       #75: KeyPress := KeyLeft;
      #80: KeyPress := KeyDown;     #77: KeyPress := KeyRight;
      else KeyPress := #0
      end
    end;
    KeyGet := KeyPress
  end;

  FUNCTION GetYESorNo(S : Strfield) :boolean; { Wait for 'Y' or 'N' }
  begin
    Clr25; gotoxy(28-length(S) div 2,25);
    write('Confirm ',S,' (Y)es or (N)o ? ');
    repeat key := upcase(KeyGet) until key in ['Y','N']; Clr25;
    GetYESorNo := key = 'Y'
  end;

  PROCEDURE Error(ERnum : integer);
  begin
    Clr25; gotoxy(15,25); Beep;
    case ERnum of
    1 : write('GATES WITH LESS THAN 2 INPUTS');
    2 : write('NO OUTPUTS SPECIFIED');
    3 : write('FILE ',Fname,' NOT FOUND')
    end;
    write(' - PRESS RETURN TO CONTINUE '); read(kbd,c); Clr25
  end;

  PROCEDURE DrawBasicOR;       { Draw an OR gate at the top of the screen }
  begin
    draw(0,0,15,0,CC); draw(0,19,13,19,CC); draw(13,0,13,19,CC);
    circle(-5,9,11,CC); FillShape(10,9,CC,CC); circle(15,9,10,CC);
    FillShape(18,9,CC,CC)
  end;

  PROCEDURE DrawBasicAND;      { Draw an AND gate at the top of the screen }
  begin
    draw(0,0,13,0,CC); draw(0,0,0,19,CC); draw(0,19,13,19,CC);
    circle(13,9,10,CC); fillshape(13,9,CC,CC); fillshape(1,1,CC,CC)
  end;
  PROCEDURE DrawInverter;      { Draw an INVERTER }
  begin
    draw(5,4,5,15,CC); draw(20,9.5,15,CC); draw(20,9,5,4,CC);
    FillShape(10,9,CC,CC);
    circle(23,9,3,CC); draw(0,9,5,9,CC); draw(27,9,31,9,CC)
  end;

  PROCEDURE DesignComponents;
  begin
    DrawBasicAND; draw(0,9,31,9,CC);
    new(GateShape[ANDGATE]); GetPic(GateShape[ANDGATE]^,0,0,31,19);
    FillScreen(0); DrawBasicAND; circle(27,9,4,CC);
    new(GateShape[NANDGATE]); GetPic(GateShape[NANDGATE]^,0,0,31,19);
    FillScreen(0); DrawBasicOR; draw(10,9,31,9,CC);
    new(GateShape[ORGATE]); GetPic(GateShape[ORGATE]^,0,0,31,19);
    FillScreen(0); DrawBasicOR; circle(27,9,4,CC);
    new(GateShape[NORGATE]); GetPic(GateShape[NORGATE]^,0,0,31,19);
    FillScreen(0); DrawInverter;
    new(GateShape[INVERTER]); GetPic(GateShape[INVERTER]^,0,0,31,19)
  end;
```

```
  PROCEDURE DrawArrow(AtX,AtY : integer);   { Draw pointer using ColorTable }
  begin
    draw(AtX+8,AtY+0,AtX+0,AtY+5,-1);       draw(AtX+0,AtY+5,AtX+4,AtY+5,-1);
    draw(AtX+4,AtY+5,AtX+4,AtY+10,-1);      draw(AtX+4,AtY+10,AtX+12,AtY+10,-1);
    draw(AtX+12,AtY+10,AtX+12,AtY+5,-1);    draw(AtX+12,AtY+5,AtX+16,AtY+5,-1);
    draw(AtX+16,AtY+5,AtX+8,AtY+0,-1)
  end;

  PROCEDURE DrawMasterOptions;     { Master Options }
  begin
    Clr25; gotoxy(20,25);
    if CurCircuit = '' then write('Circuit Validation Utility by Mark Needham.')
    else write('Current Circuit : ',CurCircuit);
    Clr01; gotoxy(5,1);
    write('Master Options :   PROCESS  SAVE    EDIT   CLEAR   LOAD    EXIT');
    FirstCol := 3; LastCol := 8; Skip := []
  end;

  PROCEDURE DrawEditOptions;   { Editing options }
  begin
    Clr25; Clr01; gotoxy(3,1); ExitPos;
    write('Edit Options : GATES  ADD   REMOVE    TRACKS  ADD   REMOVE  RETURN');
    FirstCol := 3; LastCol := 8; Skip := [5]
  end;

  PROCEDURE DrawGateOptions;
  begin
    Clr01; gotoxy(8,1); ExitPos;
    write('Gates :   AND    NAND     OR      NOR   INVERTER        RETURN');
    Clr25; gotoxy(8,25);
    write('Select Gate Type :       Then Select Position on Grid');
    FirstCol := 2; LastCol := 8; Skip := [7]
  end;

  PROCEDURE DrawRemoveGateOptions;
  begin
    ArrowHome; Clr01; gotoxy(63,1); write('RETURN');
    FirstCol := 8; LastCol := 8; Skip := []
  end;

  PROCEDURE DrawStartTrackOptions;
  begin
    DrawRemoveGateOptions;     { they are the same }
    Clr25; gotoxy(25,25); write('Select Start Gate or Input Letter')
  end;

  PROCEDURE DrawEndTrackOptions;
  begin
    ArrowHome; gotoxy(40,1); write('ERASE'); Clr25; gotoxy(8,25);
    write('Select End Gate or Output Letter, Select ERASE to Re-select Start');
    FirstCol := 5; LastCol := 8; Skip := [6,7]
  end;

  PROCEDURE DrawTrackJoinOptions;
  begin
    FirstCol := 8; LastCol := 8; Skip := []; Clr01; Clr25; gotoxy(4,25);
    write('RETURN to fix blob   S to restart   Cursor Right to Move'+
          '   ESC to Abort')
  end;

  PROCEDURE DrawCircuitBoard;   { Draw the INPUT & OUTPUT letters }
  begin
    FillScreen(0);
    for i := 1 to 6 do begin gotoxy(1,2+(i * 3)); write(chr(64+i)) end;
    for i := 1 to 3 do begin gotoxy(78,2+(i * 6)); write(chr(87+i)) end;
    gotoxy(1,22); write('INPUTS'); gotoxy(72,22); write('OUTPUTS')
  end;

  PROCEDURE ReDrawCircuit;   { Redraw the whole circuit }
  begin
    DrawCircuitBoard;
    for column := 1 to 8 do for row := 1 to 6 do
      if GridInfo[Column,row] <> None then
        PutPic(GateShape[GridInfo[Column,row]]^,ColPos(Column),RowPos(Row+1));
    WorkLine := StartLine^.LPtr;
    while WorkLine <> nil do begin              { loop for all tracks }
      with WorkLine^ do begin
        if PutBlob then Blob(SLPtr^.SX,SLPtr^.SY,1);
        WSLine := SLPtr;
        while WSLine <> nil do begin
          with WSLine^ do draw(SX,SY,EX,EY,1);
          WSLine := WSLine^.Ptr
        end;
      end;
```

```
      WorkLine := WorkLine^.LPtr              { Get next track in list }
    end
  end;

  PROCEDURE PosArrow;
  begin
    if Arrowrow > 3 then begin
      if ArrowCol = 9 then DrawArrow(624,RowPos(ArrowRow-3)+10)
      else
        if ArrowCol > 0 then DrawArrow(ColPos(ArrowCol),RowPos(ArrowRow-3)+10)
        else DrawArrow(4,RowPos(ArrowRow-3)+10)
    end
    else DrawArrow(ColPos(ArrowCol),8);
  end;

  PROCEDURE UpToTop;  { Moving arrow up to the top option row }
  begin
    ArrowRow := 1;
    if ArrowCol < FirstCol then ArrowCol := FirstCol;
    if ArrowCol > LastCol then ArrowCol := LastCol;
    while ArrowCol in Skip do ArrowCol := succ(ArrowCol);
  end;

  PROCEDURE CheckLastColUp;  { Moving arrow up at OUTPUT letters }
  begin
    if ArrowRow = 5 then UpToTop
    else begin
      if ArrowRow = 7 then ArrowRow := 5;
      if ArrowRow = 9 then ArrowRow := 7;
    end
  end;
  PROCEDURE CheckLastColDown;
  begin if ArrowRow mod 2 = 0 then ArrowRow := succ(ArrowRow) end;

  PROCEDURE GetOption;   { Main routine to move arrow pointer around screen }
  begin
    InvColour;   { Set Inverse colour mode }
    repeat
      PosArrow; key := KeyGet; PosArrow;
      case key of
      Ret       : if ArrowRow = 1 then begin
                    Command := Option; CommandNum := ArrowCol
                  end
                  else
                    if ArrowCol = 0 then begin
                      Command := InputLetter; CommandNum := ArrowRow;
                    end
                    else
                      if ArrowCol = 9 then begin
                        Command := OutputLetter; CommandNum := ArrowRow;
                      end
                      else Command := Grid;
      KeyUp     : if ArrowCol = 9 then CheckLastColUp
                  else
                    if ArrowRow > 4 then ArrowRow := pred(ArrowRow)
                    else UpToTop;
      KeyDown :   if ArrowRow = 1 then ArrowRow := 4
                  else begin
                    if ArrowRow < 9 then ArrowRow := succ(ArrowRow);
                    if ArrowCol = 9 then CheckLastColDown;
                  end;
      KeyLeft :   if ArrowRow = 1 then begin
                    if ArrowCol > FirstCol then begin
                      ArrowCol := pred(arrowCol);
                      while ArrowCol in Skip do ArrowCol := pred(ArrowCol)
                    end
                  end
                  else if ArrowCol > 0 then ArrowCol := pred(ArrowCol);
      KeyRight : if ArrowRow = 1 then begin
                    if ArrowCol < LastCol then begin
                      ArrowCol := succ(ArrowCol);
                      while ArrowCol in Skip do ArrowCol := succ(ArrowCol)
                    end
                  end
                  else begin
                    if ArrowCol < 9 then ArrowCol := succ(ArrowCol);
                    if ArrowCol = 9 then CheckLastColDown;
                  end
      end; { case }
    until key = ret;
    NormColour;
  end;

  FUNCTION CheckExit : boolean;
  begin CheckExit := (Command = Option) and (CommandNum = LastCol) end;

  PROCEDURE DoAdd;          { Add a gate to the grid, or overwrite another }
  var Comp : GateTypes;
  begin
    Exit := true; Comp := GateTypes(GateNum);
    if (Comp = INVERTER) and (Connections[ArrowCol,ArrowRow-3] > 1) then beep
    else begin
      GridInfo[ArrowCol,ArrowRow-3] := Comp;
      PutPic(GateShape[Comp]^,ColPos(ArrowCol),RowPos(ArrowRow-2))
    end
  end;
  PROCEDURE SetGate;  { Specify gate type }
  begin
    GateNum := pred(CommandNum);
    gotoxy(27,25); write(ConvGate(GateTypes(GateNum)))
  end;

  PROCEDURE AddComponent;   { Main routine to add a gate }
  begin
    DrawGateOptions; Exit := false;
    repeat
      GetOption;
      if (Command = Option) and (CommandNum in GateType) then begin
        SetGate;
        repeat
          GetOption;
          if (Command = Option) and (CommandNum in GateType) then SetGate
        until CheckExit or (Command = Grid);
        if Command = Grid then DoAdd
      end
    until CheckExit or Exit;
    CommandNum := 0
  end;

  PROCEDURE DoAddTrack;      { main routine to add a track }
  var Move,First : boolean;

    PROCEDURE NewSubLine;
    begin
      new(WSLine);
      if First then WorkLine^.SLPtr := WSLine else LSLine^.Ptr := WSLine;
      LSLine := WSLine; First := false;
    end;

    FUNCTION CheckStraight : boolean;
    begin CheckStraight := (StartX-CX = 0) or (StartY-CY = 0) end;

    FUNCTION LineNotStraight : boolean;
    begin
      LineNotStraight := Not CheckStraight or
                         Not ((CX-EndY = 0) or (CY-EndY = 0))
    end;
  begin
    Invcolour; EndX := ColPos(EndCol);
    Clr25; gotoxy(5,25);
    write('Staighten the line. SPACE for corner  RETURN to End  ESC to Abort');
    if EndCol = 9 then EndY := RowPos(EndRow-2)-10
    else
      if GridInfo[EndCol,EndRow-3] <> INVERTER then
        EndY := RowPos(EndRow-2)-19+Con[Connections[EndCol,EndRow-3]]
      else
        EndY := RowPos(EndRow-2)-10;
    new(WorkLine);
    with WorkLine^ do begin
      LPtr := nil; PutBlob := AddBlob;
      SCol := StartCol; SRow := StartRow;
      ECol := EndCol;   ERow := EndRow;
      SLPtr := nil
    end;
    CX := StartX; CY := StartY; First := true; Move := false;
    if AddBlob then Blob(StartX,StartY,1);
    repeat
      draw(StartX,StartY,CX,CY,-1); draw(CX,CY,EndX,EndY,-1);
      key := KeyGet;
      draw(StartX,StartY,CX,CY,-1); draw(CX,CY,EndX,EndY,-1);
      if key in [KeyLeft,KeyRight,KeyUp,KeyDown] then Move := true;
      case key of
      KeyUp    : CY := CY - 2;
      KeyDown  : CY := CY + 2;
      KeyRight : if CX + 2 <= EndX then CX := CX + 2;
      KeyLeft  : if CX - 2 >= StartX then CX := CX - 2;
      Space    : if Move and CheckStraight then begin
```

```
                    NewSubLine;
                    with WSLine^ do begin
                      SX := StartX; SY := StartY; EX := CX; EY := CY; Ptr := nil
                    end;
                    draw(StartX,StartY,CX,CY,1); StartX := CX; StartY := CY;
                    Move := false
                  end else Beep;
      Ret       : if LineNotStraight then begin Beep; Key := #0 end;
      end;
    until (key = ret) or (Key = ESC);
    if Key <> ESC then begin
      if (CX <> StartX) or (CY <> StartY) then begin
        NewSubLine;
        with WSLine^ do begin
          SX := StartX; SY := StartY; EX := CX; EY := CY; Ptr := nil
        end
      end;
      NewSubLine;
      with WSLine^ do begin
        SX := CX; SY := CY; EX := EndX; EY := EndY; Ptr := nil
      end;
      draw(StartX,StartY,CX,CY,1); draw(CX,CY,EndX,EndY,1);
      if EndCol < 9 then
        Connections[EndCol,EndRow-3] := succ(Connections[EndCol,EndRow-3]);
      LastLine^.LPtr := WorkLine; LastLine := WorkLine;
    end else Abort := true;
    NormColour
  end;

  FUNCTION CheckForTracks : boolean;    { Check for a track to see if a blob }
  var found : boolean;                  { is required. }
  begin
    Found := false;
    WorkLine := StartLine^.LPtr;
    while WorkLine <> nil do begin
      with WorkLine^ do
        if (SCol = StartCol) and (SRow = StartRow) and Not Found then begin
          Found := true; JoinLine := WorkLine
        end;
      WorkLine := WorkLine^.LPtr
    end;
    CheckForTracks := Found
  end;

  FUNCTION Sgn(v : integer) : integer;
  begin if v = 0 then Sgn := 0 else if v > 0 then Sgn := 2 else Sgn := -2 end;

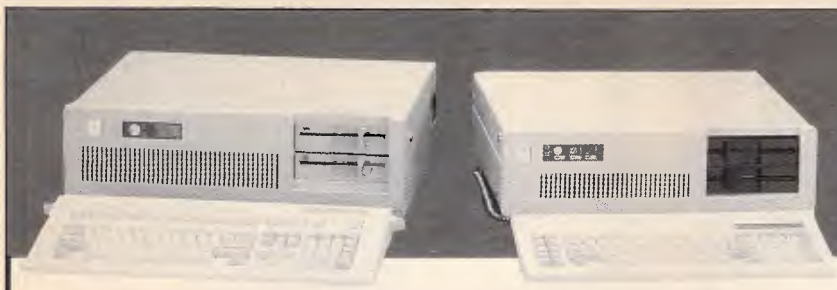
  PROCEDURE MovePointer;                          { Move blob pointer routine }
  var x,y,HM,VM : integer; AtStart,AtEnd : boolean;
  begin
    AtStart := true; AtEnd := false; AddBlob := true;
    DrawTrackJoinOptions;
    WSLine := JoinLine^.SLPtr;
    with WSLine^ do begin
      x := SX; y := SY; HM := Sgn(EX-SX); VM := Sgn(EY-SY);
    end;
    repeat
      InvColour; circle(x,y,4,-1);
      Key := KeyGet;  circle(x,y,4,-1);
      case Key of
      KeyRight : if NOT AtEnd then begin
                   x := x + HM; y := y + VM; AtStart := false
                 end;
      'S','s'  : begin
                   WSLine := JoinLine^.SLPtr;
                   with WSLine^ do begin
                     x := SX; y := SY; HM := Sgn(EX-SX); VM := Sgn(EY-SY);
                   end;
                 end;
      Ret       : begin StartX := x; StartY := y end
      end;
      with WSLine^ do
        if (x = EX) and (y = EY) then begin
          if WSLine^.Ptr = nil then AtEnd := true
          else begin
            WSLine := WSLine^.Ptr;
            with WSLine^ do begin
              x := SX; y := SY; HM := Sgn(EX-SX); VM := Sgn(EY-SY)
            end
          end
        end
    until (Key = Ret) or (Key = ESC);
    NormColour;
    if Key = ESC then begin Exit := true; Abort := true end
  end;

  PROCEDURE RemoveTrack;
  begin
    if GetYESorNo('Remove') then begin
      Connections[EndCol,EndRow-3] := pred(Connections[EndCol,EndRow-3]);
      WorkLine := StartLine^.LPtr; TempLine := StartLine;
      while WorkLine <> nil do begin
        with WorkLine^ do
          if ((ECol = EndCol) and (ERow = EndRow)) and
              ((SCol = StartCol) and (SRow = StartRow)) then begin
            TempLine^.Lptr := WorkLine^.LPtr;
            if WorkLine^.LPtr = nil then LastLine := TempLine
          end else TempLine := WorkLine;
          WorkLine := WorkLine^.LPtr
        end;
        ReDrawCircuit; Exit := true
      end
  end;

  FUNCTION EnoughRoom : boolean;    { Enough room to add another connection }
  begin
    EnoughRoom := true;
    if Command = Grid then
      EnoughRoom := ((GridInfo[ArrowCol,ArrowRow-3] in MultiInputs) and
                     (Connections[ArrowCol,ArrowRow-3] < 7)) or
                    ((GridInfo[ArrowCol,ArrowRow-3] = INVERTER) and
                     (Connections[ArrowCol,ArrowRow-3] = 0))
  end;

  PROCEDURE AddorRemTrack(opt : integer);
  begin
    repeat
      Abort := false;
      DrawStartTrackOptions; Exit := false; AddBlob := false;
      repeat
        GetOption;
        if Command = Grid then
          if GridInfo[ArrowCol,ArrowRow-3] = None then Command := Ziltch
      until (Command in [Grid,InputLetter]) or CheckExit;
      if (Command in [Grid,InputLetter]) then begin
        StartCol := ArrowCol; StartRow := ArrowRow;
        if Not Exit or (Command = Ziltch) then begin
          DrawEndTrackOptions;
          repeat
            GetOption;
            if Command = Grid then
              if (GridInfo[ArrowCol,ArrowRow-3] = None) or
                 (ArrowCol <= StartCol) then Command := Ziltch
            until NOT(Command in [Ziltch,InputLetter]);
            case Command of
              Option : if CheckExit then Exit := true;
              Grid,
              OutPutLetter
                 : begin
                     EndCol := ArrowCol; EndRow := ArrowRow;
                     case opt of
                     AddTrak : if EnoughRoom then begin
                                 StartX := ColPos(StartCol)+31;
                                 StartY := RowPos(StartRow-2)-10;
                                 if CheckForTracks then MovePointer;
                                 if Not Exit then DoAddTrack;
                                 Exit := true
                               end else Beep;
                     RemTrak : RemoveTrack
                     end { opt case }
                   end
            end { command case }
        end
      end
    until Exit or CheckExit;
    if Abort then RedrawCircuit;
    CommandNum := 0
  end;

  PROCEDURE ClearGrid;    { Clear out all grid info }
  begin
    for Column := 1 to 8 do for row := 1 to 6 do begin
      GridInfo[Column,row] := None;
      Connections[Column,row] := 0; GateDefs[Column,row] :=
    end
  end;
```



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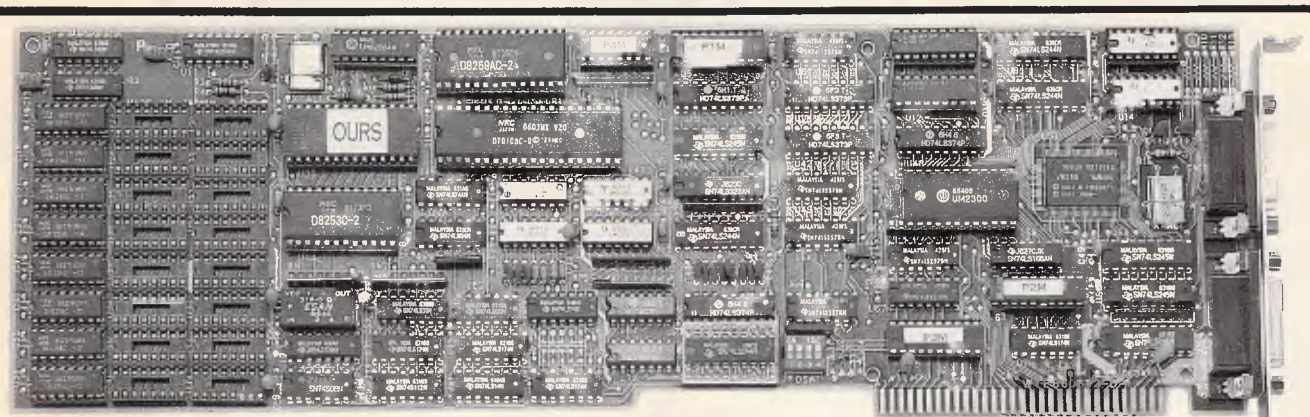

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Workststion interface	Keyboard, monitor, serial and parallel connector
Warranty	1 year limited warranty

```
PROCEDURE SubEval;  { Evaluate part of the expression. Return 1 or 0 }
begin
  T := pred(length(Stk)); while Stk[T] = ')' do T := pred(T);
  Mem := T; Ex := ''; T := succ(T);
  repeat Ex := Ex + Stk[T]; T := succ(T) until T > length(Stk);
  Ex := Ex + '*'; Value := (Ex[1] = '1'); T := 2;
  while Ex[T] <> '*' do begin
    case Ex[T] of
      '.' : Value := Value and (Ex[Succ(T)] = '1');
      '+' : Value := Value or (Ex[Succ(T)] = '1');
    end;
    T := succ(succ(T))
  end;
  if Mem = 1 then Stk := chr(48 + ord(Value))
  else begin
    if Stk[Pred(Mem)] = '-' then begin
      Mem := Pred(Mem); Value := NOT Value
    end;
    if Mem = 1 then Stk := chr(48 + ord(Value))
    else Stk := copy(Stk,1,pred(Mem))+chr(48 + ord(Value))
  end
end;
PROCEDURE Out(S : Strfield);       { Print to screen or printer }
begin if OutDev = 0 then write(S) else write(lst,S) end;

PROCEDURE Outln(S : Strfield);       { Print to screen or printer }
begin if OutDev = 0 then writeln(S) else writeln(lst,S) end;

PROCEDURE OutSp(n : integer); begin for i := 1 to n do Out(Space) end;

PROCEDURE EVAL;  { Evaluate the whole expression }
var outi : integer;
begin
  OutSp(8);
  for loop := TopRange downto LowRange do Out(State[loop]+'  '); OutSp(13);
  for Outi := 1 to 3 do begin
    if UseOut[Outi] then begin
      Stk := '  '; Eptr := 1; Expr := DefOut[Outi];
      while Expr[Eptr] <> '*' do begin
        case Expr[Eptr] of
          '(' : SubEval;
          'A'..'F' : Stk := Stk + State[ord(Expr[Eptr])];
          else       Stk := Stk + Expr[Eptr]
        end;
        Eptr := succ(Eptr)
      end; Out(Stk); OutSp(2)
    end else begin Out('-'); OutSp(2) end
  end; Outln('');
end;

FUNCTION AddBrackets(S : Strfield) : boolean;
var add : boolean; p : integer;
begin
  if S[1] <> '(' then add := true
  else begin
    i := 1; p := 1;
    repeat
      p := succ(p);
      if S[p] = '(' then i := succ(i);
      if S[p] = ')' then i := pred(i)
    until i = 0;
    Add := p <> length(S)
  end;
  AddBrackets := Add
end;

FUNCTION Proc(S : Strfield) : Strfield; { Format expression for screen }
begin
  S[0] := chr(pred(length(S)));
  while NOT AddBrackets(S) do S := copy(S,2,length(S)-2);
  Proc := S
end;

PROCEDURE DisplayTable;  { Display circuit result.  Part of PROCESS }
var F,S,N : integer;
    CarryOverTop,NoChange : boolean;
begin
  TextMode(BW80); if OutDev = 1 then write('Printing in Progress  ');
  Outln('Output Definitions For '''+FName+''' :-'); Outln('');
  for loop := 1 to 3 do if UseOut[loop] then
    Outln('   '+chr(87+loop)+' = '+Proc(DefOut[loop]));
  Outln(''); Outln('INPUTS  F  E  D  C  B  A      OUTPUTS  X  Y  Z');
  Outln(' ');
  for loop := LowRange to TopRange do
    if UseInp[loop] then State[loop] := '0' else State[loop] := 'X';
  CarryOverTop := false; NoChange := true; Eval;
  F := LowRange;
  while NOT UseInp[F] do F := succ(F);
  repeat
    if State[F] = '0' then State[F] := '1'
    else begin
      S := F; State[S] := '0';
      repeat
        if S = TopRange then CarryOverTop := true
        else begin
          N := succ(S); Exit := false;
          while NOT Exit and NOT CarryOverTop do begin
            if UseInp[N] then Exit := true
            else if N = TopRange then CarryOverTop := true
                 else N := succ(N)
          end;
          if NOT CarryOverTop then
            if State[N] = '0' then begin State[N] := '1'; NoChange := true end
            else begin
              State[N] := '0'; NoChange := false; S := N
            end
        end
      until NoChange or CarryOverTop
    end;
    if NOT CarryOverTop then Eval
  until CarryOverTop; if OutDev = 0 then writeln else writeln(lst,FFeed);
  write(' Press A Key to Continue'); Read(Kbd,c); Hires; RedrawCircuit
end;

PROCEDURE Process;          { Main routine to display circuit performance }
var GateType : GateTypes;  AnyOut,first : boolean;  Strg,Temp : Strfield;

  PROCEDURE AddToStr(S : Strfield);
  begin
    if Not First then Strg := Strg + Join[ord(GateType)];
    First := false; Strg := Strg + S;
  end;

begin
  for loop := LowRange to TopRange do UseInp[loop] := false;
  for column := 1 to 8 do
    for row := 1 to 6 do
      if GridInfo[Column,row] <> None then begin
        Strg := '';
        GateType := GridInfo[Column,row]; first := true;
        WorkLine := StartLine^.LPtr;
        while WorkLine <> nil do begin
          with WorkLine^ do begin
            if (ECol = Column) and (Erow = row+3) then begin
              if (SCol = 0) then begin
                AddToStr(chr(64 + (Srow-3)));
                UseInp[64 + (SRow-3)] := true
              end
              else begin
                Temp := GateDefs[SCol,Srow-3];
                if AddBrackets(Temp) then Temp := '('+Temp+') ';
                AddToStr(Temp)
              end
            end
          end;
          WorkLine := WorkLine^.LPtr
        end;
        if GateType in [INVERTER,NANDGATE,NORGATE] then begin
          if AddBrackets(Strg) then Strg := '('+Strg+')';
          Strg := '-'+Strg
        end
        else if AddBrackets(Strg) then Strg := '('+Strg+')';
        GateDefs[Column,row] := Strg;
      end;
    AnyOut := false;
    for loop := 1 to 3 do begin
      UseOut[loop] := false; GateType := ORGATE; Strg := ''; First := true;
      WorkLine := StartLine^.LPtr;
      while WorkLine <> nil do begin
        with WorkLine^ do begin
          if (ECol = 9) and (Erow = loop*2+3) then begin
            if (SCol = 0) then begin
              AddToStr(chr(64 + (Srow-3)));
              UseInp[64 + (SRow-3)] := true
            end
```

```
              else AddToStr(' ('+GateDefs[SCol,Srow-3]+') ');
              UseOut[loop] := true; AnyOut := true
            end
          end;
          WorkLine := WorkLine^.LPtr
        end;
        if Strg[1] <> '(' then Strg := '('+Strg+')';
        DefOut[loop] := Strg+'*'
      end;
    if NOT AnyOut then Error(2)
    else begin
       OutDev := ord(GetYESorNo('Output to Printer')); DisplayTable
    end
  end;

  FUNCTION CheckGatesOk : boolean;
  begin
    CheckGatesOk := true;
    for Column := 1 to 8 do for row := 1 to 6 do
      if (GridInfo[Column,Row] in MultiInputs) and
         (Connections[Column,Row] < 2) then CheckGatesOk := false;
  end;

  PROCEDURE RemComponent;
  begin
    Exit := false; DrawRemoveGateOptions;
    repeat
      Clr25; gotoxy(25,25); write('Select Gate to Remove');
      repeat GetOption until CheckExit or (Command = Grid);
      if (Command = Grid) then
        if (GridInfo[ArrowCol,ArrowRow-3]<>None) then begin
          if GetYESorNo('Remove') then begin
            GridInfo[ArrowCol,ArrowRow-3] := None;
            Connections[ArrowCol,ArrowRow-3] := 0;
            WorkLine := StartLine^.LPtr; TempLine := StartLine;
            while WorkLine <> nil do begin
              with WorkLine^ do
                if (ECol = ArrowCol) and (ERow = ArrowRow) then begin
                  TempLine^.Lptr := WorkLine^.LPtr;
                  if WorkLine^.LPtr = nil then LastLine := TempLine
                end
                else
                  if (SCol = ArrowCol) and (SRow = ArrowRow) then begin
                    TempLine^.Lptr := WorkLine^.LPtr;
                    if WorkLine^.LPtr = nil then LastLine := TempLine;
                    Connections[ECol,ERow-3] := pred(Connections[ECol,ERow-3]);
                  end else TempLine := WorkLine;
              WorkLine := WorkLine^.LPtr
            end;
            ReDrawCircuit; Exit := true
          end
        end else Beep
    until CheckExit or Exit;
    CommandNum := 0
  end;
  FUNCTION Exists(S : Strfield) : boolean;  { Does the file exist }
  var found : boolean;
  begin
    assign(GridFile,S); {$I-} reset(GridFile) {$I+};
    Found := (IOResult = 0); if Found then Close(GridFile);
    Exists := Found;
  end;

  PROCEDURE SaveGrid;
  begin
    assign(GridFile,FName); rewrite(GridFile);
    for column := 1 to 8 do for row := 1 to 6 do begin
      writeln(GridFile,ord(GridInfo[Column,row]));
      writeln(GridFile,Connections[Column,row])
    end;
    WorkLine := StartLine^.LPtr; writeln(GridFile,0);
    while WorkLine <> nil do begin
      with WorkLine^ do begin
        writeln(GridFile,Scol); writeln(GridFile,Srow);
        writeln(GridFile,ECol); writeln(GridFile,Erow);
        writeln(GridFile,Ord(PutBlob));
        WSLine := SLPtr; writeln(GridFile,0);
        while WSLine <> nil do begin
          with WSLine^ do begin
            writeln(GridFile,SX); writeln(GridFile,SY);
            writeln(GridFile,EX); writeln(GridFile,EY)
          end;
          WSLine := WSLine^.Ptr;
          writeln(GridFile,-ord(WSLine = nil))
        end
      end;
      WorkLine := WorkLine^.LPtr;
      writeln(GridFile,-ord(WorkLine = nil))
    end;
    close(GridFile); CurCircuit := FName;
  end;

  PROCEDURE LoadGrid;
  begin
    ClearGrid; assign(GridFile,FName); reset(GridFile);
    for column := 1 to 8 do for row := 1 to 6 do begin
      readln(GridFile,i); GridInfo[Column,row] := GateTypes(i);
      readln(GridFile,Connections[Column,row])
    end;
    LastLine := StartLine; readln(GridFile,i);
    while i <> -1 do begin
      new(WorkLine); LastLine^.LPtr := WorkLine; LastLine := WorkLine;
      with WorkLine^ do begin
        readln(GridFile,Scol); readln(GridFile,Srow);
        readln(GridFile,ECol); readln(GridFile,Erow);
        readln(GridFile,i); PutBlob := (i = 1); LPtr := nil;
        new(WSLine); SLPtr := WSLine; LSLine := WSLine; readln(GridFile,i);
        with WSLine^ do begin
          readln(GridFile,SX); readln(GridFile,SY);
          readln(GridFile,EX); readln(GridFile,EY);
          Ptr := nil
        end;
        readln(GridFile,i);
        while i <> -1 do begin
          new(WSLine); LSLine^.Ptr := WSLine;
          LSLine := WSLine;
          with WSLine^ do begin
            readln(GridFile,SX); readln(GridFile,SY);
            readln(GridFile,EX); readln(GridFile,EY); Ptr := nil
          end;
          readln(GridFile,i)
        end
      end;
      readln(GridFile,i)
    end;
    close(GridFile); RedrawCircuit; CurCircuit := Fname;
  end;

  PROCEDURE GetName(S : Strfield);
  begin
    Clr25; gotoxy(18,25); write('Enter the required file name (8 chars max) ');
    Clr01; gotoxy(40,1);
    if S <> '' then write('Current Circuit = ',CurCircuit);
    gotoxy(1,1); write('Enter File Name : '); readln(FName);
  end;

  PROCEDURE MainProc;
  begin
    repeat
      DrawMasterOptions; GetOption;
      if Command = Option then
      case CommandNum of
      3 : if CheckGatesOK then Process else Error(1);
      4 : begin
            GetName(CurCircuit); if Fname <> '' then
              if NOT Exists(FName) then SaveGrid
              else if GetYESorNO('Overwrite') then SaveGrid;
          end;
      5 : begin
            repeat
              DrawEditOptions; GetOption;
              if Command = Option then
                case CommandNum of
                AddComp : AddComponent;
                RemComp : RemComponent;
                AddTrak : AddorRemTrack(AddTrak);
                RemTrak : AddorRemTrack(RemTrak);
              end else Beep
            until CheckExit;
            Command := Ziltch
          end;
      6 : if GetYESorNO('Clear') then begin
            DrawCircuitBoard; ClearGrid; CurCircuit := '';
            Release(StartData); StartLine^.LPtr := nil;
            LastLine := StartLine; GoBack := true
          end;
```

```
      7 : if GetYESorNo('Load') then begin
            GetName(FName); if FName <> '' then
              if Exists(FName) then LoadGrid else Error(3)
          end;
      8 : if GetYESorNO('Exit') then ExitProg := true;
      end else beep
    until CheckExit
  end;

  begin
    Mark(TopHeap); ExitProg := false; new(StartLine); CurCircuit := '';
    StartLine^.LPtr := nil; LastLine := StartLine;
    HiRes; DesignComponents; DrawCircuitBoard; ExitPos; ClearGrid;
    Mark(StartData);
    repeat MainProc until ExitProg;
    Release(TopHeap); TextMode(BW80);
  end.
```

Amstrad CPC In-Line Assembler

by Stephen Devine

This program sets up a number of RSX commands which provide you with an in-line assembler facility similar to that found on BBC machines. The program should run on any of the Amstrad CPC range of computers.

This method of assembly offers considerable advantages over more traditional approaches of generating machine code routines for use with Basic programs. These usually involve the use of a separate assembler, in Basic or machine code, to generate the routines. These are then either loaded into the Basic program each time it is run, or converted into long lists of Data statements containing strings of apparently meaningless hex values. With this in-line assembler, machine code instructions can be freely interspersed with normal Basic statements. This means that time-saving machine code routines can be easily incorporated into Basic programs, and the fact that they are written in assembler means that they are easily readable and can be altered at any time. Speed of assembly is also very fast, at up to 60 instructions per second!

After typing in the program in Listing 1, you should save it to tape or disk and then RUN it. If all is well, the program will set up the necessary machine code in high memory and then automatically save it for you. (If you have made any typing errors in the Data statements, the program will inform you of them. You can then correct the offending line(s) and RUN the program again.)

The saved code contains all you need in order to use the assembler. When you subsequently want to use the assembler, just add the following line at the start of your Basic program:

MEMORY 39499 : LOAD "asm.bin", 39500 : CALL 39500

This will load the assembler into memory and initialise all the RSXs ready for use.

The assembler uses 8080 mnemonics throughout, but additional commands are provided to enable all Z80 instructions to be used. All the available mnemonics are listed with the program beside their Z80 equivalents. Note that M, X+n and Y+n are used throughout in place of the Z80's (HL), (IX+n) and (IY+n).

In addition, the following special commands are provided:

IORG, addr Tells the assembler where in memory to put the generated code.

IPHASE, addr Used to asemble code at one address (as specified by the IORG command) which will later be loaded and run at the address specified with IPHASE. For example, you may wish to load an RSX way up at 40000, but you can't assemble it there directly since it would overwrite the assembler itself. Therefore, you would use something like:

```
MEMORY 29999
IORG, 30000
IPHASE, 40000
```

and then save the assembled code using:

```
SAVE "filename. bin", b ,30000,
length
```

and later re-load it with:

```
LOAD "filename. bin",40000
```

IDEFB or IDW Each is followed by a list of values (up to 32) which will be placed consecutively into memory as single bytes.

IDEFW or IDW Each is followed by a list of values (up to 32) which will be placed consecutively into memory as 16-bit words in Z80 byte-reversed format.

IDEFS,n or IDS,n Used to reserve a space of n bytes in the code generated. Note that this space is simply skipped by the assembler — it is *not* initialised to zero.

IDEFM or IDM Followed by a quoted string (6128 only) or the address of a previously initialised string variable, it inserts the specified string into memory.

IDEFC or IDC As above, except that the very last character of the string is stored with the high bit set.

ILABEL,@ var or IDEFL,@var or IDL,@var Used to assign the current assembly address to the specified Basic variable. (The variable must be previously defined and should not be used in any other ILABEL command.)

IEND Used to signal the end of the assembly.

IEND,@var As above, but loads the specified variable with the address of the next free byte after the generated code. Thus, it is equivalent to writing ILABEL,@var : IEND and, as with ILABEL, the variable must be previously defined.

IDISPLAY or IDISPLAY,1 This command causesthe message 'Assembling at &nnnn' to appear onscreen. All subsequent commands will update the displayed value as assembly progresses, which provides useful confirmation that the assembly is still proceeding and indicates where the code is being placed. If this display option is still active when an IEWND command is met, then the program will automatically display the start

and end addresses of the generated code and its total size in bytes. Note that all displayed values are in hex.

IDISPLAY,0 This command turns off the above screen display, if active. Note that the IEND command does this automatically.

The demonstration program shown in Listing 2 illustrates how to use the assembler. The important points to note are as follows:

- Only integer variables should be used throughout, hence the DEFINT a-z in Line 40.
- Space should be reserved for the machine code to be generated by setting the top of memory as shown in line 60.
- Lines 100 and 110 must be included in any program since they initialise the necessary register constants for the program to work.
- All labels used in the assembler must first be declared, as in line 120.
- The assembler statements should all be executed twice (lines 180 and 350) to make sure that all forward-referenced labels are assigned the correct address.
- All programs must have an IORG command and this must be executed before any other command.
- If an IPHASE command is used, it must immediately follow the IORG command.
- Multiple commands are allowed on a line.
- Comments may be included using the normal Basic ' or REM.
- Conditional assembly is possible using IF . . . THEN statements; or IF . . . THEN . . . ELSE statements for short pieces of code on a single line; or WHILE . . . WEND structures for more substantial amounts of code.
- Limited macro facilities are possible using Basic's GOSUB command, and repeat operations can be assembled using FOR . . . NEXT structures.

It is also possible to use the assembler from the command level without having to construct a program. For instance, try entering the following:

```
MEMORY 29999
A =7
IORG, 30000
IMVI, A,224
ICALL, &BB5A
IRET
IEND
```

Now type:

```
CALL 30000
```

and you should see a smiling face appear on the screen! However, this method of entering code is not really recommended, even for very short programs, since it is much too easy to make a mistake. It is far better to write a proper program and save it to tape or disk before assembling and running it.

If desired, the names of any of the commands can be altered simply by changing the entries in lines 3000 to 3250 in Listing 1 and then re-running the program. However, ensure that no names are removed or added and that the entries remain in exactly the same order as in the original listing. Also, each name should only contain valid RSX characters such as A to Z.

```
10 REM Assembler Demo Program
20 REM ************************
30 '
40 DEFINT a-z  : REM Use integer variables throughout.
50 start=30000 : REM Address to assemble machine-code.
60 MEMORY start-1 : REM Reserve space for machine-code.
70 LOAD"asm.bin",39500 : REM LOAD assembler into high memory.
80 CALL 39500 : REM Set up RSX commands.
90 REM Initialize register constants.
100 B=0 : C=1 : D=2 : E=3 : H=4 : L=5 : M=6 : A=7
```

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *6663#.

```
110 X=384 : Y=640 : PSW=7 : SP=6
120 loop=0 : REM Initialize label used in assembly listing.
130 setmode=&BC0E : scrnmode=1 : REM Define some constants.
140 '
150 REM Demonstration routine to display ASCII character set.
160 REM ------------------------------------------------------
170 '
180 FOR pass=1 TO 2
190   PRINT"PASS";pass
200   IF pass=1 THEN !DISPLAY,0 ELSE !DISPLAY,1
210 '
220   !ORG,start
230   !MVI,a,scrnmode                 'Set the
240   !CALL,setmode                   'screen mode.
250   !MVI,a,ASC(" ")                 'Initialize 1st character
260   !MVI,b,128-ASC(" ")             'and character count.
270 '
280 !LABEL,@loop
290   !CALL,&BB5A                     'Display character
300   !INR,a                          'and move to next one.
310   !DJNZ,loop                      'Continue until all done.
320   !RET                            'Return to BASIC.
330   !END
340 '
350 NEXT pass
360 PRINT"Type CALL";start;"to run machine code." : PRINT
370 END
```

```
   REM Amstrad in-line assembler
   REM  (C) 1987 Stephen Devine
30 '
40 DEFINT a-z
50 start=&9A4C      'Load address for RSX (39500 decimal)
60 MEMORY start-1   'Reserve space for RSX
70 '
80 PRINT : PRINT "Running..."
90 address=start
100 FOR dataline=1000 TO 2310 STEP 10
110  sum=0
120  FOR byte=1 TO 16
130    READ a$ : num=VAL("&"+a$)
140    POKE address,num : address=address+1
150    sum=sum+num
160  NEXT byte
170  READ checksum
180  IF sum()checksum THEN PRINT "Checksum Error in line";dataline : a
bort=-1
190 NEXT dataline
200 IF abort THEN PRINT "Please correct offending line(s) and re-RUN t
he program." : END
210 '
220 address=address-5
230 FOR command=1 TO 161
240   READ word$ : word$=UPPER$(word$)
250   FOR letter=1 TO LEN(word$)-1
260     POKE address,ASC(MID$(word$,letter))
270     address=address+1
280   NEXT letter
290   POKE address,ASC(RIGHT$(word$,1))+128
300   address=address+1
310 NEXT command
320 POKE address,0 : address=address+1
330 '
340 PRINT"Machine code loaded ok."
350 CALL start
360 PRINT : PRINT "Saving RSX..."
370 SAVE "asm.bin",b,start,address-start
380 PRINT"Saved ok." : PRINT
390 END
400 '
1000 DATA 01,5A,9A,21,56,9A,CD,D1,BC,C9,00,00,00,00,87,A2,1618
1010 DATA C3,3F,9C,C3,52,9C,C3,6A,9C,C3,5C,9C,C3,5C,9C,C3,2385
1020 DATA 5C,9C,C3,B4,9C,C3,B4,9C,C3,D5,9C,C3,D5,9C,C3,FC,2885
1030 DATA 9C,C3,FC,9C,C3,13,9D,C3,13,9D,C3,37,9D,C3,37,9D,2315
1040 DATA C3,EC,9D,C3,0F,9E,C3,13,9E,C3,17,9E,C3,1B,9E,C3,2279
```

```
1050 DATA 1F,9E,C3,23,9E,C3,27,9E,C3,2B,9E,C3,2F,9E,C3,33,2011
1060 DATA 9E,C3,37,9E,C3,3B,9E,C3,3F,9E,C3,43,9E,C3,47,9E,2238
1070 DATA C3,4B,9E,C3,4F,9E,C3,53,9E,C3,57,9E,C3,5B,9E,C3,2375
1080 DATA 5F,9E,C3,63,9E,C3,67,9E,C3,6B,9E,C3,6F,9E,C3,73,2395
1090 DATA 9E,C3,77,9E,C3,7B,9E,C3,7F,9E,C3,83,9E,C3,87,9E,2558
1100 DATA C3,8B,9E,C3,8F,9E,C3,93,9E,C3,97,9E,C3,9B,9E,C3,2695
1110 DATA 9F,9E,C3,A3,9E,C3,A7,9E,C3,AB,9E,C3,AF,9E,C3,B3,2779
1120 DATA 9E,C3,B7,9E,C3,BB,9E,C3,BF,9E,C3,C3,9E,C3,C7,9E,2878
1130 DATA C3,CB,9E,C3,CF,9E,C3,D3,9E,C3,D7,9E,C3,DB,9E,C3,3015
1140 DATA DF,9E,C3,E3,9E,C3,E7,9E,C3,EB,9E,C3,EF,9E,C3,F3,3163
1150 DATA 9E,C3,F7,9E,C3,FB,9E,C3,FF,9E,C3,03,9F,C3,07,9F,2688
1160 DATA C3,0B,9F,C3,0F,9F,C3,13,9F,C3,17,9F,C3,1B,9F,C3,2060
1170 DATA 1F,9F,C3,23,9F,C3,27,9F,C3,2B,9F,C3,2F,9F,C3,33,2016
1180 DATA 9F,C3,37,9F,C3,3B,9F,C3,3F,9F,C3,43,9F,C3,47,9F,2244
1190 DATA C3,4B,9F,C3,4F,9F,C3,81,9F,C3,90,9F,C3,A5,9F,C3,2557
1200 DATA A9,9F,C3,AD,9F,C3,B1,9F,C3,DE,9F,C3,E5,9F,C3,EC,2976
1210 DATA 9F,C3,F0,9F,C3,F4,9F,C3,2A,A0,C3,40,A0,C3,44,A0,2590
1220 DATA C3,48,A0,C3,4C,A0,C3,50,A0,C3,54,A0,C3,58,A0,C3,2370
1230 DATA 5C,A0,C3,60,A0,C3,64,A0,C3,68,A0,C3,6C,A0,C3,70,2387
1240 DATA A0,C3,74,A0,C3,78,A0,C3,7C,A0,C3,80,A0,C3,84,A0,2555
1250 DATA C3,88,A0,C3,8C,A0,C3,90,A0,C3,94,A0,C3,98,A0,C3,2690
1260 DATA 9C,A0,C3,F6,A0,C3,2B,A1,C3,2F,A1,C3,33,A1,C3,37,2373
1270 DATA A1,C3,3B,A1,C3,48,A1,C3,55,A1,C3,64,A1,C3,6D,A1,2366
1280 DATA C3,7F,A1,C3,86,A1,C3,8A,A1,C3,B0,A1,C3,B4,A1,C3,2730
1290 DATA B8,A1,C3,BC,A1,C3,C0,A1,C3,C4,A1,C3,C9,A1,C3,CE,2947
1300 DATA A1,C3,D2,A1,C3,D6,A1,C3,DA,A1,C3,DE,A1,C3,E3,A1,3032
1310 DATA C3,E8,A1,DD,6E,00,DD,66,01,22,81,A2,22,85,A2,3A,1955
1320 DATA 7F,A2,B7,C4,A1,9D,DD,6E,00,DD,66,01,22,83,A2,C9,2169
1330 DATA ED,5B,83,A2,DD,6E,00,DD,66,01,73,23,72,C9,ED,5B,2069
1340 DATA 85,A2,B7,C4,60,9C,3A,7F,A2,B7,C8,AF,32,7F,A2,21,2203
1350 DATA C7,9D,CD,A8,9D,2A,81,A2,E5,CD,80,9D,21,D3,9D,CD,2544
1360 DATA A8,9D,2A,85,A2,E5,CD,80,9D,21,DD,9D,CD,A8,9D,E1,2547
1370 DATA D1,B7,ED,52,CD,80,9D,21,E7,9D,CD,A8,9D,C9,47,18,2448
1380 DATA 04,DD,23,DD,23,10,FA,C9,B7,C8,CD,AA,9C,2A,85,A2,2234
1390 DATA ED,5B,83,A2,47,DD,7E,00,77,13,23,DD,2B,DD,2B,10,1756
1400 DATA F4,22,85,A2,ED,53,83,A2,C9,B7,C8,CD,AA,9C,2A,85,2476
1410 DATA A2,ED,5B,83,A2,47,DD,7E,00,77,23,DD,7E,01,77,23,1857
1420 DATA 13,13,DD,2B,DD,2B,10,EE,22,85,A2,ED,53,83,A2,C9,1963
1430 DATA B7,C8,DD,5E,00,DD,56,01,2A,83,A2,19,22,83,A2,2A,1735
1440 DATA 85,A2,19,22,85,A2,C9,B7,C8,DD,6E,00,DD,66,01,7E,2014
1450 DATA B7,C8,23,5E,23,56,4F,06,00,2A,83,A2,09,22,83,A2,1389
1460 DATA 2A,85,A2,EB,ED,B0,ED,53,85,A2,C9,B7,C8,DD,6E,00,2515
1470 DATA DD,66,01,7E,B7,C8,23,5E,23,56,4F,06,00,2A,83,A2,1503
1480 DATA 09,22,83,A2,2A,85,A2,EB,ED,B0,ED,53,85,A2,EB,2B,2214
1490 DATA CB,FE,C9,F5,1F,1F,1F,1F,E6,0F,FE,0A,38,02,C6,07,1799
1500 DATA C6,30,CD,5A,BB,F1,E6,0F,FE,0A,38,02,C6,07,C6,30,1987
1510 DATA CD,5A,BB,C9,7C,CD,5F,9D,7D,CD,5F,9D,C9,3E,08,CD,2322
1520 DATA 5A,BB,3E,08,CD,5A,BB,3E,08,CD,5A,BB,3E,08,CD,5A,1746
1530 DATA BB,CD,80,9D,C9,2A,85,A2,CD,89,9D,C9,7E,B7,C8,CD,2629
1540 DATA 5A,BB,23,18,F7,0D,0A,41,73,73,65,6D,62,6C,69,6E,1532
1550 DATA 67,20,61,74,3A,26,20,20,20,20,00,0D,0A,0D,0A,53,701
1560 DATA 74,61,72,74,3A,26,00,0D,0A,20,20,45,6E,64,3A,26,1001
1570 DATA 00,0D,0A,20,53,69,7A,65,3A,26,00,0D,0A,0D,0A,00,608
1580 DATA 21,7F,A2,B7,28,11,DD,7E,00,DD,B6,01,20,09,36,00,1408
1590 DATA 21,E9,9D,CD,A8,9D,C9,36,01,21,B1,9D,CD,A8,9D,CD,2311
1600 DATA A1,9D,C9,CD,16,A2,3F,CD,16,A2,2F,CD,16,A2,27,CD,2040
1610 DATA 16,A2,F3,CD,16,A2,FB,CD,16,A2,0B,CD,16,A2,EB,CD,2293
1620 DATA 16,A2,E3,CD,16,A2,D9,CD,16,A2,76,CD,16,A2,E9,CD,2351
1630 DATA 16,A2,F9,CD,16,A2,00,CD,16,A2,37,CD,16,A2,C9,CD,2061
1640 DATA 16,A2,17,CD,16,A2,07,CD,16,A2,1F,CD,16,A2,0F,CD,1632
1650 DATA 16,A2,C0,CD,16,A2,C8,CD,16,A2,D0,CD,16,A2,D8,CD,2372
1660 DATA 16,A2,E0,CD,16,A2,E8,CD,16,A2,F0,CD,16,A2,F8,CD,2500
1670 DATA 3D,A2,E3,CD,41,A2,E3,CD,3D,A2,E9,CD,41,A2,E9,CD,2640
1680 DATA 3D,A2,F9,CD,41,A2,F9,CD,37,A2,A1,CD,37,A2,A9,CD,2532
1690 DATA 37,A2,B1,CD,37,A2,B9,CD,37,A2,A2,CD,37,A2,AA,CD,2382
1700 DATA 37,A2,B2,CD,37,A2,BA,CD,37,A2,47,CD,37,A2,4F,CD,2202
1710 DATA 37,A2,57,CD,37,A2,5F,CD,37,A2,A0,CD,37,A2,A8,CD,2198
1720 DATA 37,A2,B0,CD,37,A2,B8,CD,37,A2,44,CD,37,A2,A3,CD,2279
1730 DATA 37,A2,AB,CD,37,A2,B3,CD,37,A2,BB,CD,37,A2,45,CD,2294
1740 DATA 37,A2,4D,CD,37,A2,6F,CD,37,A2,67,CD,EC,A1,80,CD,2287
1750 DATA EC,A1,88,CD,EC,A1,A0,CD,EC,A1,B8,CD,EC,A1,B0,CD,3064
1760 DATA EC,A1,90,CD,EC,A1,98,CD,EC,A1,A8,CD,1A,A2,C6,CD,2861
1770 DATA 1A,A2,CE,CD,1A,A2,E6,CD,1A,A2,FE,CD,1A,A2,F6,CD,2508
1780 DATA 1A,A2,D6,CD,1A,A2,DE,CD,1A,A2,EE,0E,10,18,18,0E,1740
1790 DATA 00,18,14,0E,18,18,10,0E,08,18,0C,0E,20,18,08,0E,272
1800 DATA 28,18,04,0E,38,18,00,DD,CB,01,46,28,05,CD,4D,A2,1146
1810 DATA 18,09,DD,CB,01,4E,28,13,CD,51,A2,CD,45,A2,DD,7E,1826
1820 DATA 00,D6,80,57,3E,06,81,5F,C3,62,A2,CD,45,A2,DD,7E,1959
1830 DATA 00,81,C3,55,A2,DD,7E,00,FE,08,30,03,87,87,87,C6,1834
1840 DATA C7,C3,55,A2,DD,7E,00,B7,20,04,CD,37,A2,46,3D,20,1792
1850 DATA 04,CD,37,A2,56,CD,37,A2,5E,CD,1A,A2,DB,CD,1A,A2,2033
1860 DATA D3,0E,05,18,02,0E,04,DD,CB,01,46,28,05,CD,4D,A2,1258
1870 DATA 18,09,DD,CB,01,4E,28,10,CD,51,A2,3E,30,81,57,DD,1587
1880 DATA 7E,00,D6,80,5F,C3,62,A2,DD,7E,00,87,87,87,81,C3,2094
```

```
1890 DATA 55,A2,CD,49,A2,0E,40,18,EF,CD,49,A2,0E,41,18,E8,1803
1900 DATA 0E,40,18,06,0E,80,18,02,0E,C0,DD,46,00,DD,CB,01,1198
1910 DATA 46,28,05,CD,4D,A2,18,09,DD,CB,01,4E,28,12,CD,51,1439
1920 DATA A2,CD,45,A2,DD,7E,00,D6,80,CD,55,A2,06,06,18,03,1778
1930 DATA CD,45,A2,DD,7E,02,87,87,87,81,80,C3,55,A2,0E,10,1919
1940 DATA DD,6E,00,DD,66,01,ED,5B,83,A2,B7,ED,52,2B,2B,51,1945
1950 DATA 5D,C3,62,A2,0E,18,18,E8,0E,20,18,E4,0E,28,18,E0,1442
1960 DATA 0E,30,18,DC,0E,38,18,D8,CD,21,A2,CD,CD,21,A2,C4,1817
1970 DATA CD,21,A2,CC,CD,21,A2,D4,CD,21,A2,DC,CD,21,A2,E4,2464
1980 DATA CD,21,A2,EC,CD,21,A2,F4,CD,21,A2,FC,CD,21,A2,C3,2527
1990 DATA CD,21,A2,C2,CD,21,A2,CA,CD,21,A2,D2,CD,21,A2,DA,2424
2000 DATA CD,21,A2,E2,CD,21,A2,EA,CD,21,A2,F2,CD,21,A2,FA,2552
2010 DATA 0E,40,DD,CB,03,46,28,05,CD,4D,A2,18,09,DD,CB,03,1524
2020 DATA 4E,28,13,CD,51,A2,3E,30,81,DD,86,00,57,DD,7E,02,1613
2030 DATA D6,80,5F,C3,62,A2,DD,CB,01,46,28,05,CD,4D,A2,18,1900
2040 DATA 09,DD,CB,01,4E,28,16,CD,51,A2,DD,7E,02,87,87,87,1776
2050 DATA 81,C6,06,57,DD,7E,00,D6,80,5F,C3,62,A2,DD,7E,02,2008
2060 DATA 87,87,87,81,DD,86,00,C3,55,A2,DD,CB,03,46,28,04,1872
2070 DATA 16,DD,18,08,DD,CB,03,4E,28,13,16,FD,1E,36,CD,62,1501
2080 DATA A2,DD,7E,02,D6,80,57,DD,5E,00,C3,62,A2,DD,7E,02,2059
2090 DATA 87,87,87,C6,06,57,DD,5E,00,C3,62,A2,CD,49,A2,0E,1920
2100 DATA 4A,18,5F,0E,09,18,5B,0E,0B,18,57,0E,03,18,53,0E,605
2110 DATA C1,DD,7E,00,FE,07,20,4A,CD,16,A2,F1,0E,C5,DD,7E,2095
2120 DATA 00,FE,07,20,3D,CD,16,A2,F5,CD,4D,A2,DD,CB,01,46,1927
2130 DATA 0E,09,3E,04,20,47,18,42,CD,51,A2,DD,CB,01,4E,18,1257
2140 DATA EF,DD,23,DD,23,0E,01,CD,8E,A1,DD,56,FE,DD,5E,FF,2405
2150 DATA C3,62,A2,CD,49,A2,0E,42,18,08,0E,02,18,04,0E,0A,1075
2160 DATA 18,00,DD,CB,01,46,28,05,CD,4D,A2,18,09,DD,CB,01,1466
2170 DATA 4E,28,07,CD,51,A2,DD,36,00,04,DD,7E,00,87,87,87,1604
2180 DATA 81,C3,55,A2,CD,21,A2,3A,CD,21,A2,32,CD,2E,A2,4B,1967
2190 DATA CD,2E,A2,5B,CD,21,A2,2A,CD,4D,A2,18,F7,CD,51,A2,2109
2200 DATA 18,F2,CD,2E,A2,7B,CD,2E,A2,43,CD,2E,A2,53,CD,21,2016
2210 DATA A2,22,CD,4D,A2,18,F7,CD,51,A2,18,F2,CD,2E,A2,73,2153
2220 DATA DD,CB,01,46,28,05,CD,4D,A2,18,09,DD,CB,01,4E,28,1560
2230 DATA 11,CD,51,A2,E1,3E,06,86,57,DD,7E,00,D6,80,5F,C3,1958
2240 DATA 62,A2,E1,DD,7E,00,86,C3,55,A2,E1,7E,18,3B,E1,56,2153
2250 DATA DD,5E,00,18,41,E1,7E,CD,55,A2,DD,56,00,DD,5E,01,1830
2260 DATA 18,34,E1,5E,16,ED,CD,62,A2,18,EF,16,ED,E1,5E,18,1984
2270 DATA 25,16,DD,18,F8,16,FD,18,F4,3E,CB,18,0C,3E,ED,18,1719
2280 DATA 08,3E,DD,18,04,3E,FD,18,00,2A,85,A2,77,23,22,85,1316
2290 DATA A2,2A,83,A2,18,10,2A,85,A2,72,23,73,23,22,85,A2,1502
2300 DATA 2A,83,A2,18,00,23,23,22,83,A2,3A,7F,A2,B7,C8,CD,1691
2310 DATA A1,9D,C9,00,00,00,00,00,00,00,00,4F,52,C7,50,48,1031
2320 '
3000 DATA "ORG","PHASE","END","LABEL","DEFL","DL","DEFB","DB"
3010 DATA 'DEFW","DW","DEFS","DS","DEFM","DM","DEFC","DC","DISPLAY"
3020 DATA "CMC","CMA","DAA","DI","EI","XPSW","XCHG","XTHL"
3030 DATA 'EXX","HLT","PCHL","SPHL","NOP","STC","RET"
3040 DATA "RAL","RLCA","RAR","RRCA"
3050 DATA "RNZ","RZ","RNC","RC","RPO","RPE","RP","RM"
3060 DATA "XTIX","XTIY","PCIX","PCIY","SPIX","SPIY"
3070 DATA "CPIC","CPDC","CPIR","CPDR","INI","IND","INIR","INDR"
3080 DATA "LDIA","LDRA","LDAI","LDAR","LDI","LDD","LDIR","LDDR"
3090 DATA "NEG","OUTI","OUTD","OTIR","OTDR","RETN","RETI"
3100 DATA "RLD","RRD"
3110 DATA "ADD","ADC","ANA","CMP","ORA","SUB","SBB","XRA"
3120 DATA "ADI","ACI","ANI","CPI","ORI","SUI","SBI","XRI"
3130 DATA "RL","RLC","RR","RRC","SLA","SRA","SRL"
3140 DATA "RST","IM","IN","OUT","DCR","INR","INBC","OTBC"
3150 DATA "BIT","RES","SET"
3160 DATA "DJNZ","JR","JRNZ","JRZ","JRNC","JRC"
3170 DATA "CALL","CNZ","CZ","CNC","CC","CPO","CPE","CP","CM"
3180 DATA "JMP","JNZ","JZ","JNC","JC","JPO","JPE","JP","JM"
3190 DATA "MOV","MVI"
3200 DATA "DADC","DAD","DCX","INX"
3210 DATA "POP","PUSH"
3220 DATA "DADX","DADY"
3230 DATA "LXI","DSBB","STAX","LDAX","LDA","STA"
3240 DATA "LBCD","LDED","LHLD","LIXD","LIYD","LSPD"
3250 DATA "SBCD","SDED","SHLD","SIXD","SIYD","SSPD"
```

Z80	8080	Z80	8080
ADC A,r	ADC r	LD A,(nn)	LDA nn
ADC A,n	ACI n	LD r1,r2	MOV r1,r2
ADC HL,dd	DADC dd	LD r,n	MVI r,n
ADD A,r	ADD r	LD A,I	LDAI

ADD A,n	ADI n	LD A,R	LDAR
ADD HL,dd	DAD dd	LD I,A	LDIA
ADD IX,dd	DADX dd	LD R,A	LDRA
ADD IY,dd	DADY dd	LD SP,HL	SPHL
AND r	ANA r	LD SP,IX	SPIX
AND n	ANI n	LD SP,IY	SPIY
BIT n,r	BIT n,r	LD dd,nn	LXI dd,nn
CALL nn	CALL nn	LD BC,(nn)	LBCD nn
CALL C,nn	CC nn	LD DE,(nn)	LDED nn
CALL M,nn	CM nn	LD HL,(nn)	LHLD nn
CALL NC,nn	CNC nn	LD IX,(nn)	LIXD nn
CALL NZ,nn	CNZ nn	LD IY,(nn)	LIYD nn
CALL P,nn	CP nn	LD SP,(nn)	LSPD nn
CALL PE,nn	CPE nn	LD (nn),BC	SBCD nn
CALL PO,nn	CPO nn	LD (nn),DE	SDED nn
CALL Z,nn	CZ nn	LD (nn),HL	SHLD nn
CCF	CMC	LD (nn),IX	SIXD nn
CP r	CMP r	LD (nn),IY	SIYD nn
CP n	CPI n	LD (nn),SP	SSPD nn
CPD	CPDC	LDD	LDD
CPDR	CPDR	LDDR	LDDR
CPI	CPIC	LDI	LDI
CPIR	CPIR	LDIR	LDIR
CPL	CMA	NEG	NEG
DAA	DAA	NOP	NOP
DEC r	DCR r	OR r	ORA r
DEC dd	DCX dd	OR n	ORI n
DI	DI	OTDR	OTDR
DJNZ n	DJNZ n	OTIR	OTIR
EI	EI	OUTD	OUTD
EX (SP),HL	XTHL	OUTI	OUTI
EX (SP),IX	XTIX	OUT (C),r	OTBC r
EX (SP),IY	XTIY	OUT (n),A	OUT n
EX AF,AF'	XPSW	POP dd	POP dd
EX DE,HL	XCHG	PUSH dd	PUSH dd
EXX	EXX	RES n,r	RES n,r
HALT	HLT	RET	RET
IM 0	IM 0	RET C	RC
IM 1	IM 1	RET M	RM
IM 2	IM 2	RET NC	RNC
IN A,(n)	IN n	RET NZ	RNZ
IN r,(C)	INBC r	RET P	RP

INC r	INR r	RET PE	RPE
INC dd	INX dd	RET PO	RPO
IND	IND	RET Z	RZ
INDR	INDR	RETI	RETI
INI	INI	RETN	RETN
INIR	INIR	RL r	RL r
JP nn	JMP nn	RLA	RAL
JP (HL)	PCHL	RLC r	RLC r
JP (IX)	PCIX	RLCA	RLCA
JP (IY)	PCIY	RLD	RLD
JP C,nn	JC nn	RR r	RR r
JP M,nn	JM nn	RRA	RAR
JP NC,nn	JNC nn	RRC r	RRC r
JP NZ,nn	JNZ nn	RRCA	RRCA
JP P,nn	JP nn	RRD	RRD
JP PE,nn	JPE nn	RST n	RST n
JP PO,nn	JPO nn	SBC A,r	SBB r
JP Z,nn	JZ nn	SBC A,n	SBI n
JR n	JR n	SBC HL,dd	DSBB dd
JR C,n	JRC n	SCF	STC
JR NC,n	JRNC n	SET n,r	SET n,r
JR NZ,n	JRNZ n	SLA r	SLA r
JR Z,n	JRZ n	SRA r	SRA r
LD (BC),A	STAX B	SRL r	SRL r
LD (DE),A	STAX D	SUB r	SUB r
LD (nn),A	STA nn	SUB n	SUI n
LD A,(BC)	LDAX B	XOR r	XRA r
LD A,(DE)	LDAX D	XOR n	XRI n

Z80

r: A B C D E H L (HL) (IX+n) (IY+n)

dd: AF BC DE HL IX IY SP

8080

r: A B C D E H L M X+n Y+n

dd: PSW B D H X Y SP

BBC Interrupt-Driven Breakout

by Andrew Rolands

This program is a machine code version of the game Breakout. The keys used to play are 'Z', 'X' and the space bar; ESC is used to leave the program. The program is controlled by interrupts and runs at such a speed that it doesn't interfere with the normal operation of the computer. Consequently it can be used while the BBC is doing something else like loading another program from cassette or disk. This is what the example program has been set up to do. Other uses are also possible — for example, while recalculating a very large and complex spreadsheet — but these may be difficult to implement.

The object code for the program is under 1k in length and can be located anywhere in memory.

To try the program, type in the two short Basic programs, saving the second as 'NEXTPRO'; then type in the assembly language listing. Save it before running it in case anything goes wrong, then run it and correct any errors. When all errors have been removed, save the machine code and data as in lines 1880 and 1890. If you are using tape, save the first Basic program followed by the machine code and finally the second Basic program.

When everything is working correctly, you can swap NEXTPRO for any Basic program of your own and even alter the first program to suit yourself. You must insert lines 50 to 300 of the first program and 60 to 150 of the second program in whatever you replace them with.

The program uses standard operating system calls that are well- documented elsewhere, and should work on all the BBC machines without modification. The only exception is that users with Basic 1 have to alter the EQUB and EQUS statements. These can be replaced in the following manner by leaving the assembler temporarily, using indirection operators and POKEing the data directly into memory. For example:

replace EQUS "TODAY' by

```
JMP label1
]
$P%="TODAY"
P%=P%+LEN("TODAY")+1
[
```

replace EQUB 10:EQUB 20:EQUB 66 by

```
JMP label2
]
?P%=10
P%?1=20
P%?2=66
P%=P%+3
[
```

The program makes use of the vertical sync interrupt and uses several of these per cycle of movement within the program: the first interrupt will move the bat, the next the ball, and so on. The only way the author could achieve the movement quickly enough was to use character graphics.

Operating system calls are used throughout the program to print characters, and so on. These are made to addresses from &FF00 to &FFFF and redirected back to &200 to &2FF.

```
   10 REM INTERRUPT DRIVEN BREAKOUT
   20 REM (c) ANDREW ROWLANDS 1986
   30 REM FOR ALL BBC's OR ELECTRON
   40 :
   50 VDU 23,224,0,254,254,254,254,254,254,254,254 :REM USER DEFINED CHARACTER FOR B
   60 VDU 23,226,255,255,0,0,0,0,0,0 :REM BAT
   70 VDU 23,225,0,24,60,60,60,60,24,0 :REM BALL
   80 :
   90 REM LOAD MACHINE CODE AND SWITCH OFF ESCAPE KEY
  100 *LOAD zerodat 70
  110 *LOAD code 5000
  120 *FX 14,6
  130 :
  140 REM SET THE INTERRUPT VECTORS TO POINT TO THE START OF THE MACHINE CODE
  150 ?&220 = &5000 MOD 256
  160 ?&221 = &5000 DIV 256
  170 :
  180 MODE 5
  190 VDU 23;8202;0;0;0; :REM SWTCH FLASHING CURSOR OFF
  200 VDU 19,2,2,0,0,0 :REM CHANGE LOGICAL COLOUR 2 (YELLOW) TO ACTUAL COLOUR 2
(GREEN)
  210 REM ENABLE START OF VERTICAL SYNC EVENT
  220 *FX 14,4
  230 :
  240 TIME=0 :REPEAT UNTIL TIME > 1000 :REM WAIT FOR A BIT BEFORE LOADING THE PR
OGRAM (ARBITRARY)
  250 :
  260 REM FOR CASSETTE PUT *TAPE AND *OPT1,2 ON SEPARATE LINES HERE
  270 REM *OPT1,2 SWITCHES OFF THE CASSETTE MESSAGES
  280 :
  290 REM THE NAME OF THE PROGRAM TO BE LOADED WHILST THE GAME IS PLAYING
  300 CHAIN"NEXTPRO"
  310 :
  320 END
>
 1) REM INTERRUPT DRIVEN BREAKOUT
 2) REM (c) ANDREW ROWLANDS 1986
 30 REM FOR ALL BBC's OR ELECTRON
 40 :
 50 REM DATA HELD IN ZERO PAGE REDUCE SIZE OF CODE AND INCREASE ITS SPEED
 60 oswrch=&FFEE:osword=&FFF1:osbyte=&FFF4:osasci=&FFE3
 70 P% = &70
 80 [OPT 2
 90 .pixelcolour
100 EQUB 0:EQUB 0:EQUB 0:EQUB 0:EQUB 0     \PIXEL COLOUR
110 .ballposit EQUB 31
120 .xball EQUB 10:.yball EQUB 27:EQUB 225:EQUB 31
130 .oldxball EQUB 0:.oldyball EQUB 0:EQUB 32
140 .xincball EQUB 255:.yincball EQUB 255
150 .score EQUB 0:EQUB 0
160 .lives EQUB 3
170 .batposit
180 EQUB 31:EQUB 0:EQUB 30:EQUB 0:EQUB 0
190 .xbat EQUB 10
200 .temp EQUB 0:.temp2 EQUB 0
210 .numbrik EQUB
220 ]
230 :
240 REM MAIN CODE FOR PROGRAM
250 FOR PASS = 0 TO 2 STEP 2
260 P% = &5000
270 [OPT PASS
280 .boundary     \DRAW THE BOUNDARY AND PRINT THE SCORE etc
290 PHP:PHA:TXA:PHA:TYA:PHA
300 LDA xbat:STA initX:LDX £0
310 .jum1 LDA bound,X
320 JSR oswrch:INX:CPX £51:BNE jum1
330 LDA £(bricks MOD 256):STA &220
340 LDA £(bricks DIV 256):STA &221
350 PLA:TAY:PLA:TAX:PLA:PLP:RTS
360     \DRAW THE BRICKS ON THE SCREEN USING ONE INTERRUPT PER ROW
370 .bricks
380 PHP:PHA:TXA:PHA:TYA:PHA
390 LDA £30:JSR oswrch:LDA £10:JSR oswrch
400 LDA £0:STA numbrik:LDA £1:STA temp:STA temp2
410 LDA £(bricks2 MOD 256):STA &220:LDA £(bricks2 DIV 256):STA &221
420 PLA:TAY:PLA:TAX:PLA:PLP:RTS
430 .bricks2 PHP:PHA:TXA:PHA:TYA:PHA
440 LDA temp:CMP £5:BNE forw2:INC temp2
450 .forw2 LDA temp:CMP £10:BNE forw3:INC temp2
460 .forw3 LDA £17:JSR oswrch:LDA temp2:JSR oswrch:LDA £9:JSR oswrch
470 .bak1 LDX £1
480 .bak2 LDA £224:JSR osasci:INX:CPX £19:BNE bak2
490 LDA £9:JSR oswrch:INC temp:LDA £15:CMP temp:BCC forw1
500 PLA:TAY:PLA:TAX:PLA:PLP:RTS
510 .forw1
520 LDA £(codebat MOD 256):STA &220:LDA £(codebat DIV 256):STA &221
530 PLA:TAY:PLA:TAX:PLA:PLP
```

```
  540 .exit5 RTS
  550 .bound      \DATA FOR THE BOUNDARY etc
  560 EQUB 18:EQUB 0:EQUB 1
  570 EQUB 25:EQUB 4:EQUB 40 MOD 256:EQUB 40 DIV 256:EQUB 0:EQUB 0
  580 EQUB 25:EQUB 5:EQUB 40 MOD 256:EQUB 40 DIV 256:EQUB 1000 MOD 256:EQUB 1000
 DIV 256
  590 EQUB 25:EQUB 5:EQUB 1232 MOD 256:EQUB 1232 DIV 256:EQUB 1000 MOD 256:EQUB
1000 DIV 256
  600 EQUB 25:EQUB 5:EQUB 1232 MOD 256:EQUB 1232 DIV 256:EQUB 0:EQUB 0
  610 EQUB 31:EQUB 1:EQUB 31
  620 EQUS "LI 3   SCORE 0000":EQUB 31
  630 .initX EQUB 10:EQUB 30:EQUB 226
  640 .ball      \SECTION TO MOVE AND DISPLAY BALL
  650 PHP:PHA:TXA:PHA:TYA:PHA
  660 JSR forw5
  670 LDA £(ballhitbat MOD 256):STA &220:LDA £(ballhitbat DIV 256):STA &221
  680 PLA:TAY:PLA:TAX:PLA:PLP:RTS
  690 .forw5 LDA xball:PHA:STA oldxball:LDA yball:STA oldyball
  700 CLC:ADC yincball:STA yball
  710 PLA:CLC:ADC xincball:STA xball
  720 PHA:CMP £1:BNE j1:LDA £1:STA xincball
  730 .j1 PLA:CMP £18:BNE j2:LDA £255:STA xincball
  740 .j2 LDA yball:CMP £1:BNE j3:LDA £1:STA yincball
  750 .j3 JMP printball
  760 .pixpoi      \CHECK FOR A COLLISION BETWEEN THE BALL AND A BRICK BY CHECKIN
G THE COLOUR NEAR IT
  770 PHP:PHA:TXA:PHA:TYA:PHA
  780 JSR forw7:LDA £(codebat MOD 256):STA &220:LDA £(codebat DIV 256):STA &221
  790 PLA:TAY:PLA:TAX:PLA:PLP:RTS
  800 .forw7
  810 LDA xball:ROR A:ROR A:ROR A:PHA:AND £&C0:STA pixelcolour
  820 PLA:ROL A:AND £&1F:STA pixelcolour+1:LDA £31:SEC:SBC yball
  830 ROR A:ROR A:ROR A:ROR A:PHA:AND £&E0:STA pixelcolour+2:PLA
  840 ROL A:AND £&1F:STA pixelcolour+3:CLC:LDA pixelcolour+2:ADC £32
  850 STA pixelcolour+2
  860 LDA £0:ADC pixelcolour+3:STA pixelcolour+3
  870 LDX £pixelcolour MOD 256:LDY £pixelcolour DIV 256:LDA £9:JSR osword
  880 LDA pixelcolour+4:BEQ exit1:      \ADD SCORE
  890 EOR £3:TAX:INX:TXA:CLC:SED
  900 ADC score:STA score:LDA £0:ADC score+1:STA score+1:CLD:JSR pscore
  910 LDA yincball      \IF THE BALL HITS A BRICK THEN CHANGE ITS VERTICAL DIRECT
ION
  920 EOR £&FF:CLC:ADC £1:STA yincball:LDA £32:STA ballposit+3:DEC yball
  930 LDX £0:.jum9 LDA ballposit,X:JSR oswrch:INX:CPX £4:BNE jum9
  940 INC yball \3 LINES RESTORE REG
  950 LDA £225:STA ballposit+3:LDA yball:AND £&FE:ASL A:ASL A
  960 EOR £&FF:CLC:ADC 100
  970      \IF THE BALL HITS A BRICK THEN MAKE A SOUND, THE PITCH OF WHICH DEPEN
DS ON THE VERTICAL POSITION OF THE BRICK
  980 STA soundbrick +4:LDX £soundbrick MOD 256:LDY £soundbrick DIV 256
  990 LDA £7:JSR osword:INC numbrik
 1000 .exit1 RTS
 1010 .soundbrick EQUB 1:EQUB 0:EQUB &F7:EQUB &FF:EQUB &C0
 1020 EQUB 0     \PITCH OF SOUND
 1030 EQUB 1:EQUB 0
 1040 .printball LDX £0
 1050 .jump
 1060 LDA ballposit,X:JSR oswrch:INX:CPX £8:BNE jump:RTS
 1070 .pscore      \PRINT THE CURRENT SCORE AT THE BOTTOM OF THE SCREEN WITH LEAD
ING ZERO'S REPLACED WITH THE LETTER O
 1080 LDA £31:JSR oswrch:LDA £14:JSR oswrch:LDA £31:JSR oswrch
 1090 LDX £ASC"O":LDY £&FF:LDA score+1:JSR printscore:LDY £&FF
 1100 LDA score:JSR printscore:RTS
 1110 .printscore:PHA:LSR A:LSR A:LSR A:LSR A
 1120 JSR printit:PLA:AND £&0F
 1130 .printit BNE validch:TYA:BNE leadz
 1140 .validch LDY £0:ORA £ASC("0"):JMP osasci
 1150 .leadz TXA:JMP osasci
 1160      \MOVE AND PRINT THE BAT
 1170 .codebat PHP:PHA:TXA:PHA:TYA:PHA
 1180 JSR forw4
 1190 LDA £(ball MOD 256):STA &220:LDA £(ball DIV 256):STA &221
 1200 PLA:TAY:PLA:TAX:PLA:PLP:RTS
 1210 .forw4 LDX £158:JSR inkey:BNE zkey:LDX £189:JSR inkey:BEQ exit2
 1220 LDA xbat:CMP xbat:BCC great
 1230 .exit2 RTS
 1240 .great
 1250 LDA £226:STA batposit+3:LDA £32:STA batposit+4:DEC xbat:LDA xbat
 1260 STA batposit+1:JMP print
 1270 .zkey LDX £189:JSR inkey:BEQ next:RTS
 1280 .next LDA xbat:CMP £18:BCC less:RTS
 1290 .less LDA £32:STA batposit+3:LDA £226:STA batposit+4:LDY xbat:INC xbat
 1300 STY batposit+1
 1310 .print LDX £0
 1320 .ret LDA batposit,X:JSR oswrch:INX:CPX £5:BNE ret:RTS
 1330 .inkey LDA £129:LDY £&FF:JSR osbyte:CPY £&FF:RTS
 1340      \CHECK FOR A COLLISION BETWEEN THE BALL AND BAT AND IF SO MAKE A SOUN
D AND CHANGE THE DIRECTION OF THE BALL
 1350 .ballhitbat PHP:PHA:TXA:PHA:TYA:PHA
 1360 JSR checkend:LDA yball:CMP £16:BCC no_newwall
 1370 LDA numbrik:CMP £130      \NUMBER OF BRICKS HIT BEFORE THE WALL IS REBUILT
(1 TO 135)
 1380 BCS newwall
 1390 .no_newwall
 1400 LDA £(checksp_bar MOD 256):CMP &220:BEQ nopixpoi
 1410 LDA £(pixpoi MOD 256):STA &220:LDA £(pixpoi DIV 256):STA &221
 1420 .nopixpoi PLA:TAY:PLA:TAX:PLA:PLP:RTS
 1430 .checkend LDA yball:CMP £29:BNE exit3:JSR check3:LDA yincball
 1440 CMP £255:BNE spaceb:LDX £soundbatball MOD 256:LDY £soundbatball DIV 256
 1450 LDA £7:JSR osword
 1460 .exit3 RTS
 1470 .newwall      \IF THERE ARE ONLY A FEW BRICKS LEFT THEN PRINT A NEW WALL WA
ITING UNTIL THE BALL IS LOW ENOUGH SO THAT IT IS NOT TRAPPED WITHIN THE WALL
 1480 LDA £(bricks MOD 256):STA &220:LDA £(bricks DIV 256):STA &221
 1490 JMP nopixpoi
 1500 .spaceb
 1510 LDX £soundbatball MOD 256:LDY £soundbatball DIV 256:LDA £0
 1520 STA soundbatball:LDA £7:JSR osword:LDA £1:STA soundbatball
 1530 LDA £31:JSR oswrch:LDA xball:JSR oswrch:LDA yball:JSR oswrch
 1540 LDA £32:JSR oswrch:LDA £29:STA yball:LDA £255:STA yincball:DEC lives
 1550      \CHANGE X&Y REGISTERS
 1560 LDA £31:JSR oswrch:LDA £4:JSR oswrch:LDA £31:JSR oswrch
 1570 LDA lives:ORA £ASC("0"):JSR osasci
 1580 LDA £(checksp_bar MOD 256):STA &220
 1590 LDA £(checksp_bar DIV 256):STA &221
 1600 RTS
 1610      \CHECK TO SEE IF THE SPACE_BAR IS PRESSED AND IF SO START THE BALL MO
VING OR BEGIN A NEW GAME
 1620 .checksp_bar PHP:PHA:TXA:PHA:TYA:PHA
 1630 LDX £157   \-99 (THE SPACEBAR)
 1640 JSR inkey:BNE exit4:LDA lives:CMP £0:BNE notend1
 1650 LDA £(boundary MOD 256):STA &220:LDA £(boundary DIV 256):STA &221
 1660 LDA £0:STA score:STA score+1:LDA £3:STA lives:JMP exit4
 1670 .notend1
 1680 LDA £(codebat MOD 256):STA &220:LDA £(codebat DIV 256):STA &221
 1690 .exit4 PLA:TAY:PLA:TAX:PLA:PLP:RTS
 1700 .check3
 1710 LDA xball:CMP £18:BNE next1:LDA xbat:CMP £17:BMI next1
 1720 LDA £255:STA yincball:STA xincball:RTS
 1730 .next1
 1740 LDA xball:CMP xbat:BNE next2:LDA £255:STA yincball:RTS
 1750 .next2
 1760 LDY xbat:DEY:CPY xball:BNE next3:LDA xincball
 1770 CMP £255:BEQ skip1:LDA £255:STA xincball
 1780 .skip1 LDA £255:STA yincball
 1790 .exit13 RTS
 1800 .next3
 1810 LDY xbat:INY:CPY xball:BNE exit13:LDA xincball
 1820 CMP £1:BEQ skip2:LDA £1:STA xincball
 1830 .skip2 LDA £255:STA yincball:RTS
 1840 .soundbatball
 1850 EQUB 1:EQUB 0:EQUB &F6:EQUB &FF:EQUB 150:EQUB 0:EQUB 1:EQUB 0
 1860 ]NEXT
 1870 :
 1880 REM *SAVE zerodat 70 +1B
 1890 REM *SAVE code 5000 +3C8
   10 REM THIS IS AN EXAMPLE OF THE TYPE OF PROGRAM WHICH CAN BE LOADED WHILST P
LAYING THE GAME
   20 REM THE PROGRAM CAN BE ANY LENGTH AND CAN BE LOADED AT ANY VALID ADDRESS S
O LONG AS THE INTERRUPT MACHINE CODE OR THE SCREEN MEMORY IS NOT OVERWRITTEN
   30  REM THIS PROGRAM IS SAVED AS 'NEXTPRO'
   40 :
   50 REM RE_ENABLE THE ESCAPE KEY
   60 *FX 13,6
   70 :
   80 ON ERROR GOTO 130
   90 GOTO 90      :REM WAIT HERE UNTIL USER PRESSES ESCAPE KEY
  100 REM THE PROGRAM CAN BE CHANGED SO SOME TASK IS BEING PERFORMED WHILST WAIT
ING FOR THE ESCAPE KEY TO BE PRESSED
  110 :
  120 REM DISABLE THE START OF VERTICAL SYNC EVENT
  130 *FX 13,4
  140 :
  150 ON ERROR OFF :REM SWITCH ERROR TRAPPING OFF
  160 :
  170 REM THE MAIN PROGRAM LOADED STARTS HERE
  180 MODE6
```

```
190 PRINT' SPC(3);"The main program has NOW LOADED !"
200 PRINT SPC(7);"I hope you enjoyed playing"
210 PRINT SPC(11);"interrupt breakout"
220 PRINT SPC(1);"Prepare yourself for the next program"
```

Company Analyser

by Kevin Riordan

The booming activity on the Australian stock market of late should make Kevin Riordan's company performance analyser a welcome addition to anyone's library. It rates companies by various balance sheet criteria and runs on the Commodore 64.

Full instructions are included in the listing.

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *66637#.

```
1000 REM ********************************************************************
1001 REM **                                                                **
1002 REM **                          CROESUS                               **
1003 REM **                                                                **
1004 REM **       A PROGRAM TO ASSIST COMPANY PERFORMANCE ASSESSMENT       **
1005 REM **                                                                **
1006 REM **                    WRITTEN FOR COMMODORE 64                    **
1007 REM **                                                                **
1008 REM **                     (KEVIN RIORDAN 1986)                       **
1008 REM **                                                                **
1010 REM ********************************************************************
1011 :
1012 :
1013 REM  THIS  PROGRAM  PREPARES  MOST  OF THE WELL-KNOWN FINANCIAL RATIOS TO
1014 REM    ASSIST  THE  INVESTOR  TO ANALYSE  A COMPANY'S  PERFORMANCE  IN THE
1015 REM    MARKETPLACE.    THE USER  IS REQUIRED  TO ENTER  DETAILS  EXTRACTED
1016 REM    PRIMARILY  FROM THE BALANCE SHEET  AND INCOME STATEMENT  BUT  ALSO
1017 REM    FROM  FINANCIAL  PRESS REPORTS  ABOUT THE PRICE  AND YIELD  OF THE
1018 REM    COMPANY'S SHARES, CURRENT MARKET INTEREST RATES AND SO ON.
1019 :
1020 REM  THE PROGRAM DOES NOT DO ALL OF THE WORK.   IN ORDER TO EASE KEYBOARD
1021 REM    ENTRY,  I HAVE ARRANGED  MATTERS  SO THAT IT WILL BE NECESSARY  IN
1022 REM    SOME INSTANCES FOR THE USER TO DO  SOME SIMPLE CALCULATION OF HIS/
1023 REM    HER OWN.    IT WOULD BE  A VERY GOOD IDEA FOR ANYONE WHO INTENDS TO
1024 REM    PUT THE PROGRAM  TO SERIOUS USE  TO STUDY THE PROGRAM CODE CLOSELY
1025 REM    SO AS TO HAVE FOREKNOWLEDGE OF THE INFORMATION IT WILL DEMAND.
1026 :
1027 REM  NOW,  A WORD  ABOUT THE  FINANCIAL RATIOS,  WHICH  ARE SPLIT  BY THE
1028 REM    PROGRAM INTO SIX CATEGORIES:
1029 :
1030 REM    1. LIQUIDITY:
1031 :
1032 REM       - CURRENT RATIO:  THIS MEASURES THE FIRM'S CAPACITY TO MEET ITS
1033 REM           SHORT-TERM OBLIGATIONS.   A VALUE  BETWEEN 1.0 AND 4.5  IS
1034 REM           FAIRLY NORMAL;  OTHERWISE THE FIRM MAY EITHER HAVE TROUBLE
1035 REM           MEETING ITS SHORT-TERM BILLS OR IS NOT USING ITS ASSETS TO
1036 REM           BEST ADVANTAGE.
1037 :
1038 REM       - INVENTORY TO WORKING CAPITAL:  A HIGH VALUE MAY INDICATE THAT
1039 REM           THE FIRM  CANNOT MEET  A FINANCIAL EMERGENCY;  A LOW VALUE
1040 REM           MAY MEAN THAT IT CAN'T SATISFY ITS CLIENTS' NEEDS QUICKLY.
1041 REM           WHAT CONSTITUTES  A HIGH OR LOW VALUE  IS LARGELY A MATTER
1042 REM           FOR THE USER'S JUDGEMENT.
1043 :
1044 REM       - CURRENT DEBT TO INVENTORY:  A HIGH VALUE  REINFORCES THE VIEW
1045 REM           THAT THE FIRM WOULD BE HARD-PRESSED TO MEET OBLIGATIONS IN
1046 REM           AN EMERGENCY.  A LOW VALUE  INDICATES  THAT IT  COULD MEET
1047 REM           SHORT-TERM REQUIREMENTS WITHOUT LIQUIDATING STOCK.
1048 :
1049 REM       - QUICK RATIO:   MEASURES THE FIRM'S ABILITY TO RAISE CASH IN A
1050 REM           CRISIS.  A FIRM  WITH A HIGH PROPORTION  OF LIQUID  ASSETS
1051 REM           CAN MEET ITS OBLIGATIONS  MORE EASILY THAN ONE WHICH HAS A
1052 REM           HIGH PROPORTION OF ITS CURRENT ASSETS TIED TO INVENTORY.
1053 :
1054 REM    2. LEVERAGE:
1055 :
1056 REM       - TOTAL DEBT TO NET WORTH: A HIGH VALUE INDICATES THAT THE FIRM
1057 REM           HAS MANY CREDIT OBLIGATIONS  AND  HAS LESS MONEY AVAILABLE
1058 REM           FOR OPERATING AND PAYING THE OWNERS.
1059 :
1060 REM       - CURRENT DEBT TO NET WORTH:  MEASURES THE INTENSITY WITH WHICH
1061 REM           THE FIRM USES SHORT-TERM DEBT AND PROVIDES A BETTER NOTION
1062 REM           OF ITS SHORT-TERM POSITION THAN THE TOTAL DEBT RATIO.
1063 :
1064 REM       - FIXED ASSETS TO NET WORTH: GAUGES THE FIRM'S USE OF ITS FIXED
1065 REM           ASSETS,  ALTHOUGH CAPITAL-INTENSIVE INDUSTRIES WILL HAVE A
1066 REM           HIGHER RATIO THAN SERVICE INDUSTRIES.
1067 :
1068 REM       - TIMES INTEREST EARNED:  THE NUMBER OF TIMES INTEREST ON DEBTS
1069 REM           CAN BE PAID FROM PROFITS.
1070 :
1071 REM    3. ACTIVITY:
1072 :
1073 REM       - INVENTORY TURNOVER:    THE NUMBER OF TIMES DURING THE ACCOUNT-
1074 REM           ING PERIOD THAT THE FIRM SELLS ITS COMPLETE INVENTORY.
1075 :
1076 REM       - COLLECTION PERIOD:  THE AVERAGE NUMBER OF DAYS THE FIRM TAKES
1077 REM           TO COLLECT THE MONEY IT EARNS FROM SALES.
1078 :
1079 REM       - FIXED ASSETS TURNOVER:  MEASURES THE INTENSITY WITH WHICH THE
1080 REM           FIRM  USES ITS FIXED ASSETS  -  THE HIGHER THE RATIO,  THE
1081 REM           MORE PRODUCTIVE ARE THE ASSETS.
1082 :
1083 REM       - TOTAL ASSETS TURNOVER:    AS ABOVE FOR  BOTH FIXED AND CURRENT
1084 REM           ASSETS.
1085 :
1086 REM       - PAYABLES PERIOD:     THE AVERAGE TIME IT TAKES THE FIRM TO PAY
1087 REM           ITS BILLS.
1088 :
1089 REM    4. PROFITABILITY:
1090 :
1091 REM       - RETURN ON NET WORTH:    MEASURES EARNINGS ON OWNERS' EQUITY; A
1092 REM           HIGH RATIO  INDICATES THAT THE OWNERS' MONEY IS BEING USED
1093 REM           EFFECTIVELY TO GENERATE PROFITS.
1094 :
1095 REM       - SALES MARGIN:    COMPARES THE  AMOUNT OF PROFIT THE FIRM MAKES
1096 REM           TO THE AMOUNT OF SALES.
1097 :
1098 REM       - PRODUCTIVITY OF ASSETS:    SHOWS HOW EFFECTIVELY THE FIRM USES
1099 REM           ITS ASSETS TO  GENERATE PROFITS.     THIS RATIO WILL HAVE A
1100 REM           WIDE RANGE,  DEPENDING ON  THE INDUSTRY  IN WHICH THE FIRM
1101 REM           OPERATES,  BUT SHOULD BE  FAIRLY CONSTANT FOR A GIVEN FIRM
1102 REM           OVER A PERIOD OF TIME.
1103 :
1104 REM       - GROSS PROFIT TO SALES:    GIVES A CRUDE MEASURE  OF PROFIT PER
1105 REM           DOLLAR.
1106 :
1107 REM       - OPERATING MARGIN:     DETERMINES  THE SENSITIVITY OF INCOME TO
1108 REM           SMALL CHANGES  IN LEVELS OF SALES.    THE HIGHER THE RATIO,
1109 REM           THE MORE SENSITIVE A FIRM MAY BE JUDGED TO BE.
1110 :
1111 REM    5. COVERAGE:
1112 :
1113 REM       - FIXED CHARGE COVERAGE:    COMPARES  THE FIRM'S REVENUE  TO ITS
1114 REM           CONTRACTUAL OBLIGATIONS.     A FIRM  WITH A REASONABLY HIGH
1115 REM           RATIO CAN MEET ITS OBLIGATIONS  WITHOUT RESORTING TO MONEY
1116 REM           MANOEUVRES.
1117 :
1118 REM       - DEBT SERVICE COVERAGE:  A SIMILAR MEASURE.
1119 :
1120 REM    6. STOCK:
1121 :
```

MARC ADLER
NEW YORK WORD

Marc Adler, author of New York Word, took his Bachelors degree in Computer Science from State University of New York at Albany. He received his Masters degree, in Computer Science, from the University of Arizona. He pursued his Ph.D at the Kourant Institute of Mathematics at N.Y.U. before he determined it was hopeless. His word processing program is an easy to use, powerful, text editing and formatting tool. In fact, it contains many features such as:

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```
1122 REM        - EARNINGS PER SHARE:   THE AMOUNT OF PROFIT  GENERATED BY EACH
1123 REM             ORDINARY  SHARE.    THIS RATIO  HAS A DIRECT EFFECT ON THE
1124 REM             PRICE OF THE FIRM'S SHARES.
1125 :                                   ♦
1126 REM        - PRICE TO EARNINGS:    INDICATES  HOW THE  MARKET PERCEIVES THE
1127 REM             VALUE OF THE FIRM'S SHARES.
1128 :
1129 REM        - CAPITAL ASSET PRICING MODEL:     ILLUSTRATES  A  TECHNIQUE FOR
1130 REM             ESTIMATING  AN INVESTOR'S  REQUIRED RATE OF RETURN, TAKING
1131 REM             INTO ACCOUNT  CURRENT MARKET CONDITIONS  AND  THE INHERENT
1132 REM             RISK IN THE  INDIVIDUAL FIRM'S SHARES.   THE VOLATILITY OF
1133 REM             THE FIRM'S SHARES  IS A CRITICAL PART  OF THE EQUATION AND
1134 REM             USERS WILL  PROBABLY HAVE  MORE DIFFICULTY  WITH THIS ITEM
1135 REM             THAN  ANY OTHER REQUIRED BY THE PROGRAM.  A LOW VOLATILITY
1136 REM             RATING  INDICATES A FIRM  WHOSE SHARES  EXPERIENCE SMALLER
1137 REM             THAN  AVERAGE  PRICE FLUCTUATIONS.   A VOLATILITY VALUE OF
1138 REM             1  IS APPROPRIATE  TO A FIRM  WHICH CLOSELY FOLLOWS MARKET
1139 REM             PRICE VARIATIONS.
1140 :
1141 REM        - PROJECTED MARKET PRICE:      ESTIMATES  THE LONG-TERM  AVERAGE
1142 REM             PRICE  OF THE  FIRM'S SHARES, .TAKING INTO ACCOUNT  GROWTH
1143 REM             AND THE DIVIDENDS IT PAYS TO ITS SHAREHOLDERS.
1144 :
1145 :
1146 REM  I HAVE ARRANGED  FOR THE PROGRAM  TO RUN IN 80-COLUMN MODE,  THEREBY
1147 REM    ENSURING  THAT FINAL OUTPUT  IS  COMPLETELY  CONTAINED ON A SINGLE
1148 REM    SCREEN.   LINES 1500-2211  CONTAIN THE  NECESSARY  CODE  AND USERS
1149 REM    WHO ARE  ALREADY  USING MY PROGAM 'B@COL' (APC, APRIL 1986, PP204-
1150 REM    206) MAY OMIT THESE LINES ALTOGETHER AND SIMPLY ENTER:
1151 :
1152 REM              1500 IF X=0 THEN X=1:LOAD "B@COL",8,1
1153 REM              1501 SYS49152
1154 :
1155 REM  NOTE THAT THE  FIGURE OF .51  USED IN LINES 3308-3308 REPRESENTS THE
1156 REM    PRESENT RATE OF COMPANY TAX (49%)  EXPRESSED AS A DECIMAL FRACTION
1157 REM    AND SUBTRACTED FROM 1.   THIS IS THE ONLY CRITICAL CONSTANT IN THE
1158 REM    PROGRAM AND WILL NEED TO BE CHANGED FROM TIME TO TIME.
1159 :
1160 :
1500 PRINT"{2DOWN}CHECKING DATA LINES..{2DOWN}":P=49152
1501 FORX=2000TO2211:SUM=0:FORY=1TO16:READH$:GOSUB1505
1502 SUM=SUM+D:POKEP,D:P=P+1:NEXT:READH$:GOSUB1505:IFSUM=DTHEN1504
1503 PRINT"{2DOWN}DATA ERROR IN LINE"X"- PLEASE CHECK TYPING.":END
1504 PRINT"LINE"X"OK":NEXT:SYS49152:GOTO2500
1505 D=0:FORZ=1TOLEN(H$):A=ASC(MID$(H$,Z,1))-48
1506 D=16*D+A+7*(A)9):NEXT:RETURN
1510 :
2000 DATAA0,3F,B9,BB,C0,99,A6,02,BB,D0,F7,A9,A0,B4,FD,B5,98F
2001 DATAFE,A9,C8,85,FB,A9,C0,85,FC,A2,0D,B1,FB,91,FD,C8,B8A
2002 DATAD0,F9,E6,FE,E6,FC,CA,D0,F2,A9,36,85,01,A9,C7,BD,B70
2003 DATAFA,FF,A9,A7,8D,FB,FF,AD,02,DD,09,03,BD,02,DD,A9,97D
2004 DATAFC,20,00,DD,8D,00,DD,A9,20,0D,11,D0,BD,11,D0,A9,73E
2005 DATA48,BD,18,D0,A2,00,B6,D4,8E,5B,AC,8E,5E,AC,8E,5F,7D0
2006 DATAAC,A2,0B,BE,86,02,A2,0F,BE,20,D0,8E,21,D0,20,00,63D
2007 DATAA0,20,E0,A2,A9,A7,BD,26,03,A9,B2,8D,24,03,A9,02,702
2008 DATABD,25,03,BD,27,03,4C,BA,02,48,20,DE,02,6B,20,24,46B
2009 DATAA1,4C,BA,02,48,20,DE,02,68,20,9C,A0,48,20,C4,02,5E3
2010 DATAA9,37,B5,01,68,60,98,4B,8A,48,A0,03,B9,E6,02,AA,6CE
2011 DATAB9,FB,00,99,E6,02,96,F8,88,10,F1,68,AA,6B,A8,60,BDI
2012 DATA20,C4,02,A9,36,85,01,60,A0,00,AD,21,D0,29,0F,AA,5CB
2013 DATAAD,86,02,0A,0A,0A,0A,BD,59,AC,BA,0D,59,AC,20,A7,552
2014 DATAA7,99,00,D0,98,00,D1,99,00,D2,CB,0B,20,B7,A7,2B,758
2015 DATAD0,DB,A0,E8,20,A7,A7,99,FF,D2,20,B7,A7,BB,D0,F4,AD2
2016 DATA60,48,A9,01,8D,5F,AC,6B,20,32,A1,A9,00,8D,5F,AC,6B6
2017 DATAA5,C6,F0,FC,7B,20,B4,E5,C9,B3,D0,10,A2,09,78,B6,95D
2018 DATAC6,BD,E6,EC,90,76,02,CA,D0,F7,F0,E4,C9,0D,D0,D1,B46
2019 DATAA0,07,20,A7,A7,B1,FB,4D,4D,AC,91,FB,20,B7,A7,A0,B81
2020 DATA4F,84,D0,20,A7,A7,B1,D1,C9,20,D0,03,B8,D0,F4,CB,963
2021 DATAB4,C8,A0,00,B4,D3,84,D4,A5,CA,30,3A,85,D3,C5,C8,959
2022 DATA90,34,B0,5E,A5,99,D0,0E,A5,09,B5,CA,A0,4C,AC,B5,B15
2023 DATAC9,85,D6,4C,C6,A0,20,B7,A7,4C,66,F1,A0,07,20,A7,865
2024 DATAA7,B1,FB,4D,4D,AC,91,FB,20,B7,A7,4C,4B,A0,98,4B,BB7
2025 DATA8A,48,A5,D0,F0,E6,20,A7,A7,A4,D3,B1,D1,B5,D7,20,A00
2026 DATA87,A7,29,3F,06,D7,24,D7,10,02,09,80,90,04,A6,D4,647
2027 DATAD0,04,70,02,09,40,20,B7,A7,E6,D3,20,B4,E6,C4,CB,7DC
2028 DATAD0,1A,A9,00,B5,D0,A9,0D,A6,99,E0,03,F0,06,A6,9A,7F6
2029 DATAE0,03,F0,03,20,32,A1,A9,0D,20,B7,A7,B5,D7,6B,AA,76B
2030 DATA68,AB,A5,D7,C9,DE,D0,02,A9,FF,1B,60,4B,A5,9A,C9,975
2031 DATA03,D0,04,6B,4C,32,A1,4C,D5,F1,4B,BD,51,AC,9B,4B,722
2032 DATABA,4B,A9,00,BD,57,AC,20,4E,A1,20,CC,A6,20,05,A7,67B
2033 DATA6B,AA,6B,AB,6B,60,AD,51,AC,20,B4,E6,AD,51,AC,C9,B91
2034 DATA20,90,5B,C9,60,B0,13,C9,40,90,3E,C9,B0,F0,4C,3B,7BB
2035 DATAAD,51,AC,E9,40,8D,51,AC,B0,2F,C9,7F,90,0B,F0,29,B35
2036 DATAC9,A0,90,37,B0,0B,38,AD,51,AC,E9,20,BD,51,AC,80,B10
2037 DATA18,C9,C0,B0,0B,38,AD,51,AC,E9,40,8D,51,AC,B0,09,7AA
2038 DATA1B,AD,51,AC,69,80,BD,51,AC,AD,5E,AC,F0,04,CE,5E,B0C
2039 DATAAC,60,AD,5C,AC,D0,03,8D,5D,AC,60,AD,5E,AC,05,D4,B1A
2040 DATAF0,1F,AD,51,AC,C9,20,B0,22,C9,0D,F0,5A,C9,14,F0,B61
2041 DATA04,A5,D4,D0,35,AD,5E,AC,D0,30,A9,01,8D,57,AC,D0,843
2042 DATA52,AD,5C,AC,D0,41,BD,5D,AC,F0,3C,AD,51,AC,C9,BD,8DA
2043 DATAF0,35,C9,94,D0,0B,A5,D4,D0,07,A9,01,8D,5B,AC,D0,8BB
2044 DATA26,38,AD,51,AC,E9,40,8D,51,AC,AD,5E,AC,D0,09,A5,7F0
2045 DATAD4,D0,08,BD,5D,AC,F0,08,CE,5E,AC,A9,01,BD,5D,AC,852
2046 DATAA9,00,8D,57,AC,F0,78,A9,01,8D,57,AC,A9,00,8D,5B,76C
2047 DATAAC,85,D4,AD,51,AC,C9,20,B0,66,C9,08,D0,05,A0,B0,B74
2048 DATA8C,91,02,C9,09,D0,05,A0,00,BC,91,02,C9,0D,D0,05,630
2049 DATA48,20,E9,A3,68,C9,0E,D0,05,A0,01,8C,58,AC,C9,11,715
2050 DATAD0,08,EE,4C,AC,48,20,89,A3,6B,C9,12,D0,0B,A0,01,70E
2051 DATA8C,5C,AC,8C,5D,AC,C9,13,D0,11,A0,00,B4,09,8C,4C,6EB
2052 DATAAC,4B,20,89,A3,A8,F0,8D,4D,AC,6B,C9,1D,D0,07,E6,86A
2053 DATA09,48,20,BD,A3,68,C9,14,D0,05,4B,20,12,A4,68,60,5A1
2054 DATAC9,BD,D0,05,4B,20,E8,A3,6B,C9,8E,D0,05,A0,00,BC,7E1
2055 DATA58,AC,C9,91,D0,0B,CE,4C,AC,4B,20,89,A3,68,C9,92,853
2056 DATAD0,08,A0,00,BC,5C,AC,8C,5D,AC,C9,93,D0,05,48,20,73A
2057 DATAE0,A2,68,C9,94,D0,05,48,20,FF,A4,68,C9,9D,D0,07,6CC
2058 DATAC6,09,4B,20,BD,A3,68,60,20,A7,A7,A0,00,84,F8,BC,748
2059 DATA4F,AC,BC,50,AC,A3,E0,B5,FC,BD,F7,A2,9B,99,00,E0,9C4
2060 DATA88,D0,FA,EE,F7,A2,AD,F7,A2,C9,FF,D0,EF,9B,A0,40,C1E
2061 DATA99,00,FF,88,10,FA,B5,09,8D,4C,AC,A9,F0,8D,4D,AC,85C
2062 DATAAD,5F,AC,F0,06,A0,07,A9,F0,91,FB,A2,18,8D,31,A8,8CA
2063 DATA8D,37,A3,8D,17,A8,8D,36,A3,A9,20,A0,4F,99,FF,FF,898
2064 DATA88,10,FA,CA,10,E7,20,9D,A3,4C,B7,A7,A9,00,8D,50,7D3
2065 DATAAC,A5,09,4A,0A,2E,50,AC,0A,2E,50,AC,0A,2E,50,AC,540
2066 DATA8D,4F,AC,AC,4C,AC,B9,E3,A7,85,F8,1B,B9,FD,A7,6D,9D1
2067 DATA50,AC,B5,FC,18,A5,F8,6D,4F,AC,B5,FB,A5,FC,69,E0,A07
2068 DATAB5,FC,A5,09,29,01,F0,03,A9,0F,2C,A9,F0,8D,4D,AC,74F
2069 DATA60,A9,FF,B5,CA,A5,09,85,D3,30,0D,C9,50,90,14,A9,800
2070 DATA00,B5,09,EE,4C,AC,B0,0B,E6,09,CE,4C,AC,30,18,A9,6D5
2071 DATA4F,85,09,AD,4C,AC,85,D6,30,0D,C9,19,90,0C,CE,4C,6B2
2072 DATAAC,20,25,A6,4C,C2,A3,EE,4C,AC,A9,01,8D,56,AC,AD,814
2073 DATA5F,AC,F0,0F,A0,07,20,A7,A7,B1,FB,4D,4D,AC,91,FB,89D
2074 DATA20,87,A7,AE,4C,AC,BD,17,AB,85,D1,BD,31,A8,85,D2,BE3
2075 DATA4C,19,A7,EE,4C,AC,A9,00,B5,09,8D,5E,AC,BD,5D,AC,756
2076 DATABD,5C,AC,20,BD,A3,AD,21,00,29,0F,CD,61,AC,F0,03,788
2077 DATA20,00,A0,AD,21,D0,8D,61,AC,60,20,A7,A7,A9,01,BD,6FD
2078 DATA5F,AC,A9,09,D0,03,4C,F1,A4,A0,07,B1,FB,4D,4D,AC,B0A
2079 DATA91,FB,3B,A5,F8,E9,0B,85,FD,A5,FC,E9,00,85,FE,A5,A89
2080 DATA09,29,01,D0,17,B1,F8,29,F0,4A,4A,4A,4A,BD,52,AC,692
2081 DATA81,FD,29,F0,0D,52,AC,91,FD,88,10,E9,AC,4C,AC,C8,94D
2082 DATA18,B9,F0,A7,69,E0,BD,5A,AC,3B,89,E3,A7,E9,01,BD,943
2083 DATA54,AC,AD,5A,AC,E9,00,8D,55,AC,A9,08,BD,53,AC,A0,B07
2084 DATA04,AD,54,AC,8D,92,A4,AD,55,AC,8D,93,A4,38,A9,50,817
2085 DATAE5,09,4A,69,00,AA,18,08,28,2E,FF,FF,08,3B,AD,92,63E
2086 DATAA4,E9,08,8D,92,A4,AD,93,A4,E9,00,8D,93,A4,CA,D0,983
2087 DATAE7,B8,F0,04,28,4C,79,A4,28,CE,54,AC,D0,03,CE,55,7E0
2088 DATAAC,CE,53,AC,D0,89,A0,07,B1,FB,4D,4D,AC,91,FB,AE,9D5
2089 DATA4C,AC,BD,17,A8,85,FD,BD,31,A8,B5,FE,3B,A9,4F,E5,924
2090 DATA09,AA,A4,09,B1,FD,88,91,FD,C8,CB,CA,10,F6,A9,28,94D
2091 DATAA0,4F,91,FD,C6,09,20,8D,A3,A9,00,8D,56,AC,20,87,7A8
2092 DATAA7,A9,00,8D,5F,AC,60,20,62,AC,89,E3,A7,E9,08,B5,82F
2093 DATAFD,89,FD,A7,E9,00,85,FE,18,A5,FE,69,E0,85,FE,A0,AED
2094 DATA07,B1,FD,29,0F,F0,03,4C,12,A6,B8,10,F4,A0,07,81,6CB
2095 DATAFB,4D,4D,AC,B0,60,AC,AD,5F,AC,F0,05,AD,60,AC,91,801
2096 DATAFB,A5,09,29,01,F0,11,18,A5,FB,69,0B,B0,54,AC,A5,72F
2097 DATAFC,69,00,B0,55,AC,90,0A,A5,FB,6D,54,AC,A5,FC,8D,BEB
2098 DATA55,AC,A9,0B,B0,53,AC,A0,04,AD,54,AC,8D,78,A5,AD,7E6
2099 DATA55,AC,8D,79,A5,3B,A9,50,E5,09,4A,AA,18,08,28,6E,875
2100 DATAFF,FF,08,1B,AD,78,A5,69,08,8D,78,A5,90,03,EE,79,7FD
2101 DATAA5,CA,D0,EA,BB,F0,04,28,4C,61,A5,2B,EE,54,AC,D0,905
2102 DATA03,EE,55,AC,CE,53,AC,D0,BE,1B,A5,FB,69,0B,B5,FD,BF8
2103 DATAA5,FC,69,00,B5,FE,A5,09,29,01,F0,1F,A0,07,B1,FB,7C7
2104 DATA29,0F,0A,0A,0A,0A,BD,52,AC,81,FD,29,0F,8D,52,AC,4DC
2105 DATA91,FD,B1,FB,29,F0,91,FB,BB,10,E3,A0,07,B1,FB,4D,3FA
2106 DATA4D,AC,8D,60,AC,AD,5F,AC,F0,05,AD,60,AC,91,FB,20,BA4
2107 DATABD,A3,20,A7,A7,AE,4C,AC,8D,17,AB,85,FD,8D,31,A8,BD8
2108 DATA85,FE,38,A9,4F,E5,09,AA,A8,4E,81,FD,C8,91,FD,8B,9C5
2109 DATA88,CA,10,F6,A9,20,A4,09,91,FD,A9,00,8D,56,AC,20,7B4
2110 DATAB7,A7,AD,5E,AC,C9,50,F0,03,EE,5E,AC,60,20,A7,A7,BE7
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2111 DATAA0,E1,8C,35,A6,88,8C,38,A6,A0,00,B9,40,E1,99,00,7ED
2112 DATAE0,C8,D0,F7,EE,35,A6,EE,38,A6,AD,35,A6,C9,FF,D0,B24
2113 DATAEA,98,99,00,FE,C8,D0,FA,99,00,FF,C8,C0,C1,90,FB,B14
2114 DATAA5,FB,E9,40,85,FB,A5,FC,E9,01,85,FC,A2,01,BD,17,9CC
2115 DATAA8,8D,84,A6,BD,31,A8,8D,85,A6,CA,BD,17,A8,8D,87,907
2116 DATAA6,BD,31,AB,8D,88,A6,A2,08,A0,00,B9,FF,FF,99,FF,998
2117 DATAFF,C8,D0,F7,EE,B5,A6,EE,88,A6,CA,D0,EE,A2,18,BD,BC2
2118 DATA17,A8,8D,A8,A6,BD,31,A8,8D,A9,A6,A9,20,A0,4F,99,850
2119 DATAFF,FF,88,10,FA,20,87,A7,A9,7F,8D,00,DC,AD,01,DC,929
2120 DATAC9,F8,0B,A9,7F,8D,00,DC,20,D0,08,C8,EA,CA,D0,FC,9A5
2121 DATA88,D0,F9,60,A9,80,85,FE,20,A7,A7,AD,51,AC,29,01,B1F
2122 DATAF0,03,A9,0F,2C,A9,F0,8D,4E,AC,AD,51,AC,4A,0A,26,71B
2123 DATAFE,0A,26,FE,0A,26,FE,18,69,4B,85,FD,AD,58,AC,D9,829
2124 DATA03,A9,A8,2C,A9,AA,65,FE,85,FE,4C,B7,A7,AD,57,AC,913
2125 DATAD0,0E,8D,56,AC,20,18,A7,20,8A,A7,E6,09,20,8D,A3,6ED
2126 DATA60,20,44,A3,20,A7,A7,A0,07,AE,56,AC,F0,04,A3,00,6C9
2127 DATAF0,05,B1,FD,2D,4E,AC,AE,4E,AC,E0,F0,D0,04,4A,4A,8AA
2128 DATA4A,4A,8D,52,AC,AD,4D,AC,C9,0F,F0,0A,AD,52,AC,0A,74C
2129 DATA0A,0A,0A,8D,52,AC,A9,FF,AE,56,AC,D0,05,AD,4D,AC,77C
2130 DATA49,FF,31,FB,0D,52,AC,C0,07,D0,08,AE,5F,AC,F0,03,7CA
2131 DATA4D,4D,AC,AE,56,AC,D0,17,AE,5C,AC,D0,05,AE,5D,AC,81F
2132 DATAF0,0D,4D,4D,AC,48,AD,51,AC,09,80,8D,51,AC,6B,91,741
2133 DATAFB,88,10,95,AD,5E,AC,05,D4,F0,24,A9,00,8D,5D,AC,80B
2134 DATAF0,10,A4,09,AD,51,AC,20,A7,A7,91,D1,4C,B7,A7,48,826
2135 DATA78,AD,0E,DC,29,FE,8D,0E,DC,A9,34,85,01,68,60,48,720
2136 DATAA9,36,85,01,AD,0E,DC,09,01,8D,0E,DC,58,68,60,48,5E5
2137 DATA98,4B,8A,48,A9,A7,48,A9,DA,48,08,20,B7,A7,78,4C,75F
2138 DATA47,FE,20,A7,A7,68,AA,68,A8,68,40,00,40,B0,C0,00,6FD
2139 DATA40,80,C0,00,40,B0,C0,00,40,80,C0,00,40,80,C0,00,600
2140 DATA40,80,C0,00,40,00,01,02,03,05,06,07,08,0A,0B,0C,201
2141 DATA0D,0F,10,11,12,14,15,16,17,19,1A,1B,1C,1E,1F,00,14C
2142 DATA50,A0,F0,40,90,E0,30,80,D0,20,70,C0,10,60,80,00,780
2143 DATA50,A0,F0,40,90,E0,30,80,D0,D4,D4,D4,D4,D5,D5,D5,A0F
2144 DATAD6,D6,D6,D7,D7,D7,D8,D8,DB,D9,D9,D9,D9,DA,DA,DA,DB1
2145 DATADB,DB,DB,44,AA,AA,AE,BA,8A,6A,00,C4,AA,A8,C8,A8,9DB
2146 DATAAA,C4,00,CE,A8,AB,AE,A8,A8,CE,00,E4,8A,B8,EA,BA,9C2
2147 DATA8A,84,00,AE,A4,A4,E4,A4,A4,AE,00,EA,2A,2A,2C,2A,772
2148 DATAAA,4A,00,BA,BE,8E,8A,BA,8A,EA,00,CE,AA,AA,AA,AA,898
2149 DATAAA,AE,00,C4,AA,AA,CA,8A,8A,84,02,C6,A8,AB,C4,A2,950
2150 DATAA2,AC,00,EA,4A,4A,4A,4A,4A,4E,00,AA,AA,AA,AA,AE,74E
2151 DATAAE,4A,00,AA,AA,4A,44,44,A4,A4,00,E6,24,44,44,44,63C
2152 DATAB4,E6,00,46,A2,82,C2,82,82,E6,00,20,72,24,2F,24,689
2153 DATA22,20,20,04,04,04,04,04,00,04,00,A0,AA,0E,0A,0E,1EA
2154 DATA0A,00,00,4A,E2,84,E4,24,E8,4A,00,42,A2,A4,40,A0,65C
2155 DATAA0,60,10,28,44,82,82,82,44,28,00,00,A0,44,EE,44,584
2156 DATAA0,00,00,00,00,00,0E,00,60,20,40,01,01,02,06,04,17C
2157 DATA08,48,00,44,AC,A4,A4,A4,A4,4E,00,4E,A2,24,42,82,5F6
2158 DATA8A,E4,00,AE,A8,EE,22,22,2A,26,00,4E,A2,82,C4,A4,720
2159 DATAA8,48,00,44,AA,AA,46,A2,A4,48,00,00,00,44,00,00,4A0
2160 DATA44,04,08,10,20,4E,80,4E,20,10,00,84,4A,22,14,24,2F4
2161 DATA40,84,00,04,04,0E,FE,0A,04,0E,00,20,20,20,20,2F,20,2A3
2162 DATA20,20,20,00,0F,F0,00,00,00,00,00,04,04,04,04,04,173
2163 DATA04,F4,04,20,20,20,2C,26,22,22,22,22,22,36,1C,00,2AA
2164 DATA00,00,00,88,88,B4,B4,82,B2,81,F1,1F,18,2B,28,48,55D
2165 DATA48,88,88,F8,10,16,1F,1F,16,10,10,00,09,0F,0F,0F,31B
2166 DATA06,F0,00,40,40,40,41,43,42,42,42,42,90,90,66,69,69,55B
2167 DATA66,90,90,62,62,92,92,62,62,F2,02,02,42,42,EF,E2,77D
2168 DATA42,42,02,42,82,42,82,42,82,42,82,0F,07,17,63,A3,4C9
2169 DATAA3,A1,01,0C,0C,0C,0C,0C,0C,0C,0C,0C,0F,00,00,00,F0,2A4
2170 DATAF0,F0,F0,08,08,08,08,08,08,08,F8,A1,51,A1,51,A1,685
2171 DATA51,A1,51,0F,0E,0C,0C,AC,5B,A8,58,32,32,32,33,32,477
2172 DATA32,32,32,02,02,02,03,30,30,30,30,00,00,00,E0,20,25F
2173 DATA20,2F,2F,02,02,02,3F,20,20,20,20,02,02,02,FE,22,269
2174 DATA22,22,22,8C,BC,BC,BC,BC,BC,8C,8C,8C,3F,3F,30,30,30,5D4
2175 DATA30,30,30,F0,F0,F0,00,00,0F,0F,0F,10,10,10,10,1C,3E9
2176 DATA1C,1C,FC,32,32,32,3E,00,00,00,00,CC,CC,CC,CC,03,53B
2177 DATA03,03,03,40,A0,AC,A2,8E,8A,6E,0B,80,80,C6,A8,A8,6D3
2178 DATAA8,C6,00,20,20,64,AA,AE,A8,66,00,20,40,44,EA,4A,650
2179 DATA46,42,04,80,84,C0,A4,A4,A4,A4,00,08,28,0A,2A,2C,570
2180 DATA2A,AA,40,C0,40,4A,4E,4E,4A,EA,00,00,00,C4,AA,AA,646
2181 DATAAA,A4,00,00,00,C6,AA,AA,C6,82,B2,00,00,CE,A8,8E,736
2182 DATA82,8E,00,00,40,EA,4A,4A,4A,4E,00,00,00,AA,AA,AE,568
2183 DATAAE,4A,00,00,00,AA,AA,46,A2,A2,0C,06,04,E4,24,44,53B
2184 DATA84,E6,00,46,A2,82,C2,82,B2,E6,00,20,72,24,2F,24,689
2185 DATA22,20,20,04,04,04,04,04,00,04,00,A0,AA,0E,0A,8E,1EA
2186 DATA0A,00,00,4A,E2,84,E4,24,E8,4A,00,42,A2,A4,40,A0,65C
2187 DATAA0,60,10,2B,44,82,82,82,44,28,00,00,A0,44,EE,44,584
2188 DATAA0,00,00,00,00,00,0E,00,60,20,40,01,01,02,06,04,17C
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2188 DATA08,48,00,44,AC,A4,A4,A4,A4,4E,00,4E,A2,24,42,82,5F6
2189 DATABA,E4,00,AE,AB,EE,22,22,2A,26,00,4E,A2,82,C4,A4,720
2191 DATAA8,48,00,44,AA,AA,46,A2,A4,48,00,00,00,44,00,00,4A0
2192 DATA44,04,08,10,20,4E,80,4E,20,10,00,B4,4A,22,14,24,2F4
2193 DATA40,84,00,04,04,0A,FE,0A,0A,0A,00,C4,AA,AB,C8,AB,57E
2194 DATAAA,C4,00,CE,AB,AB,AE,AB,AB,CE,00,E4,8A,BB,EA,BA,9C2
2195 DATA8A,B4,00,AE,A4,A4,E4,A4,A4,AE,00,EA,2A,2A,2C,2A,772
2196 DATAAA,4A,00,BA,BE,BE,8A,BA,BA,EA,00,CE,AA,AA,AA,AA,898
2197 DATAAA,AE,00,C4,AA,AA,CA,BA,8A,84,02,C6,AB,AB,C4,A2,850
2198 DATAA2,AC,00,EA,4A,4A,4A,4A,4A,4E,00,AA,AA,AA,AA,AE,74E
2199 DATAAE,4A,00,AA,AA,4A,44,44,A4,A4,00,E2,22,42,4F,42,63D
2200 DATAB2,E2,02,42,B2,42,82,42,B2,42,82,52,A9,54,A2,59,6C0
2201 DATAA4,52,A9,0C,0C,0C,0C,0C,0C,0C,0C,0F,00,00,00,F0,2FE
2202 DATAF0,F0,F0,0B,0B,0B,0B,0B,0B,0B,FB,A1,51,A1,51,A1,685
2203 DATA51,A1,51,04,09,02,04,A9,52,A4,59,32,32,32,33,32,449
2204 DATA32,32,32,02,02,02,03,30,30,30,30,00,00,00,E0,20,25F
2205 DATA20,2F,2F,02,02,02,3F,20,20,20,20,02,02,02,FE,22,269
2206 DATA22,22,22,BC,BC,BC,BC,BC,BC,8C,3F,3F,30,30,30,30,504
2207 DATA30,30,30,F0,F0,F0,00,00,0F,0F,0F,00,20,20,20,AC,499
2208 DATA6C,2C,0C,32,32,32,3E,00,00,00,00,CC,CC,CC,CC,03,4A8
2209 DATA03,03,03,00,FF,00,FF,00,FF,00,FF,00,FF,00,FF,00,603
2210 DATAFF,00,FF,00,FF,00,FF,00,FF,00,20,A7,A7,AC,4C,AC,B0D
2211 DATAC8,38,60,00,00,00,00,00,00,00,00,00,00,00,00,00,160
2212 :
2498 :
2499 REM  MAIN PROGRAM
2500 DIMBS(16),SP(7),IS(15),RA(25)
2998 :
2999 REM  ENTER BALANCE SHEET DETAILS
3000 DATA"CASH AND ITS EQUIVALENT","ACCOUNTS RECEIVABLE"
3001 DATA"JET INVENTORY","TOTAL CURRENT ASSETS"
3002 DATA"TOTAL FIXED ASSETS (LESS DEPRECIATION)"
3003 DATA"INTANGIBLE ASSETS","TOTAL ASSETS","ACCOUNTS PAYABLE"
3004 DATA"CURRENT LIABILITIES","LONG-TERM DEBT","TOTAL LIABILITIES"
3005 DATA"TOTAL PREFERENCE SHARES","TOTAL ORDINARY SHARES"
3006 DATA"RETAINED EARNINGS"
3007 PRINTCHR$(142)"[CLR][DFF]BALANCE SHEET ENTRY[2DOWN]"CHR$(14)
3008 OPEN1,0:FORX=1TO14:READD$:PRINTD$TAB(40)":":NEXT
3009 PRINT"[14UP]";:FORX=1TO14:PRINTTAB(42))
3010 INPUT#1,BS(X):PRINT:NEXT:PRINTCHR$(142)
3011 BS(15)=BS(12)+BS(13):BS(16)=BS(11)+BS(15)
3098 :
3099 REM  ENTER INCOME STATEMENT DETAILS
3100 DATA"SET SALES","COST OF GOODS SOLD"
3101 DATA"GROSS PROFIT","GROSS OPERATING PROFIT"
3102 DATA"TOTAL DEPRECIATION","JET OPERATING PROFIT"
3103 DATA"OTHER INCOME","GROSS INCOME","INTEREST PAID"
3104 DATA"JET INCOME BEFORE TAX","TOTAL TAXES PAID"
3105 DATA"DIVIDENDS PAID","RETAINED EARNINGS","LEASE PAYMENTS"
3106 DATA"SINKING FUND PAYMENTS"
3107 PRINT"[2DOWN]INCOME STATEMENT ENTRY[2DOWN]"CHR$(14)
3108 FORX=1TO15:READD$:PRINTD$TAB(40)":":NEXT
3109 PRINT"[15UP]";:FORX=1TO15:PRINTTAB(42))
3110 INPUT#1,IS(X):PRINT:NEXT:PRINTCHR$(142)
3198 :
3199 REM  ENTER SHARE PRICE DETAILS
3200 DATA"CURRENT SHARE PRICE","CURRENT SHARE DIVIDEND"
3201 DATA"MARKET INTEREST RATE %","COMMONWEALTH BOND RATE %"
3202 DATA"CURRENT SHARE BETA","CURRENT SHARE GROWTH RATE %"
3203 DATA"# OF ORDINARY SHARES"

3204 PRINT"[2DOWN]SHARE PRICE DETAILS[2DOWN]"CHR$(14)
3205 FORX=1TO7:READD$:PRINTD$TAB(40)":":NEXT
3206 PRINT"[7UP]";:FORX=1TO7:PRINTTAB(42))
3207 INPUT#1,SP(X):PRINT:NEXT:PRINTCHR$(142):CLOSE1
3298 :
3299 REM CALCULATE AND TRUNCATE RATIOS TO APPROPRIATE DECIMAL PLACES
3300 RA(1)=BS(4)/BS(9):RA(2)=BS(3)/(BS(4)-BS(9)):RA(3)=BS(9)/BS(3)
3301 RA(4)=(BS(4)-BS(3))/BS(9):RA(5)=(BS(10)+BS(9))/(BS(16)+BS(14)-BS(6))
3302 RA(6)=BS(9)/(BS(16)+BS(14)-BS(6)):RA(7)=BS(5)/(BS(16)+BS(14)-BS(6))
3303 RA(8)=(IS(6)+IS(9))/IS(9):RA(9)=IS(1)/BS(3):RA(10)=(BS(2)*365.25)/IS(1)
3304 RA(11)=IS(1)/BS(5):RA(12)=IS(1)/(BS(4)-BS(9)):RA(13)=IS(1)/BS(7)
3305 RA(14)=(BS(8)*365.25)/IS(1):RA(15)=(IS(10)-IS(11))/(BS(7)-BS(6))
3306 RA(16)=(IS(10)-IS(11))/IS(1):RA(17)=(IS(8)-IS(11))/B6(7)
3307 RA(18)=IS(3)/IS(1):RA(19)=IS(4)/IS(1)
3308 RA(20)=BS(8)/(IS(9)+IS(14)+(IS(15)/.51))
3309 RA(21)=(IS(10)+IS(9)+IS(14))/(IS(9)+IS(14)+(IS(5)/.51))
3310 RA(22)=(IS(10)-IS(11))/SP(7):RA(23)=SP(1)/((IS(10)-IS(11))/SP(7))
3311 RA(24)=SP(4)+(SP(5)*(SP(3)-SP(4)))
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3312 RA(25)=100*(SP(2)*(1+(SP(6)/100)))/(SP(3)-SP(6))
3313 FORX=1TO25:F=100:IFX=10ORX=14ORX=23ORX=25THENF=10
3314 IF(X)14ANDX(20)ORX>22ORX>24THENF=1000
3315 RA(X)=INT(F*RA(X))/F:NEXT
3398 '
3399 REM  DISPLAY FORMATTED RATIOS IN CATEGORIES
3400 PRINT"[CLR][TAB(22)CHR$(142)"COMPANY PERFORMANCE ANALYSIS RATIOS"
3401 PRINT"[DOWN]LIQUIDITY:[DOWN]"CHR$(14)
3402 DATA"[3SPC]-URRENT RATIO[15SPC]:"
3403 DATA"[3SPC]-NVENTORY TO WORKING CAPITAL:"
3404 DATA"[3SPC]-URRENT DEBT TO INVENTORY[3SPC]:"
3405 DATA"[3SPC]QUICK RATIO[17SPC]:"
3406 FORX=1TO4:READD$:PRINTD$:NEXT:PRINT"[4UP]"
3407 FORX=1TO4:D$=STR$(RA(X)):Y=0:FOR2=1TOLEN(D$):IFMID$(D$,Z,1)="."THENY=Z
3408 NEXT:IFY=0THEND$=D$+".0":Y=LEN(D$)-1
3409 D$=RIGHT$(D$,LEN(D$)-1):FOR2=1TO37-Y:PRINT"[RIGHT]";:NEXT:PRINTD$:NEXT
3410 PRINTCHR$(142)"[DOWN]LEVERAGE:[DOWN]"CHR$(14)
3411 DATA"[3SPC]OTAL DEBT TO NET WORTH[5SPC]:"
3412 DATA"[3SPC]-URRENT DEBT TO NET WORTH[3SPC]:"
3413 DATA"[3SPC]-IXED ASSETS TO NET WORTH[3SPC]:"
3414 DATA"[3SPC]IMES INTEREST EARNED[7SPC]:"
3415 FORX=1TO4:READD$:PRINTD$:NEXT:PRINT"[4UP]"
3416 FORX=5TO8:D$=STR$(RA(X)):Y=0:FOR2=1TOLEN(D$):IFMID$(D$,Z,1)="."THENY=Z
3417 NEXT:IFY=0THEND$=D$+".0":Y=LEN(D$)-1
3418 D$=RIGHT$(D$,LEN(D$)-1):FOR2=1TO37-Y:PRINT"[RIGHT]";:NEXT:PRINTD$:NEXT
3419 PRINTCHR$(142)"[DOWN]ACTIVITY:[DOWN]"CHR$(14)
3420 DATA"[3SPC]-NVENTORY TURNOVER[10SPC]:"
3421 DATA"[3SPC]-OLLECTION PERIOD[11SPC]:"
3422 DATA"[3SPC]-IXED ASSETS TURNOVER[7SPC]:"
3423 DATA"[3SPC]OORKING CAPITAL TURNOVER[4SPC]:"
3424 DATA"[3SPC]OTAL ASSETS TURNOVER[7SPC]:"
3425 DATA"[3SPC]AYABLES PERIOD[13SPC]:"
3426 FORX=1TO5:READD$:PRINTD$:NEXT:PRINT"[6UP]"
3427 FORX=9TO14:D$=STR$(RA(X)):Y=0:FOR2=1TOLEN(D$):IFMID$(D$,Z,1)="."THENY=Z
3428 NEXT:IFY=0THEND$=D$+".0":Y=LEN(D$)-1
3429 D$=RIGHT$(D$,LEN(D$)-1):FOR2=1TO37-Y:PRINT"[RIGHT]";:NEXT:PRINTD$:NEXT
3430 PRINT"[HOME][2DOWN]"TAB(40)CHR$(142)"PROFITABILITY:[DOWN]"CHR$(14)
3431 DATA"-ETURN ON NET WORTH[8SPC]:"
3432 DATA"SALES MARGIN[15SPC]:"
3433 DATA"RODUCTIVITY OF ASSETS[15SPC]:"
3434 DATA"[ROSS MARGIN[11SPC]:"
3435 DATA"[PERATING MARGIN[11SPC]:"
3436 FORX=1TO5:READD$:PRINTTAB(43)D$:NEXT:PRINT"[5UP]";
3437 FORX=15TO19:D$=STR$(RA(X)):Y=0:FOR2=1TOLEN(D$):IFMID$(D$,Z,1)="."THENY=Z
3438 NEXT:IFY=0THEND$=D$+".0":Y=LEN(D$)-1
3439 D$=RIGHT$(D$,LEN(D$)-1):FOR2=1TO76-Y:PRINT"[RIGHT]";:NEXT:PRINTD$:NEXT
3440 PRINTTAB(40)CHR$(142)"[DOWN]COVERAGE:[DOWN]"CHR$(14)
3441 DATA"-IXED CHARGE COVERAGE[6SPC]:"
3442 DATA"-EBT SERVICE COVERAGE[6SPC]:"
3443 FORX=1TO2:READD$:PRINTTAB(43)D$:NEXT:PRINT"[6UP]";
3444 FORX=20TO21:D$=STR$(RA(X)):Y=0:FOR2=1TOLEN(D$):IFMID$(D$,Z,1)="."THENY=Z
3445 NEXT:IFY=0THEND$=D$+".0":Y=LEN(D$)-1
3446 D$=RIGHT$(D$,LEN(D$)-1):FOR2=1TO76-Y:PRINT"[RIGHT]";:NEXT:PRINTD$:NEXT
3447 PRINTTAB(40)CHR$(142)"[DOWN]STOCK:[DOWN]"CHR$(14)
3448 DATA"-ARNINGS PER SHARE[9SPC]:"
3449 DATA"RICE TO EARNINGS[10SPC]:"
3450 DATA"-APITAL ASSET PRICING MODEL:"
3451 DATA"PROJECTED MARKET PRICE[5SPC]:"
3452 FORX=1TO4:READD$:PRINTTAB(43)D$:NEXT:PRINT"[4UP]";
3453 FORX=22TO25:D$=STR$(RA(X)):Y=0:FOR2=1TOLEN(D$):IFMID$(D$,Z,1)="."THENY=Z
3454 NEXT:IFY=0THEND$=D$+".0":Y=LEN(D$)-1
3455 D$=RIGHT$(D$,LEN(D$)-1):FOR2=1TO76-Y:PRINT"[RIGHT]";:NEXT:PRINTD$:NEXT
3456 PRINT"[4DOWN]128SPC]TRESS ANY KEY TO EXIT";
3457 POKE198,0:WAIT198,1:POKE198,0:SYS64738
READY.
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This table replaces the first spread in last month's Communications Special modem survey.

Pages one and two suffered at the hands of a corrupt database . . .the table presented below is what should have appeared last month but updated to exclude several modems no longer on-sale.

Make	Model	Telecom approved	300 Baud	1200/75 Baud	1200/75 speed conversion	1200 HDX	1200 FDX	2400 HDX	2400 FDX	4800 HDX	4800 FDX	9600 HDX	9600 FDX	'Bell' standard	Auto originate	Auto answer	Auto dial	Auto re-dial	Auto speed sense	Dial back security	Dialling directory	Internal help	Xon/Xoff support
ABE COMPUTERS.	MAXWELL 1. KIT		•	•	•									•	•								•
ABE COMPUTERS.	MAXWELL 2 KIT.		•			•	•							•	•	•	•					•	•
ABE COMPUTERS	MAXWELL 3. KIT.		•			•	•	•	•					•	•	•	•					•	•
ABE COMPUTERS	MAXWELL 4. KIT.		•	•		•	•							•	•	•	•					•	•
ABE COMPUTERS	MAXWELL 5 KIT.		•	•	•	•	•	•	•					•	•	•	•					•	•
ABE COMPUTERS	MODEL 1 KIT		•	•										•	•								
APPLE	APPLE 1200	•	•	•	•									•	•	•	•						•
AUTOMATIC ICE CO.	AP2 FOR APPLEII,IIGS		•	•	•	•								•	•	•	•	•	•		•	•	•
BLACK BOX CATALOG	1200A	•					•							•	•	•	•		•			•	
BLACK BOX CATALOG	1234SA	•	•	•	•		•		•					•	•	•	•		•			•	
BLACK BOX CATALOG	123SA	•	•	•	•		•							•	•	•	•		•			•	
BLACK BOX CATALOG	21/23	•	•	•	•									•	•	•	•		•			•	
BLACK BOX CATALOG	2400A	•					•		•					•	•	•	•		•			•	
BLACK BOX CATALOG	PC123	•	•	•	•		•							•	•	•	•		•			•	

PABX support	Hayes compatible	Videotex s'ware supplied	TTY s'ware supplied	Speaker	Battery	Internal/External modem	Acc. coupler or Modem	Asynch/Synch	No indicator LEDS	Mains or Int power supply	Other features	Price, including sales tax	Distributor	Telephone
					•	Ext	M	Asynch	10	Int	CAN BE UPGRADED USING SAME MOTHER-BOARD TO A 5.	$200	ABE COMPUTERS.	03-288-2144
	•				•	Ext	M	Both	10	Int	COMMUNICATIONS SOFTWARE AVAILABLE.	$424	ABE COMPUTERS.	03-288-2144
	•				•	Ext	M	Both	10	Int	CAN BE UPGRADED TO NEXT MODEL. B & T $ 625.00.	$466	ABE COMPUTERS.	03-288-2144
	•				•	Ext	M	Both	10	Int	SIZE OF 5" DISK DRIVE FOR INTERNAL MOUNTING	$495	ABE COMPUTERS.	03-288-2144
	•				•	Ext	M	Both	10	Int	BUILT & TESTED COST $ 696.00.	$800	ABE COMPUTERS.	03-288-2144
					•	Int	M	Asynch	4	Int	CAN FIT IN A 5" DISK DRIVE.	$95	ABE COMPUTERS	03-288-2144
•	•	•		•		Ext	M	Asynch	0	Mains		$730	APPLE AUSTRALIA	(02)8885888
•		•	•	•	•	Int	M	Asynch	1	Int	ERROR CORREC-TION.VIDEOTEXT & COMMS IN EPROM	$299	AUTOMATIC ICE CO.	049 633188
•	•	•	•	•		Ext	M	Asynch	8	Mains	COMES WITH FREE RS-232 TESTER	$685	DATACRAFT DIRECT MARKETING	03-725-1144
•	•	•	•	•		Ext	M	Both	8	Mains	COMES WITH FREE RS-232 TESTER	$1309	DATACRAFT DIRECT MARKETING	03-725-1144
•	•	•	•	•		Ext	M	Both	8	Mains	INCLUDES FREE RS-232 TESTER	$1095	DATACRAFT DIRECT MARKETING	03-725-1144
•	•	•	•	•		Ext	M	Asynch	8	Mains	COMES WITH FREE RS-232 TESTER	$443	DATACRAFT DIRECT MARKETING	03-725-1144
•	•	•	•	•		Ext	M	Asynch	8	Mains	COMES WITH FREE RS-232 TESTER	$959	DATACRAFT DIRECT MARKETING	03-725-1144
•	•	•	•	•		Int	M	Asynch	0	Int	COMES WITH FREE RS-232 TESTER	$884	DATACRAFT DIRECT MARKETING	03-725-1144

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