September 1995

EXE

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The Software Developers' Magazine

Modelling the real world

A hairy problem

3D for the masses

EXCLUSIVE: Delphi 95 for Windows 95

All about C++'s new typecasts

Browsing code with Object Master

Jules' survival experience

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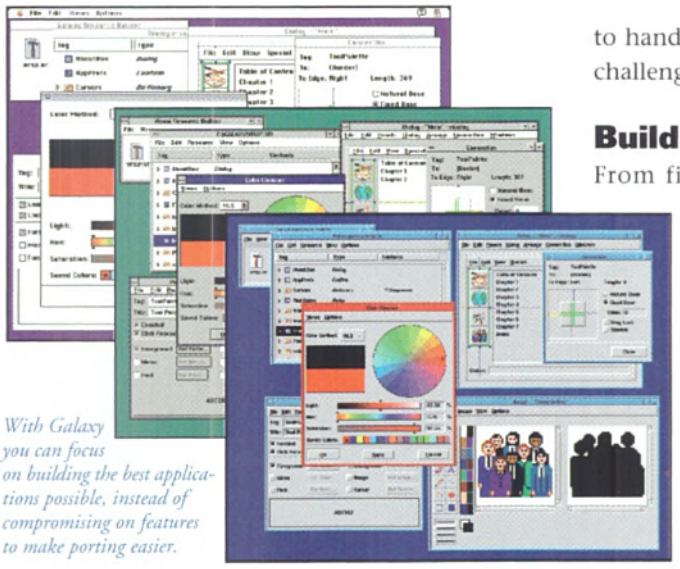

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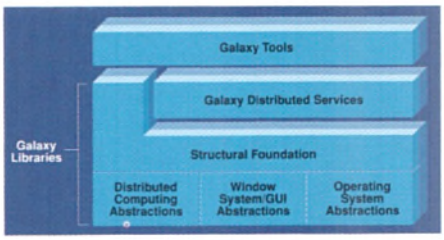

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EXE

The Software Developers' Magazine

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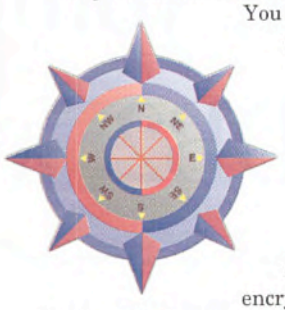

You may feel frustrated by the limitations of your compiler environment when browsing some code. Barry Smith reviews Object Master for Windows whose goal is to ease source code navigation.

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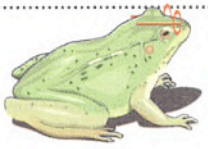

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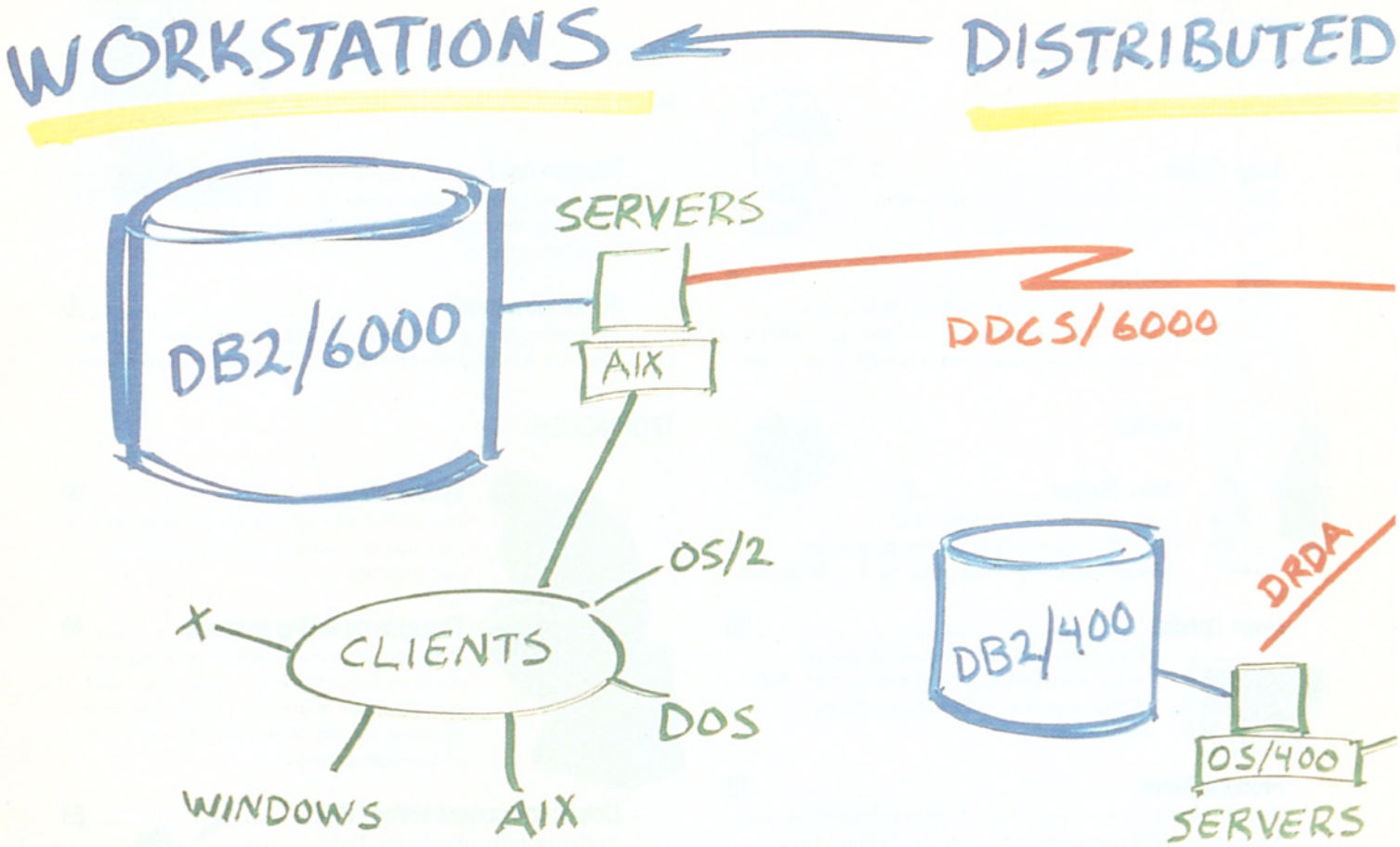

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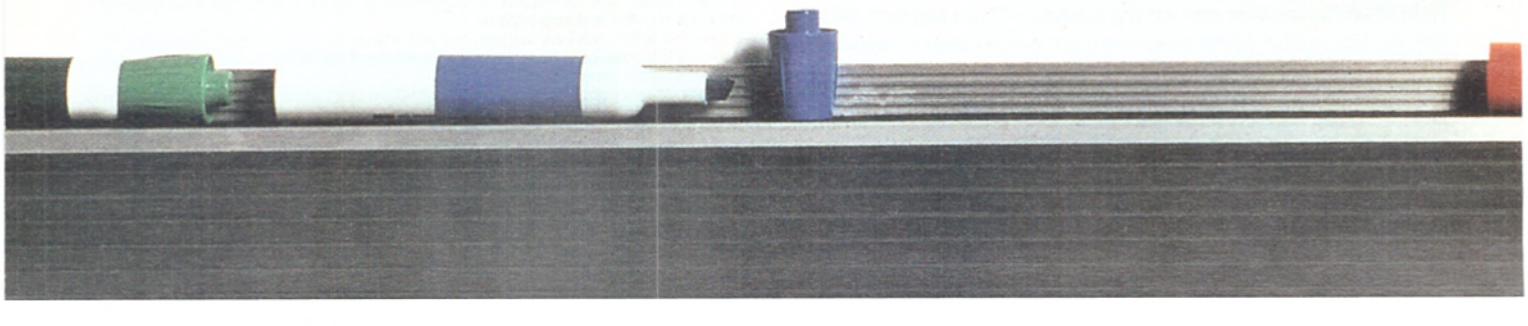

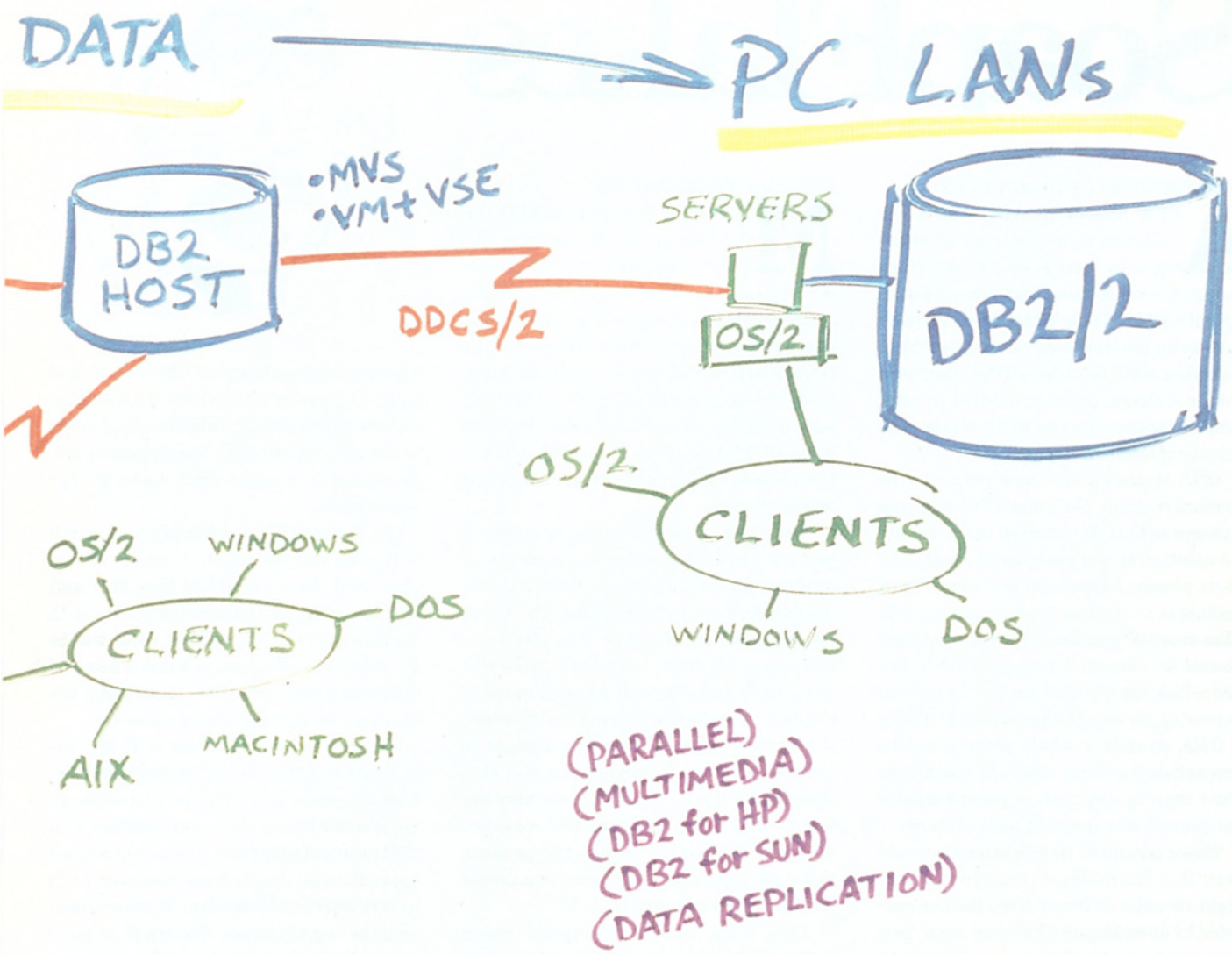

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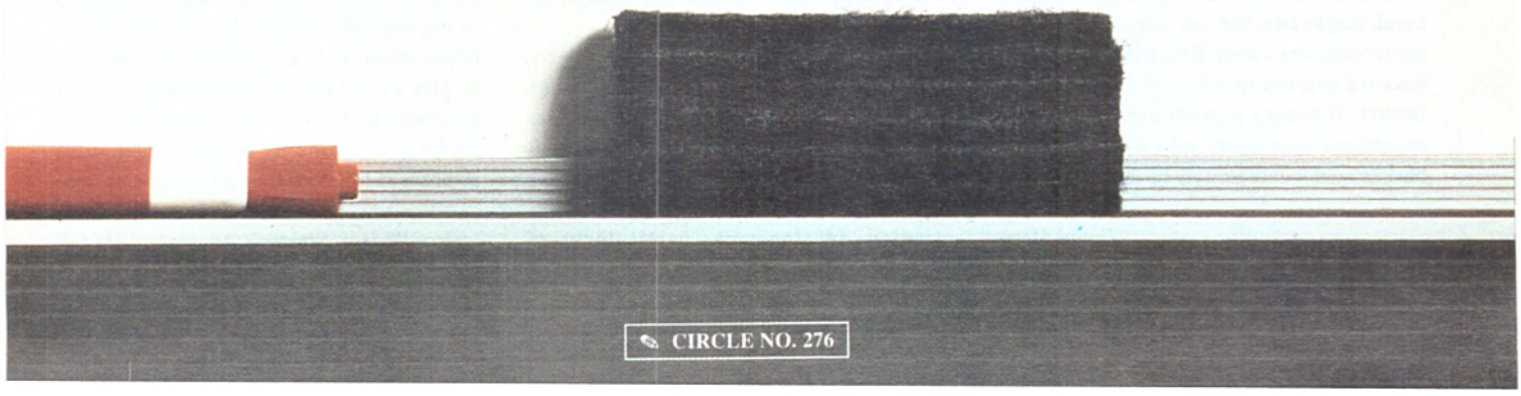

CIRCLE NO. 276

SoapFlakes

Programmer or biochemist?

A FEW MONTHS AGO *Newsweek* published an article titled 'Computing is in their genes'. It described the experiences of some researchers *computing* with DNA. Their latest breakthrough was solving the travelling salesman problem with what could be called a DNA computer. This is a classic problem studied in most computer science courses, will it also become a classic of biochemistry?

DNA strands create new molecules by chemical reaction. The initial DNA sequence is chosen so that the obtained molecules are the solution to the problem at hand. The whole process happens in test tubes. DNA reaction is a very slow process, one reaction takes about 30 minutes. So why this sudden interest for computing purposes? DNA computers look like the ultimate tool for parallel processing. By using billions or even trillions of DNA strands a whole process can be accomplished several orders of magnitude faster than by any current supercomputer and in *much* less space. At least in theory.

These advances in biochemistry could mean that the future of computing science might be quite different from the one predicted by Jules May in *EXE*'s last issue: 'programmers in the future ... will not be engineers, they will be artists ... One thing is sure: the people who make programs will soon be hippies again.'

If DNA research continues to make progress, in the future a good part of problem solving will be done with DNA engineering instead of using mere electronic computers. We will then be at the starting point of a new science: the convergence of biochemistry and computing. Instead of going back to the *hippies'* time, developers are heading toward a future with white coats. Sorting a data dictionary by tinkering with test tubes is an experience that few developers must have dreamt of.

When computers first appeared, IBM and the likes were convinced that the market for them could be counted on the fingers of one hand, maybe two, but not more. Then, when microcomputers were first built, hobbyists were the only one to believe it would have an impact. If history repeats itself with DNA computers, developers with a biochemistry background will definitely have an edge.

David Mery

OS/2 vs Windows 95

MICROSOFT HAS TURNED the spotlight on the PC operating system marketplace with its publicity campaign for Windows 95. As a result, many people have become interested in the alternatives. And first among these is IBM's OS/2 Warp: a full 32-bit, multi-tasking, multi-threading operating system which has been available since March 1992. This has given IBM time to tune and polish it to the point where it's a sophisticated, mature and robust offering.

Let's look at this from the developer's point of view. One of the major trends in application development these days is towards *task-centred* computing. The key to using a computer this way is an object-oriented user interface. OS/2 has sported this since 1992, and Microsoft has attempted to emulate the principle in Windows 95, which is why there appear to be many similarities between the two. However, once you dive down under the covers, things are very different. OS/2 Warp has benefited considerably from IBM's three decades of experience at developing operating systems that people can bet their businesses on.

OS/2 Warp has a much superior object model (SOM, the System Object Model). A major reason for its superiority is that it complies to a key industry standard, the Common Object Request Broker Architecture (CORBA) from the Object Management Group. SOM enables binary compatibility between a variety of object-oriented languages - a key benefit when code reuse is the objective. And SOM is a base technology in OpenDoc, the component architecture from CI Lab.

OpenDoc is important in three key respects: it enables very easy creation of compound documents; applications can be created from a kit of parts; and it will interoperate with OLE 2 from Microsoft. Indeed, many developers are giving thought to using OpenDoc to develop OLE parts as a protection from potential unexpected changes in the OLE API.

Creating OpenDoc code is an attractive proposition to the smaller development shops that want to compete with the vendors of today's monolithic applications by developing component-based applications. So, I believe OS/2 is the best platform for object-oriented development, particularly of Client/Server applications. OS/2 is the ideal platform for running this kind of application - where multitasking, multithreading, crash protection, and an object-oriented user interface based on a sound object model are key prerequisites.

In the early days, OS/2 faced an uphill battle for acceptance, for a variety of reasons. And there's no doubt that Microsoft will face some of the same problems with Windows 95. Not the least of these will be the reluctance of people to adopt a new and different operating system, particularly one that's not an upgrade but an upheaval.

There are several things that MS has going for it - Office 95 and the Microsoft Network are potentially very powerful weapons. So, it doesn't have the initial problem that IBM once had with OS/2 - the lack of a major application for the platform. However, I will be very interested to see how Microsoft copes with the support issues. There will be many people trying to get help on the new user interface, and also to report problems - despite a beta program, a brand new operating system will have many bugs. There will also be programmers trying to understand how best to program for both Win 95 and NT simultaneously, an interesting challenge, given the difference in user interfaces between the two.

Finally, of course, in case developers are debating whether to develop for 16- or 32-bit Windows, or are considering whether the 9 million OS/2 sales makes this a market they want to invest in, IBM has announced the Developer API extensions to OS/2. This is support for some 700 of the Win32 API calls, which makes it possible for developers to create a common code base between OS/2, NT and Win 95. This will enable developers to exploit OS/2's considerable toolset for development of their applications, and still be able to run on Windows platforms with relatively little extra effort. And they have IBM's award-winning support capabilities as peace of mind for their development, too.

Steve Walker, Strategic Advocate, IBM UK

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News & Views

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If you are serious about C++, you should check out **Watcom C/C++ 10.5** - it's their best one yet.

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CIRCLE NO. 277

Mayhem!

The essentials of life are food, shelter and a modem. How does one survive when one of these is missing? **Jules** describes a terrible experience.

I'm sitting here, writing these lines, naked. No, don't cringe, gentle reader: whatever you're imagining, it is as nothing compared to the full revolting horror of the reality. But I'm not referring to my lack of clothing, I'm referring to my lack of a modem.

For better or worse, I've surrounded myself with technology. I actually quite like being surrounded by technology: I'm one of the fortunate few who understands most of it and is not frightened of it, and because of that, I'm able to expand into it and make all these machines part of me. This is fine while everything is working properly, but it causes no end of problems when something breaks.

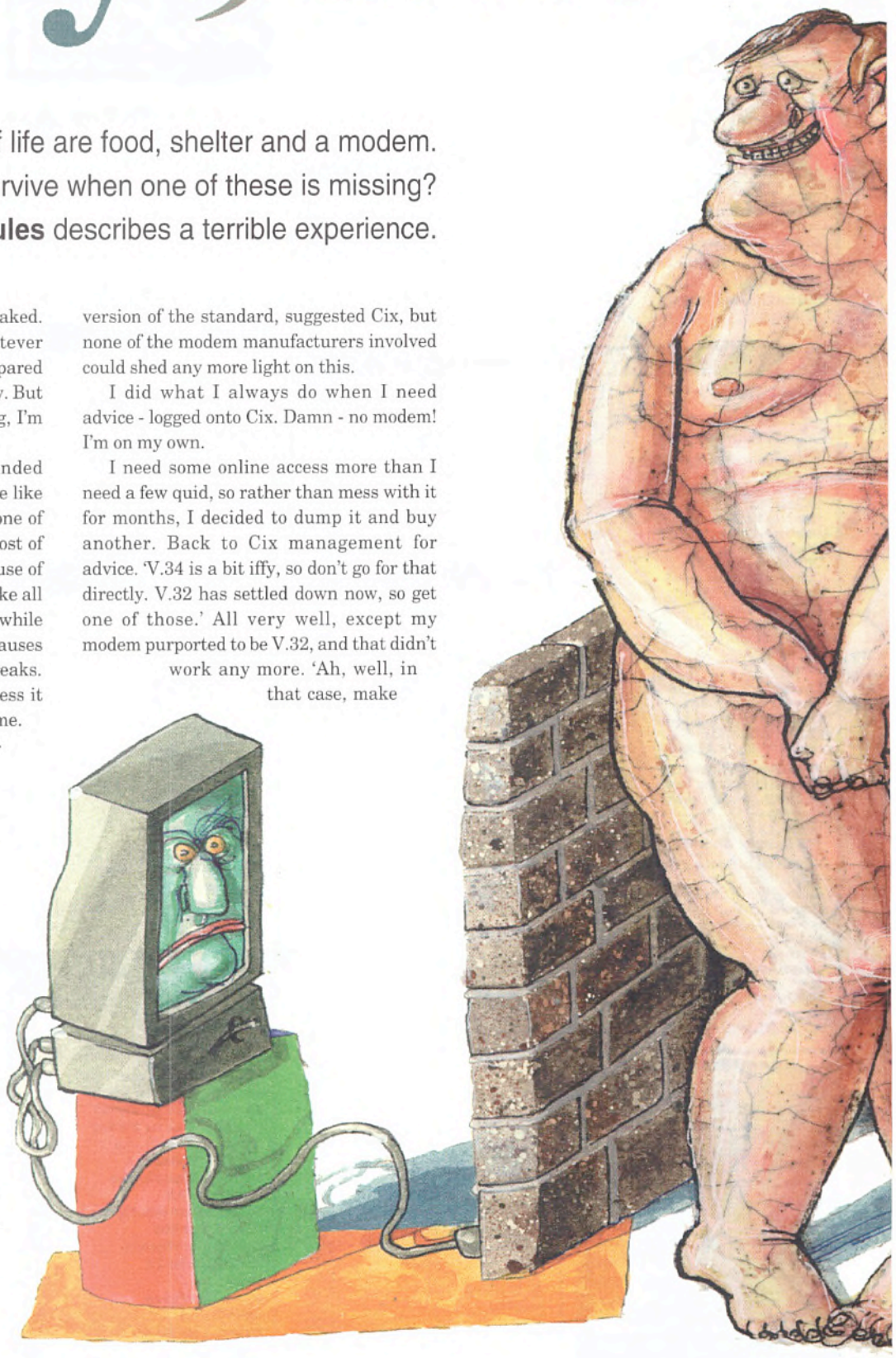
It was my modem that broke. I guess it was an old modem, and well past its time. It should have been replaced by something no less capable but smaller and cheaper. And, when it broke, it did so not because anything went wrong inside it, but because Cix changed its modems to something different, and it was no longer prepared to talk to them. But the modem was no longer working, and something needed mending.

Now, I remembered why I hadn't bothered to replace it. It was already working, and for a modem that's something to be proud of. I had completely forgotten how hard it is to tame these things.

First of all, I had to find out what had gone wrong. Cix's old modems were talking in V.32bis (whatever that is), and their new modems were talking V.32bis, and my modem was talking V.32bis, but the new V.32bis was sufficiently different from the old one that my modem could talk to the old ones just fine, but not to the new ones. Perhaps it's an old version of the standard, suggested Cix, but none of the modem manufacturers involved could shed any more light on this.

I did what I always do when I need advice - logged onto Cix. Damn - no modem! I'm on my own.

I need some online access more than I need a few quid, so rather than mess with it for months, I decided to dump it and buy another. Back to Cix management for advice. 'V.34 is a bit iffy, so don't go for that directly. V.32 has settled down now, so get one of those.' All very well, except my modem purported to be V.32, and that didn't work any more. 'Ah, well, in that case, make



sure you don't get anything with a Rockwell chipset inside it - they're known to be a bit funny. Don't worry, though: hardly anything uses Rockwell any more.'

My normal suppliers are all on Cix, and I couldn't contact them, because I had no modem. So I tried phoning around. It took three phone calls before I found a modem supplier with any modems in stock. (As an aside, can anyone explain to me how someone can stay in business without any stock of what they're selling?) Anyhow, I asked the salesman what chipset his modem had inside it. He didn't know. He suggested another supplier, who had some modems in stock, who might know. The other supplier said that his modems had Rockwell chips. I said I'd been told they were dodgy. He said 'Oh, no. Rockwell is OK. In fact, most of the modems in the world have Rockwell inside them. What you've got to watch for is AT&T. But don't worry, nobody uses AT&T chips - they're a bit dodgy, you see.'

I gave up trying to decide who I should believe. 'If I buy your modem and it doesn't work with my services, can I send the modem back?' The salesman assured me that there's nothing wrong with his modems, that it would work just fine, and that I wouldn't want to send it back. I insisted 'But if I do want to send it back, can I?' He relented after a five minute argument.

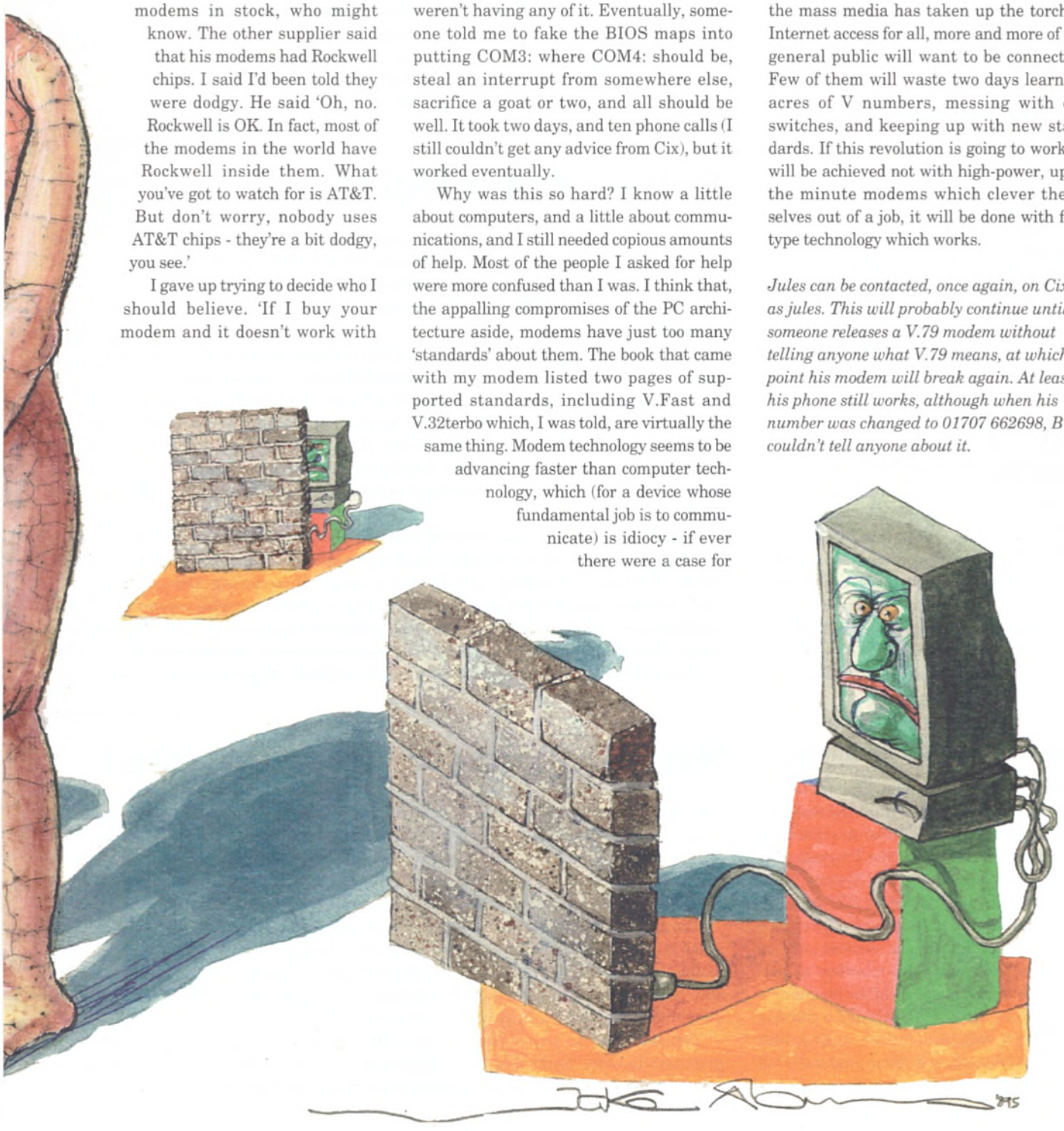
The modem arrived, and I plugged it in. Could I get it to work? Like hell! The book of words said quite clearly that it can't be used on COM3: when there's a mouse in COM1:. Quite true; I tried. But, it wouldn't work in COM4: at all, and COM2: was already in use. I tried to tell Windows where it was, and the BIOS setup, and they weren't having any of it. Eventually, someone told me to fake the BIOS maps into putting COM3: where COM4: should be, steal an interrupt from somewhere else, sacrifice a goat or two, and all should be well. It took two days, and ten phone calls (I still couldn't get any advice from Cix), but it worked eventually.

Why was this so hard? I know a little about computers, and a little about communications, and I still needed copious amounts of help. Most of the people I asked for help were more confused than I was. I think that, the appalling compromises of the PC architecture aside, modems have just too many 'standards' about them. The book that came with my modem listed two pages of supported standards, including V.Fast and V.32terbo which, I was told, are virtually the same thing. Modem technology seems to be advancing faster than computer technology, which (for a device whose fundamental job is to communicate) is idiocy - if ever there were a case for a proper standardisation procedure, modems are it.

But, it doesn't have to be this way. Fax users for years have just been able to call each other, and let the faxes negotiate on what language they should speak. There aren't two pages of fax standards, there's only half a dozen. Someone who brings out a fax with a clever new modulation wouldn't advertise the fact, because fax users just don't care, and even if they did, few would be able to use the facility.

In the past, the kind of unreliability and awkwardness which I experienced were only to be expected. In the future it won't do. Now the mass media has taken up the torch of Internet access for all, more and more of the general public will want to be connected. Few of them will waste two days learning acres of V numbers, messing with dip switches, and keeping up with new standards. If this revolution is going to work, it will be achieved not with high-power, up to the minute modems which clever themselves out of a job, it will be done with fax-type technology which works. ■

Jules can be contacted, once again, on Cix as jules. This will probably continue until someone releases a V.79 modem without telling anyone what V.79 means, at which point his modem will break again. At least his phone still works, although when his number was changed to 01707 662698, BT couldn't tell anyone about it.



Middleware demystified

Market research company Ovum's new report, *Middleware: the Key to Distributed Computing*, 'sweeps away the confusion' surrounding exactly what middleware is and why it matters. The report defines middleware as 'off-the-shelf connectivity software which supports distributed processing at run-time and which is used by developers to build distributed software'. Middleware is divided into six categories: database connectivity; message-oriented middleware; Remote Procedure Calls; Object Request Brokers; Distributed Computing Environment middleware; and distributed transaction process monitors. Ovum can be reached on 0171 2552670. The report costs £995.

Object Marketplace

Oracle is taking the idea of object reuse to its logical conclusion with a new software distribution strategy called Object Marketplace. Oracle will resell third-party Power Object components and OCX controls, as part of the Oracle Store located on the company's Web site. Developers will be a paid a royalty of about 50% of the sale price of their objects, and will be responsible for support and maintenance. Oracle will charge a fee to offset testing costs. More information can be found at http://www.oracle.com/.

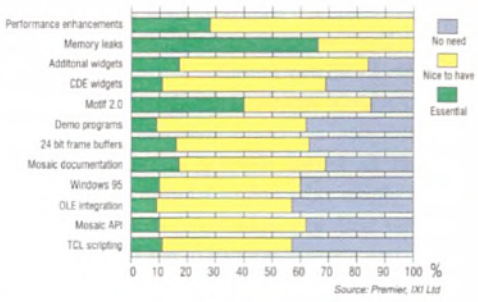
Is Windows 95 secure?

The August issue of the *Virus Bulletin* carries a mention of a Windows 95 virus. According to the article, this first virus for the just-released operating system makes use of the shared data area to capture keypresses. Any inter-task communication mechanism is by definition a good place to write data for legitimate but also for viral and/or buggy software. The *Virus Bulletin* is on 01235 555139.

Novell's RTOS programmer

Novell has started a new programme to help developers integrate NetWare and real-time operating systems (RTOSs) in embedded solutions. The RTOS Vendor Programme is part of the Novell Embedded Systems Technology (NEST) initiative (see *EXE* April '95 pp. 20-27) to create embedded applications that connect 'intelligent' devices such as printers, faxes and video-recorders to NetWare networks. Members of the programme will receive the RTOS SDKs and a training program to help them include an embedded network connection in their products. Call Novell on 01344 724000 for more information on NEST and RTOS.

Motif survey



IXI, the software company behind the X-Windows-based GUI Premier Motif, has conducted a survey of its customers. The results of the survey, published in IXI's newsletter *Premier*, shed some light on users' priorities when it comes to GUI fixes and enhancements.

Fairly obviously, the most useful features that had arrived over the last year were performance improvements and general bug fixes. A fix for a problem with Sun numeric keypads was deemed particularly important.

As for forthcoming features, the removal of memory leaks was considered far and above the most essential anticipated improvement - something perhaps all software manufacturers should pay heed to. Other requested enhancements included more documentation, improved performance and a greater variety of GUI widgets.

About 70% of users felt that IXI's Wintif, a library that can be linked into an application in place of the standard Motif library to give Motif applications a Windows look-and-feel, was an important factor in their choice of Premier Motif as a cross-platform toolkit.

Roll on 64-bit Unix!

A group of industry leaders, including supporters of standard processor architectures such as Intel's 80x86, Hewlett-Packard's PA-RISC, Digital's Alpha chip and Sun's SPARC, has endorsed the development of a widely-accepted set of 64-bit API's for Unix. AT&T, IBM, Motorola and SunSoft are among the 60-odd companies behind the programme.

Just as 16-bit architectures and operating systems on the desktop plagued developers with annoying concerns like segmented memory models and a 64 KB limit on contiguous blocks of data, 32-bit systems are now reaching their boundaries, allowing up to 4 GB of 'flat' (unsegmented) memory to be addressed. Some corporate databases need to hold more than 4 GB of data in memory at once in order to achieve the performance required to process millions of transactions overnight. A 64-bit architecture allows 16 exabytes (16 billion gigabytes) of RAM to be addressed directly.

The 64-bit Unix API specification will comply with and track existing industry standards such as XPG 4.2 (X/Open's single Unix specification, aka Spec 1170), POSIX, SVID, CDE and X-Windows. X/Open will oversee the resulting API set, which will cover needs ranging from those of supercomputers and enterprise servers to those of workstations. As the effort is the first specification targeted at 64-bit implementations, it has the opportunity to be the most comprehensive consolidation of Unix APIs to date. The API specification will be publicly available by the end of the year.

Smalltalk masterpiece unveiled

ParcPlace Systems and Digitalk announced their new product strategy at their combined users' conference in August. The two companies, which are on the verge of completing their merger, intend to integrate their core product lines into one product based on ParcPlace's VisualWorks. In the short term, however, ParcPlace-Digitalk plans to release upgraded versions of VisualWorks and Visual Smalltalk Enterprise (VSE) in the fourth quarter of 1995.

The new single product line, code-named VanGogh, should be available by spring 1996. As a step in that direction, the next releases of VisualWorks and VSE will be 100% language-compatible. VanGogh will be based on VisualWorks' Smalltalk libraries, tools and ANSI compliance, and adds keys parts of Digitalk's product line such as the PARTS Workbench, SLLs (Smalltalk Link Libraries) and Windows 95 compatibility.

Two new products are on the cards too - code-named 'Wadsworth', which will allow programmers to write World Wide Web applications, and 'ServerWorks', an optimised server environment designed to improve server performance and scalability. ParcPlace can be reached on 01252 719100.

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Borland's Developer Conference

This year, Borland's Annual Developer Conference looked like a Delphi event. **Will Watts** reports direct from San Diego, California.

New President a hit at San Diego

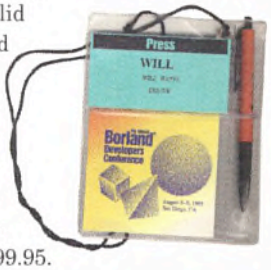
Borland's new president Gary Wetsel was in bullish form at the company's Sixth Annual Developer Conference at San Diego. Filling Philippe Kahn's shoes for the first time, Wetsel, who has imposed slashing cuts on Borland's operations, was able to announce the first quarterly profit since 1993. In front of over 2000 attendees, Wetsel promised to continue the upward trend, focusing specifically on Windows 95, for which the company announced a slew of new products.

New face for dBASE

Borland has shipped Visual dBASE (formally 'dBASE for Windows') version 5.5 and the Visual dBASE compiler, priced around US $350 each. Although 16-bit, Visual dBASE can take advantage of Windows 95 features such as icon tips, long filenames and right-click menus. The compiler kit allows royalty-free applications to be created and distributed, and includes the ability to make distribution disks. A client/server version of Visual dBASE, costing about US $695, should also be shipping by the time you read this. Borland also previewed Paradox for Windows 95/NT, due to ship before Q2 of 1996.

CodeGuard

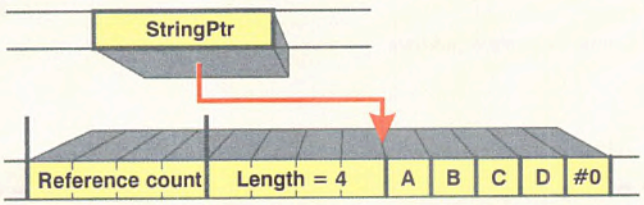
Also showing for the first time at San Diego - CodeGuard for Borland C++ 4.5, a debugging tool that integrates with the C++ IDE. The developer activates the CodeGuard option, and then begins testing his application as normal. CodeGuard automatically discovers bugs such as memory leaks, invalid memory references, memory overruns and uninitialised data access and displays detailed information about the error in the IDE Message Window. Double-clicking on the message causes the IDE to jump to the source line which caused the error. CodeGuard should be available in the UK by the time you read this; US introductory price is $99.95.



First showing of Delphi 95

Star of the Developers Conference was Delphi 95, the 32-bit version of the company's smash hit development system. Previewing in public for the first time, the product boasts a large number of new features:

- Full support for Windows 95 controls, including Rich Text Format, slider, progress bar and hierarchy controls.
- Multi-threading support. The VCL libraries are now fully re-entrant, and language support has been added for thread-local variables.
- Various enhancements for the product's database support, including an SQL Monitor (which logs SQL conversations), a data dictionary and improved deployment/installation facilities.
- A new 32-bit compiler, featuring the ability to track multiple errors (the existing 16-bit compiler stops as soon as it encounters an error), OBJ support and a number of language extensions. Optimisations carried out by the compiler, which shares its engine with Borland's 32-bit C++, include register variables and parameter passing, loop induction variables and common subexpression elimination.



- A new implementation of the **string** type, upping the maximum legal length from 255 characters to 4 GB. Strings are automatically dynamically allocated, using internal descriptors which contain both a length and reference count. The compiler automatically implements a copy-on-write scheme, which invisibly and safely minimises string space consumption, and also appends a null byte to the text so that it can be cast to a C style string for use in Windows API calls.
- Full support for OCX and OLE automation. The latter is elegantly implemented via a new data type **variant**. The following code associates a Microsoft Word object with the variable **MSWord** and uses VBA to insert a Delphi string **S** into a Word document.

```
var
  MSWord: Variant;
  S : String;
  ...
begin
  S := 'Some string';
  MSWord := CreateOleObject('Word.Basic');
  MSWord.Insert(S);
  ...
```

Note that the **Insert** method is dynamically bound at runtime. Standard Delphi classes, which use the same syntax for method calls, are statically bound at compile time. According to Borland's Anders Hejlsberg, Delphi 95's Object Pascal is the first language to combine early and late binding in this way. Group Product Manager Zack Urlocker assured us that Delphi 95 (aka 'Delphi 95/NT', aka 'Delphi 32') will include substantially revised and expanded documentation - he acknowledged that the documentation with the 16-bit version was below Borland's normal standards, attributing the poor quality to 'Version 1.0 difficulties'. Delphi 95 is now in beta and is due to ship within 90 days of the Windows 95 release.

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Power Objects

Oracle is shipping Power Objects, a cross-platform visual tool targeting initially Windows and Macintosh platforms. OS/2 is planned for later this year. The scripting language, called Oracle Basic, has the same syntax as Visual Basic. A local database is included in the product. Power Objects supports OCX and OLE 2.0 and OpenDoc when available. The price was not announced but is expected to be comparable to VB Professional's. A free 90-day trial version can be downloaded form http//www.oracle.com.

Apollo

xBase specialist Successware has launched Apollo, a Delphi add-on which can be linked to database applications as a replacement for the Borland Database Engine (BDE). Apollo allows Delphi developers to use Clipper (NTX) and FoxPro (CDX) indexes directly, without incurring the large performance overhead associated with ODBC drivers. Other benefits include a much smaller deployment 'footprint' than the BDE, and the ability to use standard Delphi data aware controls. One drawback is that Apollo does not contain an SQL engine, so SQL-based classes such as `TQuery` cannot be used with the system. Apollo is sold by QBS Software (0181 9944842) at £115.

Parallel Informix

Sun Microsystems and Informix are jointly developing a version of the Informix OnLine eXtended Parallel Server database software for Sun SPARCcluster. OnLine XPS will benefit users with very large data processing requirements such as those entailed by data warehousing and on-line transaction processing applications. It is the latest product based on Informix's parallel database Dynamic Scalable Architecture (DSA), and delivers new features such as enhanced parallel SQL operations. OnLine XPS for the SPARCcluster system will be available early 1996.

Insight++

User Interface Technologies has released Insight++ version 2.0, a development tool which automatically detects many kinds of programming and run-time errors. By compiling your program with Insight++, a version of the code is created which includes calls to the Insight library. Insight++ can be used to find memory leaks, memory corruption, mismatched parameter types to functions like `printf` and much more. Insight is available for Unix platforms at a starting cost of $1495. Call 01223 302041 for details.

Back to Basic

It's here - Visual Basic 4.0 for Windows 95 and Windows NT. Due out on 12 September, after a somewhat protracted beta-testing phase, the new 32-bit version of VB sports many enhancements, although most of the changes are not to the IDE, apart from the obvious Windows 95 gizmos, but under the surface.

VB 4.0 comes in three editions: Standard, Professional and Enterprise. Visual Basic for Applications is the core language for all three. An improved Jet database engine also features in each edition. The Professional and Enterprise Editions supports Remote Automation, a subset of the Network OLE functionality likely to be part of Cairo. Remote Automation is a communication layer between a VB client and a VB server.

The new version can target both 16-bit and 32-bit Windows. An in-depth review will feature in next month's issue. If you can't wait that long check out the story on EXplodE (http://www.exe.co.uk/edit/e-words/vb4/vb4.html).

Light Lib for Delphi

DFL Software has released a Delphi-specific version of its Images Windows library. Light Lib Images includes Delphi-style controls for the display and manipulation of BMP, PCX, GIF, JPG and TGA file formats, TWAIN scanner support and the ability to store graphics images in BLOB fields in Delphi-supported databases. A feature of particular interest to EXE readers is support for the new PNG file format, which is designed to avoid the patent levy imposed by Unisys on formats using the LZW compression algorithm.

Light Lib has just finished a beta version of a Delphi Business Graphics library, which will also feature data-awareness for codeless graphing of database data. Light Lib Images can be obtained from QBS Software (0181 9944842) and from Rhino Publishing (01302 364861). From the Standard version to the Combo Professional one, prices range from £149 to £329.

Real-time DOS

The UK company IMS released a real-time, pre-emptive multi-tasking 32-bit DOS-compatible operating system. The kernel itself is real-time. Real/32, as it is called, is based on a DOS emulation licensed from Novell (originally Digital Research). The code is optimised to make full use of the dual pipeline architecture of the 486 and the Pentium but will also run on a 386. A single machine running Real/32 can serve up to 64 users potentially running as many as eight Windows and/or DOS sessions. Up to 82 serial ports can be serviced at a maximum speed of 115 Kbps. IMS emulates virtual 16550 even if the serial cards have only non-FIFO chips.

Similarly to the DOS emulation of OS/2, Real/32 cannot run VxDs and support for Win32s is limited. For protected mode applications, Real/32 support DPMI 0.9 and Borland DPMI extensions. IMS considers that DPMI 1.0 is not a standard worth supporting as long as Windows doesn't use it. Tasks can run in the same virtual machine (VM) or in separate ones, communication is done through shared memory or with semaphores which can be locals to a VM or global.

The working set for the kernel is quoted as 1 MB but a 4 MB configuration is recommended. The OS cannot be executed from ROM, so a PC with a hard disk is the standard configuration to run Real/32. Clients can be anything from dumb terminals to full scale PCs. They can be connected either via a network (ODI, NetWare, TCP/IP, Lantastic, Windows or NT) or via a serial link.

Development for Real/32 is done with standard DOS and Windows tools. There's a specific API to access multi-tasking, inter task communication and synchronisation, and serial communication functions. At the time of writing the API is accessed via an interrupt but IMS promised for September libraries for most mainstream languages.

A one-off licence costs £185. IMS refused to disclose the price of a *gold disk* or of the SDK. To contact directly IMS, call 01276 686569.

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CIRCLE NO. 280

Letters

We welcome short letters on any subject that is relevant to software development. Please write to: The Editor, EXE Magazine, St. Giles House, 50 Poland Street, London W1V 4AX or email **editorial@dotexe.demon.co.uk** Unless your letter is marked 'not for publication', it will be considered for inclusion. Letters may be edited.

What is Microsoft up to?

Dear Sir,
I was amazed when I ran a utility that showed how much memory was being used by this monster [Windows 95]. With no application loaded - 15.9 MB! It runs OK on my 16 MB machine, but when I put it on a friend's 8 MB P90, it was diskswap time... just like Windows 3 used to be like on a 4 MB 486-33!

A realistic target for Win95 is a 16 MB Pentium-90 (my work machine). On that platform, it's bloody impressive. On a 16 MB 486-66 (my home machine) its borderline.

Why couldn't Borland have written Windows? It would be fast, small and reliable then.

Gordon Bamber
Speak Out forum on EXplodE

Service not #included

Dear Sir,
I feel that Crosbie Fitch failed in his intentions in last month's 'Service #included'. No-one in their right mind would even contemplate Crosbie's proposed solution. Indeed, few would suggest that there even was a problem, other than with Crosbie's understanding of the issue. Admittedly, `#include` is a duff legacy of the C language.

First, nested `#includes` can lead to definitions getting compiled twice. This can be avoided by conditional compilation. Second, nested `#includes` and the rules used to search for header files means that it's possible to pick up the wrong header when there are multiple versions of it in different directories. This can be avoided by prohibiting nested `#includes`. Third, it's pain to maintain lists of header files, especially if nested `#include` directives are banned.

The first two problems are trivial. The third - 'solved' by the Fitch method - is an unavoidable part of C++ code maintenance. A few seconds thought is surely more bearable than Crosbie's torturous answer.

Jocelyn Arbuckle
Bristol

For beta or for worse

Dear Sir,
I read the article Beta Times in the last issue with great interest. I was however disappointed that only Windows 95 developers were interviewed. The article could have been enhanced with the point of view of developers for other platforms including Windows 3.1.

I personally have developed several applications for Windows 3.1 and have no intention at all of moving to Windows 95. Why should I move from a tried and tested operating system to the first version of a half 16-bit, half 32-bit OS rushed to the production line? In addition if you compare the actual Windows 3.1 market to the Windows 95 one, conclusions are easy to draw. Even Microsoft reckons that not all Windows 3.1 users will upgrade (move?) immediately to Windows 95.

Dr Stephen Trobard
Internet address supplied

The choice of publishing only answers from Windows 95 developers was deliberate. We did receive a few answers from developers who had decided not to develop for Windows 95 but these were not quoted. The goal of this article was to have actual Windows 95 developers reactions on the difficulty or ease of targeting this platform.

Microsoft has claimed that the move from one OS to the other was straightforward and expect most developers to work on the new platform. The only way to have a less biased analysis of the advantages and disadvantages of writing for Windows 95 was to interview only developers that had worked with the betas - Ed.

Are programmers artists?

Dear Sir,
I disagree partly but strongly with Jules' last column where he predicted that developers would be artists in the future, as if they were not today. The development of a program is, and has always been, a work of art. Why do you chose one particular language and then one particular instruction? Give the same task to two programmers and you will end up with two completely different programs.

You can recognise the signature of very good programmers just by reading their source code. Good programmers are proud of their code. If communication is sometimes hard between the real world and developers, it is because, as all artists, they live in an artificial world. And by that I don't mean taking drugs. The development of software is akin to the creation of a virtual world of which the programmer has full control. It is much easier to live in this perfect world than in the real one.

Perhaps Jules should consider why software companies which announce release dates never (or very rarely) manage to meet them (the vaporlist in Ctrl Break is a brilliant idea). It's not because of last minutes bugs - or features. It's much more fundamental than that. Introducing a few bugs into an application is the only way a developer can create the time he needs to craft beautiful code with all the commercial pressure put on him. Once convinced that the code is aesthetically perfect then bugs can be eliminated.

Richard Fritton
Internet address supplied

Methodology mix-up

Dear Sir,
I tried to call the phone number mentioned in the news item 'Methodology merger', page 8 of the last issue. Instead of a human being answering the phone, all I got is sort of modem tones. Do you have a valid phone number?

Marc Stevens
Kent

Our apologies to Mr Stevens and to all the readers who called us. We printed the fax number of IDE instead of the phone number which is 01483 579000.

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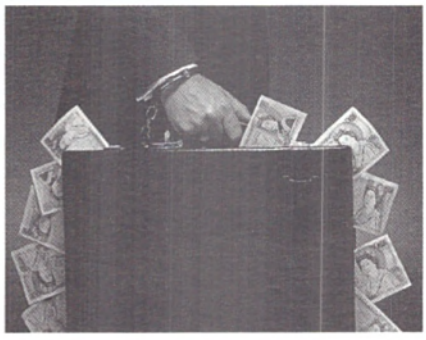

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CIRCLE NO. 282

Problem Hair?

What can be achieved in terms of modelling the real world? **Alex Parkinson** succeeds in generating hairs.

IN RECENT YEARS a great deal of computer graphics research has been concerned with the simulation of natural phenomena such as plants and clouds. There has also been some success in modelling hairless animals such as dinosaurs. Less success has been achieved with simulating mammals such as human beings. Human modelling is extremely difficult; whereas we have only a few preconceived ideas about how dinosaurs looked and moved, we all have an extremely good idea about how a person should look. As a result even very subtle deficiencies in a human model are instantly recognisable, and often very disconcerting.

The simulation of hair is accepted as one of the most challenging areas within the field of human modelling. To understand why, one must consider the current state of the art of computer graphics. Modern rendering is based around polygonal modelling. Polygons are good for modelling large, smooth objects. To model a hair using polygons every hair segment would have to be created from a cylinder primitive. Since no hair is totally straight, a number of these primitives would have to be used to model a single hair. There are be typically 100,000 hairs on a human head, requiring models containing many millions of polygons. Even assuming you could create such a model, the rendering would present extraordinary problems.

Polygonal models are rendered using shading and ray tracing techniques. Shading considers the relationship between a single polygon and the light sources in the scene, and derives a colour for the object from some illumination model. Ray tracing involves following the path of light as it is reflected and refracted though a scene. The lighting of hair would be practically impossible to simulate using either of these methods. Hair is slightly translucent, reflective and has a rough *scaly* surface. Light does not simply reflect off the surface of the hair as in a traditional shading model. Some of the light is reflected, some passes through the hair and is refracted and attenuated, some is scattered off the rough surface either out into the scene or back into the hair. To attempt to trace these scattering effects fully would be practically impossible. And that's not the only problem one encounters.

Hair is extremely thin, around 0.05 mm. Rendered at any reasonable range this will be less than one pixel width, and with traditional rendering techniques this would cause extreme aliasing problems.

Finally there is the problem of modelling the huge variation of hair styles that exist, and the complexities within them. Traditional methods would involve the individual placing and shaping of thousands of individual hairs.

The technique

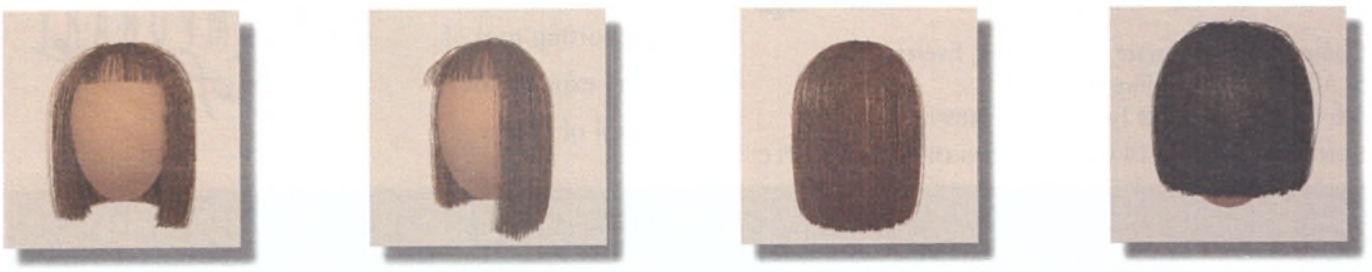
Consider what you see when you look at hair. An individual hair is almost invisible because it is very thin and slightly transparent. It is the build up of hair upon hair that you see. This explains why volumetric methods (see box on *Previous research*) produce good results, because they consider the contribution of the hairs all along the ray. However hair is not volumetric in the same way that, for instance, clouds are, the contribution to what you see comes from hairs a few deep, not from right through the hair body.

Our method is based around splines and micro-cylinders. Instead of using a model based on line segments that produces hair which is ostensibly straight, a spline form is used allowing the definition of hair with a natural curl. The hair is considered as a series of micro-cylinders placed along this spline form, using a look-up table method to describe the micro-cylinder. The normals in the micro-cylinder may be perturbed to give the effect of scales.

The hair is then shaded using the coordinates and normals information from the micro-cylinder. To allow the hair to be as thin as possible, supersampling is used for anti-aliasing. The spline definition and the anti-aliasing are used to alleviate the problems associated with the traditional models: the thickness and straightness of the hair.

To achieve the softness of the volumetric images a compromise solution is employed. Instead of simply z-buffering the hairs, they are additionally rendered to a *blur* buffer. Here the hairs previously rendered to the z-buffer are ignored in favour of the hairs underneath. To simulate the light scattering as it passes through the hair the image on this buffer is *blurred*. The two buffers are then merged with a value corresponding to the transparency of the hair. Coupled to the supersampling this means that a single hair contributes very little to the image. Instead the influence of the hairs is accumulated as they lie one on top of the other simulating the way that light is scattered and attenuated as it moves through them.

Using a shadow buffer to create shadowing effects, this method creates the variation



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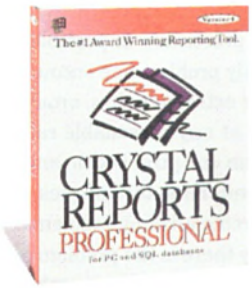

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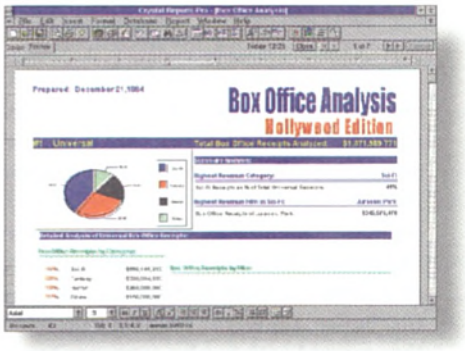

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CIRCLE NO. 283

```
struct cylinder_lookup_element {
   vector coord ;
   vector normal;
   struct cylinder_lookup_element *next;
   struct cylinder_lookup_element *prev;
};
struct cylinder_lookup_element *new_cylinder_lookup_element(vector c,
                                                            vector n)
{
   cylinder_lookup_element *toreturn;
   /* Create a new cylinder lookup element */
   toreturn = (struct cylinder_lookup_element *)
              malloc(sizeof(struct cylinder_lookup_element));
   /* Copy vectors c and n to coordinate and normal positions */
   copy_vector(c, toreturn->coord);
   copy_vector(n, toreturn->normal);
   toreturn->next = NULL;
   toreturn->prev = NULL;
   return toreturn;
}

struct cylinder_lookup_element *
build_cylinder_lookup_table(int num_samples, float length)
{
   vector normal, coord;
   int na; /* Number of samples to be taken along length */
   int nb; /* Number of samples to be taken around edge */
   float theta, rota, z;
   struct cylinder_lookup_element *toreturn, *newelement, *last;
   float Ax, Ay, Az, Bx, By, Bz, s, t;
   Ax = 0.1;
   Ay = 0.1;
   Az = 0.1;
   Bx = 0.1;
   By = 0.1;
   Bz = 0.1;
   toreturn = newelement = last = NULL;

   /* Ceil is used to round up, giving slightly
      more samples than requested */
   nb = ceil((2 * num_samples) / (-1 + sqrt(1 + (8 * PI * num_samples))));
   na = ceil(((float) num_samples) / nb);
   z=0;
```

```
/* Rota is used to rotate the sample start point round, this is
   for situations where nb is small so that there is more of a
   chance of a sample facing the eye position */
rota = 0;
for(i=0; i<na; i++)
{
   theta= rota;
   s = ((4 * PI) * i) / na;
   for(j=0; j<nb; j++)
   {
      new_vector(cos(theta) ,sin(theta),y,coord);
      /* Calculate the normal vector, perturb by a sine wave
         function in both directions along the unrolled cylinder,
         s and t, where s is length and t is circumference.
      shiftx = Ax cos(t) + Bx cos(s)
      shifty = Ay cos(t) + By cos(s)
      shidtz = Az cos(t) + Bz cos(s)
      */
      t = ((4 * PI) * j) / nb;
      new_vector(cos(theta),sin(theta),0,normal);
      normal[X] = normal[X] + (Ax * cos(t)) + (Bx * cos(s));
      normal[Y] = normal[Y] + (Ay * cos(t)) + (By * cos(s));
      normal[Z] = normal[Z] + (Az * cos(t)) + (Bz * cos(s));
      /* Now re-normalise the normal */
      normalise_vector(normal);
      if (!toreturn)
      {
         toreturn= new_cylinder_lookup_element(coord, normal);
         last = toreturn;
      }
      else
      {
         new_element= new_cylinder_lookup_element(coord, normal);
         last->next = newelement;
         newelement->prev = last;
         last = newelement;
      }
   theta = theta + ((2*PI)/nb);
   }
   y= y + (length/(na-1));
   rota = rota + ((2*PI)/na);
}
return toreturn;
```

Listing 1 - Creating the micro-cylinder look-up table

of light and shade as seen across real hair, and gives the natural sense of depth missing from previous segment models.

A single hair

To produce a single hair a micro-cylinder is created and oriented to lie on the spline description. The values of the coordinates and normals of the micro-cylinder are then used as parameters in an illumination model.

The construction of a hair is based on surface sampling. It consists of taking a mathematical description of a surface and reducing it to discreet elements which describe the surface characteristics in certain positions. For large objects (compared to screen resolution) it is impractical because the number of samples you require becomes very big. Instead polygonal methods are used and then some method of interpolation is carried out. However small objects can be described using a relatively low number of samples without loss of detail. This is the theory behind the construction of the micro-cylinder look-up table, a relatively few number of samples is used to describe the whole cylinder.

A micro-cylinder is a look-up table of evenly spaced co-ordinate and normal pairs, as shown in Figure 1. The cylinder is created along the z axis with unit radius and variable length.

To construct the micro-cylinder two parameters are required, the length and the total number of samples required. Two values are then found, the number of samples to be taken along the length, N_b, and the number to be taken around each cross section, N_a. In cases where the ratio of samples to length is low there can be very few samples taken around each slice, perhaps only one. This means that only one side of the cylinder would be described. To prevent this, the start angle of the samples is rotated by $2\pi/N_a$ for each cross section then incremented by $2\pi/N_b$ to find each sample position. This means that even if only two samples are taken they will still be on opposite sides of the cylinder.

To simulate the scaly surface of the hair the normals in the micro-cylinder are perturbed. A wave function is used with roughness scaling values with parameters to control the level of light scattering. The result is subtle, but significant. The transition of shade along a hair is broken up by the roughness, giving it a more realistic feel.

The code for the construction of the micro-cylinder is shown in Listing 1, the function `build_cylinder_lookup_table` takes the total number of samples required, and the length of the micro-cylinder. The radius is set to one unit, and the light scattering parameters are hard coded.

The number of samples required for a micro-cylinder depends on the height and

Language

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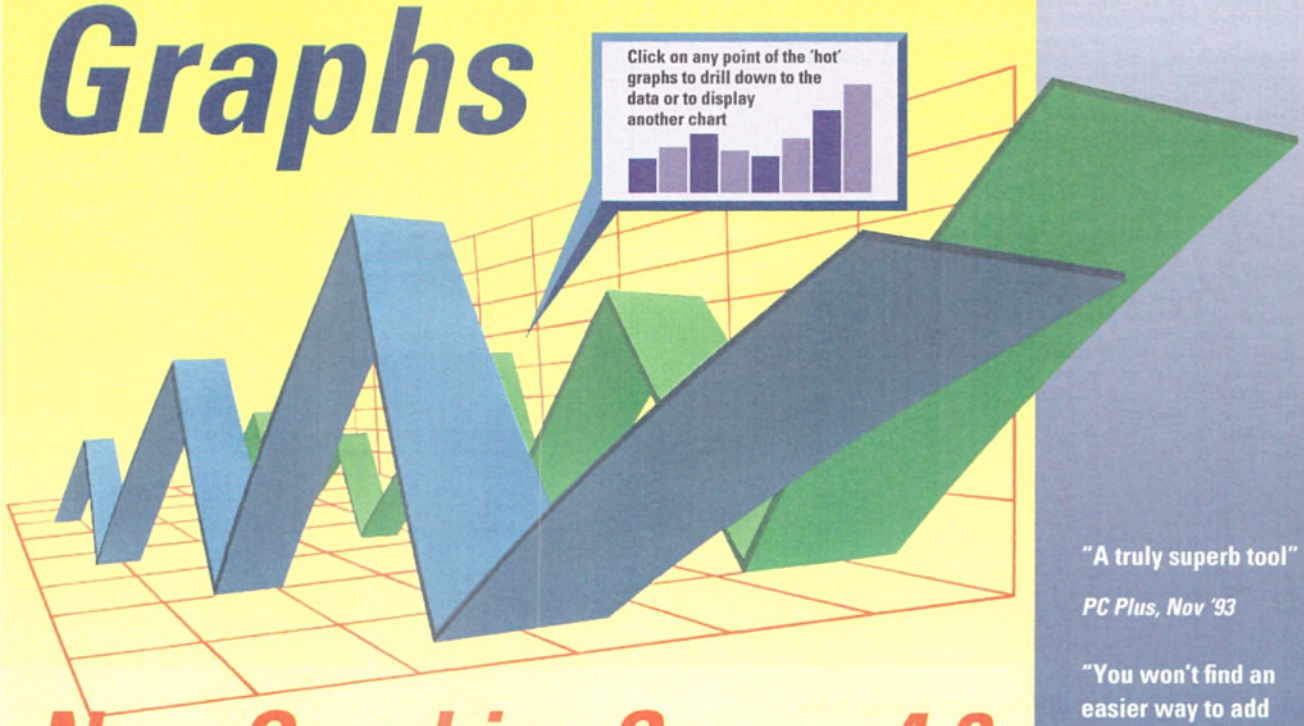
Programmable Graphs



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✎ CIRCLE NO. 284

radius of the micro-cylinder, the distance of the cylinder from the viewer and the perspective model being used. The Niquist limit is applied with respect to the resolution of the screen, this states that the frequency of sampling must be greater than twice the observed frequency of the information. In this context, the micro-cylinder must contain at least two samples for every pixel it is projected onto. In the implementation, one micro-cylinder is created for the closest hair in the scene, since this will require the most samples. In this way the hair can get as close to the view point as required and never cause any artefacts as would be seen in a polygonal model.

To position the micro-cylinder on the spline it is translated and rotated. Using direction cosines much of the rotation can be pre-calculated then applied to the coordinates and the normals of the cylinder. Intuitively, to describe the shape of the hair, an interpolating spline, one that passed through its control points, is desirable. In addition it is required for the spline to maintain a high level of continuity and give a natural smooth line. For these reasons a matrix transformation (Catmull-Rom spline) is applied. Listing 2 shows one of the functions for rendering a section of a hair to the z-buffer. The structure `angles` contains the angles for rotation, and the function `rotate_point` applies the rotations to a

Previous research

The existing research into rendering hair falls into two categories: those involving volumetric methods and those based around segment descriptions.

Volumetric modelling has been used to simulate natural phenomenon such as clouds. In this system, objects are considered not as surfaces but as volumes with varying densities. A ray casting algorithm projects parallel rays from the viewer into the volume. The effect of the light scattered in the direction of the eye is calculated and integrated along a ray to form a single brightness value. Two adaptations of this method have been used to render hair, the more general 'hypertexture' developed by Perlin and Hoffert, an attempt to model many different complex textures using a unified model; and 'texels' (texture-voxels) developed by Kajiya and Kay, used to create a three dimensional fur texture that can be mapped onto any surface. These volumetric methods undoubtedly produce the best hair images currently seen. However they are both fundamentally methods of covering a surface in a fur like texture, they require complex parametrizations and have extremely high render times (around eight hours for an image). It is unclear how these methods could be adapted to allow easy rendering of different hair types and styles.

The other research, such as that by Watanabe, Suenaga and Anjyo, or Usami and Kurihara, concentrates on fast rendering of more explicit models. The modelling task is reduced in complexity as far as possible, by using prisms instead of cylinders for example, and a minimum number of segments. By using powerful custom hardware to do much of the work, render times can be drastically reduced down to a few minutes per image. The models are very flexible and can be used to model complex hair styles, however the speed and flexibility are gained at the expense of realism. The hair produced is too thick, too straight and too artificial looking. The traditional shading cannot generate the complex interaction of light and shade required and as a result the hair has no softness.

The goal of the work at Teesside is to develop a set of algorithms that combine the flexibility of the segment models with the image quality produced by the volumetric methods. The modelling method should be flexible enough so that it can be used to describe hair of any shape and style. The renderer should produce a realistic soft and natural look to the hair, allowing a large level of variation in the look of the hair, its colouring and the way it appears in different lighting conditions. The rendering time should be within practical limits so that animation of full hair images would be a reasonable prospect.

```
matrix catmull_rom_matrix = {{-0.5,   1.5, -1.5,  0.5},
                             {   1 , -2.5,    2, -0.5},
                             {-0.5,     0,  0.5,    0},
                             {   0 ,    1,    0,    0}};
float calc_delta(vector p1, vector p2)
{   return(1 / ( fabs(p1[X] - p2[X]) +
                 fabs(p1[Y] - p2[Y]) +
                 fabs(p1[Z] - p2[Z])));
}
/* (t**3, t**2, t, 1) * 1/2 * catmull_rom_matrix *
                      (P(i-3), P(i-2), P(i-1), P)
   with t running from 0 to 1 in steps of delta */
void catmull_rom(vector p1, vector p2, vector p3, vector p4,
                 struct cylinder_lookup_element *head,
                 ZBuffer the_buffer)
{
   float t= 0;
   float *swap, *from, *to, delta;
   four_vector from_v, to_v, t_vector, tm_vector;
   vector new_coord, new_normal, moved_coord, tangent;
   struct angles a;
   struct cylinder_lookup_element *current;
   delta = calc_delta(p2,p3);
   from = from_v;
   to = to_v;
   new_four_vector(0,0,0,1,t_vector);
   mult_four_vector(t_vector, catmull_rom_matrix, tm_vector);
   from[X] = (tm_vector[0] * p1[X]) +
             (tm_vector[1] * p2[X]) +
             (tm_vector[2] * p3[X]) +
             (tm_vector[3] * p4[X]);
   from[Y] = (tm_vector[0] * p1[Y]) +
             (tm_vector[1] * p2[Y]) +
             (tm_vector[2] * p3[Y]) +
             (tm_vector[3] * p4[Y]);
   from[Z] = (tm_vector[0] * p1[Z]) +
             (tm_vector[1] * p2[Z]) +
             (tm_vector[2] * p3[Z]) +
             (tm_vector[3] * p4[Z]);
   from[H] = 1;
   t = t + delta;
   while (t<=1)
   {
      new_four_vector(pow(t ,3), pow(t,2),t,1,t_vector);
      mult_four_vector(t_vector, catmull_rom_matrix, tm_vector);
      to[X] = (tm_vector[0] * p1[X]) +
              (tm_vector[1] * p2[X]) +
              (tm_vector[2] * p3[X]) +
              (tm_vector[3] * p4[X]);
      to[Y] = (tm_vector[0] * p1[Y]) +
              (tm_vector[1] * p2[Y]) +
              (tm_vector[2] * p3[Y]) +
              (tm_vector[3] * p4[Y]);
      to[Z] = (tm_vector[0] * p1[Z]) +
              (tm_vector[1] * p2[Z]) +
              (tm_vector[2] * p3[Z]) +
              (tm_vector[3] * p4[Z]);
      to[H] = 1;
      /* Put a cylinder on the segment then draw it to z buffer */
      set_up_angles(from,to, &a);
      subtract_vectors(from, to, tangent);
      normalise_vector(tangent);
      current = head;
      while (current)
      {
         rotate_point(current->coord , moved_coord,a);
         add_vectors(moved_coord, from, moved_coord);
         project_point(moved_coord, new_coord);
         if ((moved_coord)[Z] > buffer_getval(the_buffer, new_coord))
         {
            rotate_point(current->normal , new_normal,a);
            buffer_setval(the_buffer, new_coord, moved_coord,
                          new_normal, tangent);
         }
         current = current->next;
      }
      swap = from;
      from = to;
      to = swap;
      t = t + delta;
   }
}
```

Listing 2 - Rendering a Catmull-Rom hair to Z-buffer

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```
struct hair_style {
   struct wisp *first; /* Pointers to the hairs in the style */
   struct wisp *last;
};
struct wisp {
   hair *keyhair;
   struct hair *first_hair;
   struct hair *last_hair;
   vector p1; /* Vectors defining plane of growth */
   vector p2;
   struct wisp *next;
};
struct hair {
   struct hair *next;
   struct cp *first_cp;
   struct cp *last_cp;
};
struct cp {
   vector pos ;
   struct cp *next;
   struct cp *prev;
};
void draw_style( struct hair_style *style,
                 struct cylinder_lookup_element *head,
                 ZBuffer the_buffer )
{
   /* Draws the whole style to the Z Buffer */
   struct wisp *current_wisp;
   struct hair *current_hair;
   current_wisp = style->first;
   while (current_wisp)
   {
      draw_hair(current_wisp->keyhair, head, the_buffer);
      current_hair = current_wisp->first_hair;
      while (current_hair)
      {
         draw_hair(current_hair , head, the_buffer);
         current_hair = current_hair->next;
      }
      current_wisp = current_wisp->next;
   }
}
```

```
void draw_hair(struct hair *todraw,
               struct cylinder_lookup_element *head,
               ZBuffer the_buffer)
{
   /* Draws an individual hair to the Z Buffer */
   int ok, points_left;
   struct cp *cps[4];
   struct cp *current_cp;
   /* find the first four points */
   points_left = 1;
   current_cp = todraw->first_cp;
   if (current_cp)
   {
      for(i=0 ; i<4; i++)
            if (points_left)
            {
               if (current_cp)
               {
                  cps[i] = current_cp;
                  current_cp = current_cp->next
               }
               else points_left = 0;
            }
   }
   else points_left = 0;
   /* Now continue until you run out of points */
   while (points_left)
   {
      catmull_rom(cps[0]->pos , cps[1]->pos, cps[2]->pos,
                  cps[3]->pos, head, the_buffer);
      if (current_cp)
      {
         cps[0] = cps[1];
         cps[1] = cps[2];
         cps[2] = cps[3];
         cps[3] = current_cp;
         current_cp = current_cp->next;
      }
      else points_left = 0;
   }
}
```

Listing 3 - Style Data Structures and Functions to Call Catmull-Rom Drawing

vector. The function `buffer_setval` sets the value in the z-buffer for the given co-ordinate.

The illumination model

The 'Kajiya anisotropic illumination model' is used in most existing segment-based methods because it gives good control over the diffuse and specular behaviour of the cylinder. It was chosen as the illumination model for this method. Figure 2 shows the elements involved in the calculation.

The illumination is calculated using a constant ambient, and calculated diffuse and specular term, as follows:

$$\Psi_{diffuse} = K_d \sin\theta_{vl}$$
$$\Psi_{specular} = K_s \cos^p \phi_{er}$$

where

K_d	diffuse coefficient
p	Phong exponent used to control the highlight sharpness
K_s	specular reflectance coefficient
θ_{vl}	angle between cylinder direction and light vector
ϕ_{er}	angle between eye and reflection vectors

The illumination model gives a good variation of shade across the length of the hair, and a well defined specular highlight. The parameters are easy to control to produce the desired colouring effects.

Rendering to buffers

The hairs are initially rendered to shadow buffers for each of the lights in the scene, then to the supersampled combined z and frame buffer.

The shading information is calculated from the illumination model and an occlusion value for the shadowing. Because the whole basis of the rendering technique is that the light penetrates beneath the first layer of hair, the shadowing must be varied over a shadow depth.

For the rendering of the hair three effects are required:

- the translucence of the hairs, so that one hair viewed on its own would merge into background,
- the way that hairs back each other up so that the a pixel in the final image is the combination of the contribution of a number of hairs through to a certain depth and...
- the scattering of the light as it passes through the hair.

The first two suggest some form of accumulation buffer, the last one some sort of blurring. These are combined into a single 'blur buffer'. After the scene has been rendered to the z-buffer it is rendered again to a new buffer. However, this time in addition to the normal z-buffering a second test is made against the existing z-buffer such that hairs that have already been rendered are ignored. This rendering will consider only what is below the surface. In addition the new colour does not simply overwrite the existing one, instead it is merged and scattered.

To implement this a 'blur filter' is defined; typically a 3x3 matrix with a centre value of 0.9 and surrounding values of 0.1. This is applied to the new pixel value, meaning that the centre pixel becomes a combination of 0.9 times the new value and 0.1 times the previous value, for the surrounding pixels it is the other way round. Because the centre number is less than one, no information is ever thrown away. All hairs that are rendered to this buffer will have a contribution, however small. This filter is adjustable in two ways: first a bigger filter would scatter the light over a wider area, secondly changing the values would increase or decrease the light that can be scattered (the surrounding numbers) and the backing up effect (the centre number). The buffers are merged with a value corresponding to the translucence of the hair (0.9 Z-buffer + 0.1 blur-buffer, for example).

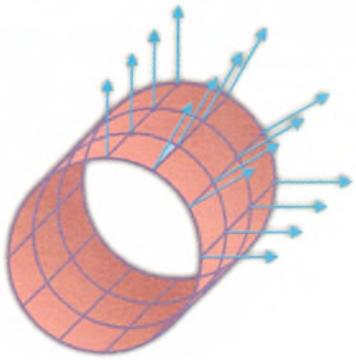

Figure 1 - Positions of samples on cylinder

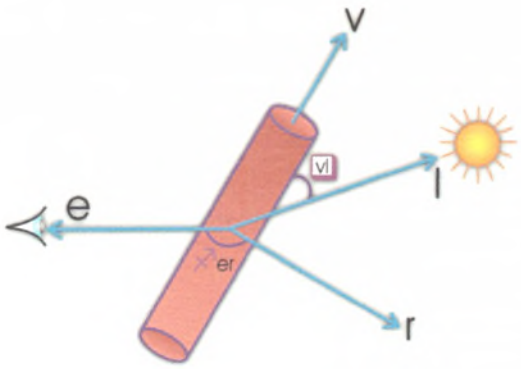

Figure 2 - The vectors used in the shading calculation

Hair styles

Although it is reasonably easy to define the shape of an individual hair by positioning the spline's control points, to position the thousands of hairs individually in a style would be impractical. When examining various hair styles it becomes apparent that each hair has a relationship to those around it and it is bundles of hair that form the patterns which make up the overall shape.

Complex hair styles can be described using perhaps a hundred *key hairs*. Then around these key positions additional hairs can be positioned automatically and parametrically (controlled by the user). These groups of hair are called 'wisps' and are described using three parameters: number of hairs, density and randomness. The hairs grow from a surface, therefore each wisp has an associated plane of growth upon which the roots of all the hair lie.

The data structure is therefore hierarchical, a style is created from a number of wisps, each one containing a key hair and a number of hairs grown parametrically. Finally, each hair consists of a number of control points. Listing 3 shows the data structures. The functions `draw_style` and `draw_hair` show how the wisps are used to draw the entire style to the z-buffer.

Parameterize 'n' Go

The results are pleasing. With no specific hardware graphics support, an image containing many thousands of hairs can be rendered in under an hour. The hairs form continuous smooth curves. The shadowing and blurring courses a realistic variation of light and shade. The highlight on the hair as it curves is also very realistic. The shading function is convincing, but it is the shadowing and the blurring that really give the hair a sense of softness and depth.

All the images shown in the article were generated using a Silicon Graphics Iris Indigo, with a MIPS R4400 CPU, a MIPS R4010 FPU and a GR2-XZ graphics board. The Iris had 64 MB of main memory, a 16 KB instruction cache and a 1 MB secondary unified instruction and data cache.

As can be seen from the colour pictures a number of different looks have been produced that would be impossible using traditional polygonal modelling. The use of wisps

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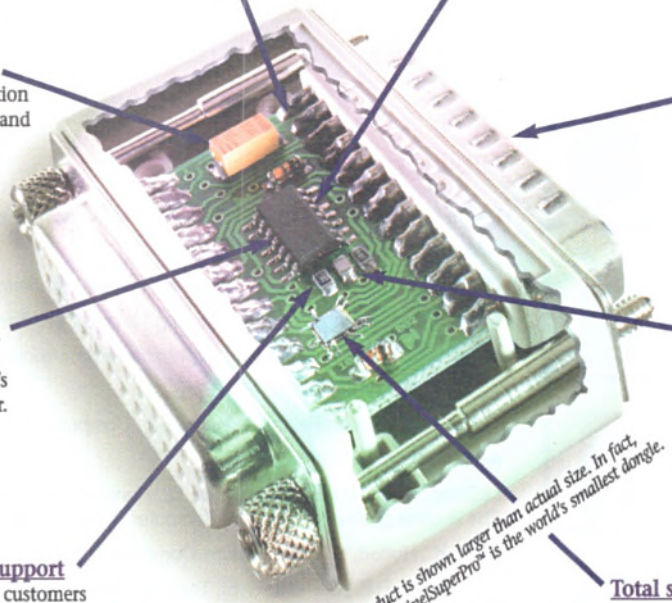

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and splines means that full complex hair styles can be described in terms of a few hundred control points, and the splines give the hair a natural curve or curl never available with previous methods. The use of the micro-cylinder look-up table allows fast rendering of hairs while having the extra bonus that the normals can be altered to simulate the scales. The surface sampling adapts to the distance of the hair from the eye, this means that the hair will remain smoothly curved and correctly rendered however close the viewer gets to it.

The key element of the system is its flexibility, not only in the shape of the hairs and the styling, but also in the parametrization of the shading model, and the configuration of blurring and transparency.

Although render times are high compared with those achieved using other segment models, the quality of the output is comparable to volumetric approaches which take considerably more time and are not flexible enough to produce a wide range of styles and hair types. It is hoped that the result of the continuing research will be a combined system incorporating flexible hair styling and animation tools.

Alex Parkinson is now in the first year of his PhD research at the University of Teeside.

He's working on the realistic simulation of hair and fur.

Alex Parkinson can be reached via email at A.T.Parkinson@tees.ac.uk

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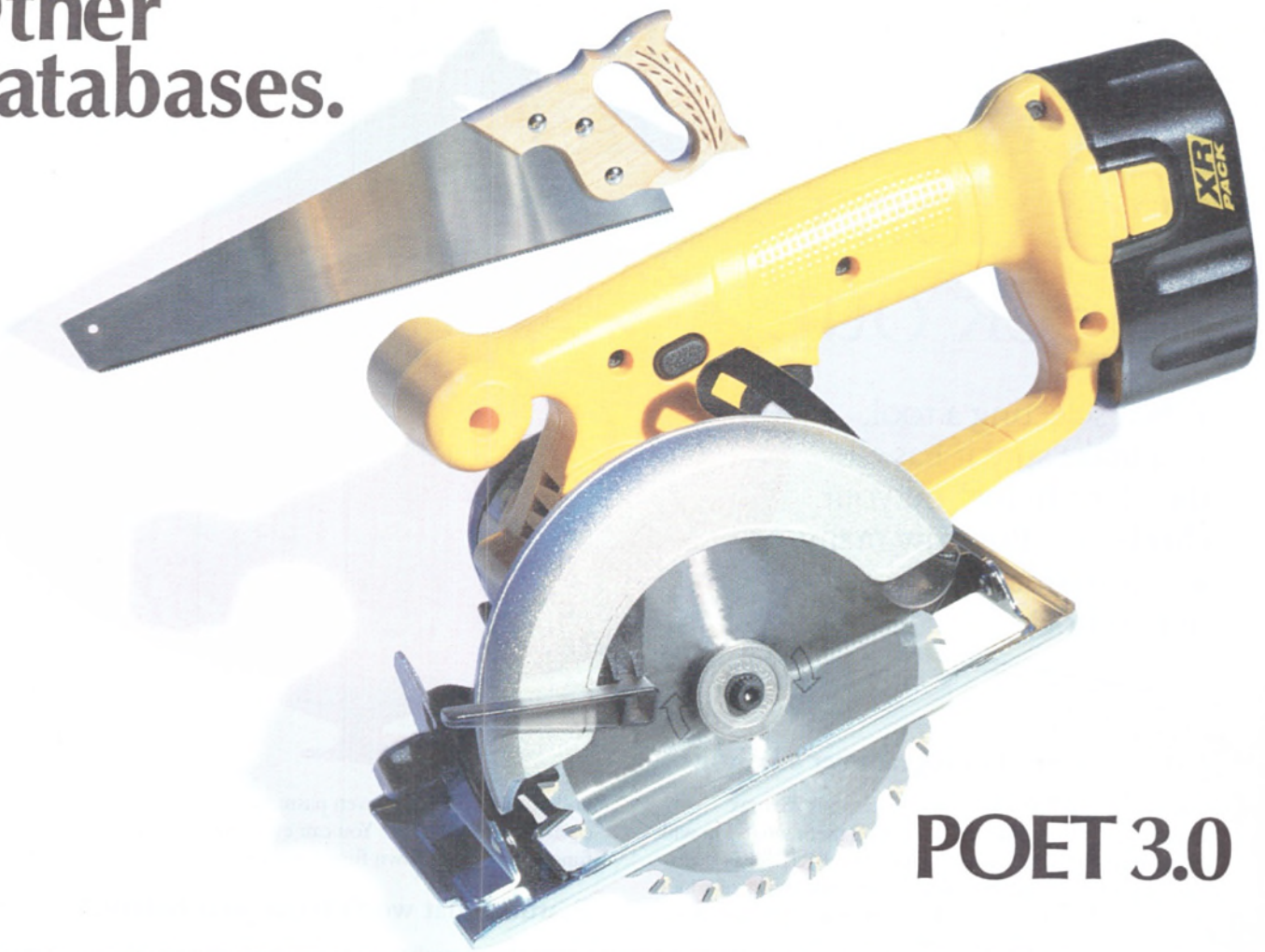

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3D for the masses

3D-Ware promises a quick route to the next smash hit game, but does it live up to its promise? **Philip Harris** takes a look.

Game creation utilities have always been popular products. From the early days on the ZX Spectrum, companies were releasing tools with promises of instant games and instant fame. With the advent of more advanced computers like the Atari ST and Amiga, game creation tools evolved from the point and click simplicity of the *Shoot Em Up Construction Kit* to the more traditional programming language approach. Each time one of these products was released users would flock to the stores, filled with visions of money and the next smash hit game. Of course it never quite worked out that way, but none seemed to notice.

It was inevitable that the PC would be the next target for the game development roller-coaster. There have been one or two *virtual world* toolkits available for some time and the Windows game market has recently been blessed (or cursed, depending on how you look at it) with Klik & Play, a general purpose system which aims to give even the most non-technical user the ability to create stunning games. 3D-Ware from Virtek International is the latest addition to the range of tools available and although it is aimed squarely at C/C++ programmers, its aim is still to provide an easy way to write award winning games.

More than just 3D

3D-Ware is primarily a 3D graphics library, designed to help you write games in the same vein as Elite, TFX and Inferno. Indeed the last two products used earlier versions of the 3D-Ware engine. In addition to the 3D graphics commands, the library provides file I/O, mouse and joystick input, string functions, palette functions and even some fast maths functions.

There are two versions of the package, the Personal Edition and the Professional Edition. Both packages are royalty free with the Professional Edition adding Gouraud shading, texture mapping and autoscaling sprites to the features in the Personal Edition. Both packages are limited to a resolution of 320x200 pixels with 256 colours. This limitation allows a fast update rate but objects are quite heavily pixellated.

The software comes on two disks and consumes a little under 3 megabytes of disk space. The package consists of a suite of utilities

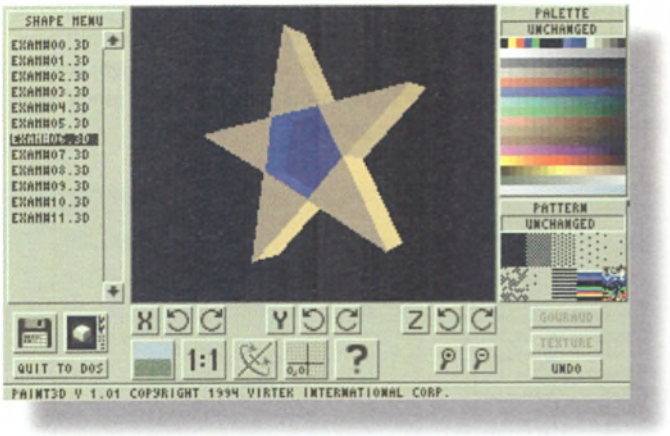

Figure 1 - The shape created using the definition in Listing 1, shown being edited within paint 3D

Figure 2 - One of the sample programs showing a flock of birds circling in the sky

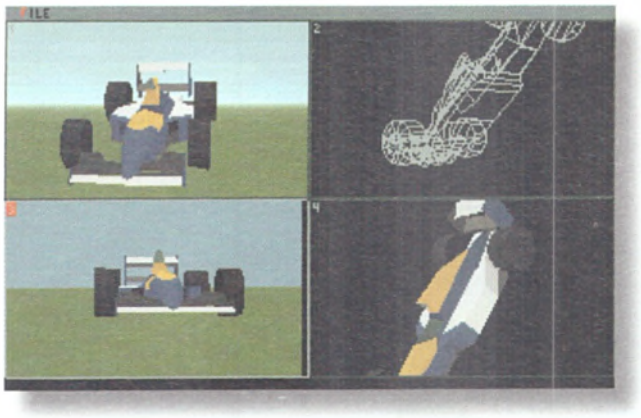

Figure 3 - The second sample program demonstrating its display capabilities using a vaguely familiar motor racing car

which perform the various tasks associated with creating the data for use within your 3D application, a library of functions, over 150 example files and 400 pre-built shapes.

Two programs are also supplied to demonstrate the library's capabilities. The first shows a flock of simple 3D birds circling in the sky (see Figure 2), the number of birds and their distance can be adjusted. The second example shows four images of a motor racing car (see Figure 3) each of which can be spun, in filled or wireframe mode, with or without a horizon.

Virtek must be congratulated on the amount of example material included although I would have liked more advanced pre-built samples beyond the two that are supplied. Ideally a simple flight simulator type application ready to run would have given a much more interesting introduction to the package.

Four main tools are supplied: the *shape compiler*, the *world editor*, *paint 3D* and the *palette editor*. All the tools are mouse driven and have a consistent look and feel. A status line gives a description of the function currently selected and details of any keyboard shortcuts associated with it.

The shape compiler

Objects used within a 3D-Ware program such as cars, boats, trees, roads, etc are called *shapes*. Shape creation is the most complicated aspect of creating a 3D-Ware application but is strangely left until last in the manual's description of the tools. This is probably to avoid putting the user off as the description of shape creation gets pretty unfriendly. (The 334 page manual covers the tools supplied for creating 3D objects followed by a very brief introduction to writing a 3D game before it launches into a function by function break down of the library.)

Creating a shape involves two stages, first you need to create a .SH file. This is a text description of an object written in what is almost a programming language. The .SH file is then passed to the *shape compiler* which creates a .3D file used by the 3D-Ware routines. The contents of a .SH file is effectively a program which controls the drawing of the shape. It can include various commands to increase the speed of drawing the object.

The first line indicates the palette file which is associated with the shape. Palette files are created using the *palette editor*. The second entry within the shape is the *visible range specifier*. This is the distance the shape needs to reach before it is no longer displayed. Two optional parameters `DOT` and `QUAD` allow you to specify a distance beyond which the object is displayed as a coloured dot or group of four dots respectively.

```
   SHAPE 10000

;;;;;;;;;;vertex list;;;;;;;;;;;;;;;;;;;;;;;;

   VERTEX 01,00,-120,-20
   VERTEX 02,114,-36,-20
   VERTEX 03,70,98,-20
   VERTEX 04,-70,98,-20
   VERTEX 05,-114,-36,-20
   VERTEX 06,28,-36,-20
   VERTEX 07,44,16,-20
   VERTEX 08,00,48,-20
   VERTEX 09,-44,16,-20
   VERTEX 10,-28,-36,-20

   VERTEX 11,00,-120,20
   VERTEX 12,114,-36,20
   VERTEX 13,70,98,20
   VERTEX 14,-70,98,20
   VERTEX 15,-114,-36,20
   VERTEX 16,28,-36,20
   VERTEX 17,44,16,20
   VERTEX 18,00,48,20
   VERTEX 19,-44,16,20
   VERTEX 20,-28,-36,20

;;;;;;;;;;facet list;;;;;;;;;;;;;;;;;;;;;;;;

   IFVIS 18,20,16 GOTO no_hole
      ;this one line checks if the cavity mouth is
      ;NOT visible by checking the reverse side of
      ;the hole. If the check is TRUE then the hole
      ;mouth is not visible and the following seven
      ;DRWcommands are bypassed by the GOTO command.
      ;Note how the three vertices used do not belong
      ;to an actual facet but a THEORETICAL FACET
      ;that defines the hole mouth.

   DRWPOLY 091,10,06,16,20   ;these facets belong to the
   DRWPOLY 090,06,07,17,16   ;cavity in the back of the
   DRWPOLY 088,07,08,18,17   ;star.
   DRWPOLY 089,08,09,19,18   ;
   DRWPOLY 090,09,10,20,19   ;
   DRWPOLY 092,06,10,09      ;
   DRWPOLY 092,08,07,06,09   ;

no_hole:

   DRWPOLY 220,01,10,20,11   ;these 10 facets make up the
   DRWPOLY 220,02,06,16,12   ;outside edge of the star. The
   DRWPOLY 220,03,07,17,13   ;same colour trick has been used
   DRWPOLY 220,04,08,18,14   ;to avoid sorting as can be seen
   DRWPOLY 220,05,09,19,15   ;in EXAMPLE#03.
   DRWPOLY 218,10,05,15,20   ;
   DRWPOLY 218,09,04,14,19   ;
   DRWPOLY 218,08,03,13,18   ;
   DRWPOLY 218,07,02,12,17   ;
   DRWPOLY 218,06,01,11,16   ;

   IFVIS 1,4,3 GOTO no_face
      ;this line checks if the star face is NOT visible
      ;by checking its reverse side. Again, note that
      ;the three vertices used in this check do not
      ;belong to any one existing facet but cover the
      ;largest area of the face being tested. It is wise
      ;to check the largest surface area as this avoids
      ;possible IFVIS errors arising from performing the
      ;maths on very small areas.

   DRWPOLY 216,01,06,10   ;these 7 facets make the front
   DRWPOLY 216,02,07,06   ;face of the star
   DRWPOLY 216,03,08,07   ;
   DRWPOLY 216,04,09,08   ;
   DRWPOLY 216,05,10,09   ;
   DRWPOLY 216,09,10,06   ;
   DRWPOLY 216,06,07,08,09;

no_face:

   DRWPOLY 222,20,16,11   ;these 5 facets make the back
   DRWPOLY 222,16,17,12   ;face of the star
   DRWPOLY 222,17,18,13   ;
   DRWPOLY 222,18,19,14   ;
   DRWPOLY 222,19,20,15   ;

   RETURN
```

Listing 1 - A shape definition example supplied with the package

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The main section of the shape definition consists of a list of vertices in the form:

```
VERTEX v,x,y,z
```

Whre **v** is the vertex number and **x**, **y** and **z** are it's co-ordinates.

After all the vertices have been specified the *Facet* list uses the specified vertices to create dots, quads, lines, balls, polygons, sprites, etc to build up the shape. Some additional commands enable rotating, shifting or scaling shapes by transforming their co-ordinates. Others can be used to repeat portions of a shape and to control the order of rendering by skipping portions of a shape which are not visible. Performance of the 3D-Ware engine depends to some extent on the ordering of the facets within a shape.

By the time you've created a shape you may well end up with something that looks more like Basic than a shape definition (see Listing 1). Luckily help is at hand with utilities to convert from standard .DXF format to .SH and back again. Several examples are included on disk and in the manual.

This difficulty in creating shapes for use in 3D-Ware programs is one of the package's weakest point, without a modelling tool that can output .DXF format most users will find it very tricky to create interesting objects. Even with a modelling tool, objects may still need to be optimised by hand to get good results.

He's got the whole world....

Once you have created your shapes the *world editor* is used to combine any scenery you have into a world in which your players will fly, drive or walk in. There are three modes within the *world editor*: the *shape viewer* mode, the *world viewer* mode and a *preview* mode in which you can move around, within your world, to check the location of each object.

The *shape viewer* mode lets you preview the shapes available and build up a selection to be used within the world. Facilities are present to rotate the object on each axis and zoom in. Should you 'lose' the object from the display, a useful button resets the view to the origin.

Once you have selected the shapes you wish to use, you can move into the *world viewer*. This presents a top down view of your world as it stands. Again there are buttons to move around within the world. Objects are placed in the world by stepping through the list of objects selected in the *shape viewer* and clicking on the ones you want to add. There is no on screen list of shapes so if you have a lot of different shapes in use it can be time consuming to find the shapes you require.

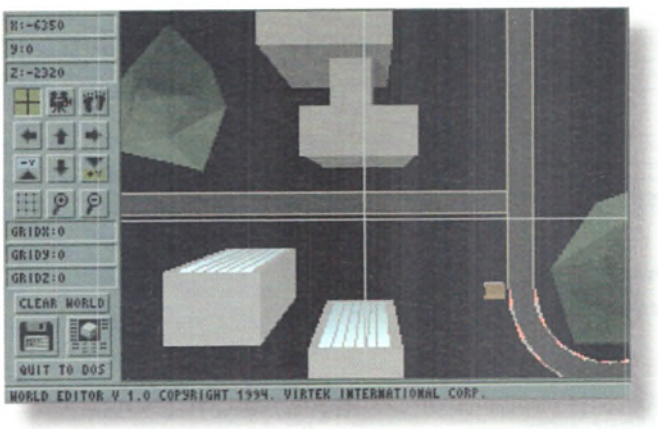

Figure 4 - A world under construction within the world editor

Shapes can be rotated and moved, either by clicking and dragging with the mouse, by using the movement tools on the toolbar or by entering the exact position of the object in the on screen co-ordinate boxes. A grid tool simplifies the alignment of objects.

Once you have placed your scenery you can walk or fly around your newly created world to get a more accurate view of how things are looking. A camera mode gives precise control over your location and is designed to check the location of objects within the world, rather than for getting a feel of how your game will play.

As is usually the case, initial planning of the world will make creating an interesting location much easier. A serious game could well require large amounts of graph paper to complete.

Painting the town

The *paint 3D* tool is used to modify the colour and texture of individual facets of a shape. Each facet can be given a colour, a pattern, a Gouraud shaded effect or have a bitmap applied to it.

The interface to *paint 3D* is very similar to the *shape viewer* mode of the *world editor*, Virtek has tried to keep a consistent feel to the various modules which is a welcome change from the common hotchpotch of graphics utilities.

The main display contains a list of the available objects and an image of the object currently being edited. This image can be rotated and zoomed to get at the portion of the object you wish to add colour to. Colours are selected from a palette on the right hand side of the screen. Once a colour is selected, clicking on a part of the object will set the colour of that particular facet to the colour you just have selected.

The pattern option applies basic patterns to the facet, including an animated one which alternates between two colours and is ideal

```
#include "..\3D-Ware\dddware.h"
short    Xpos=0, Ypos=0, Zpos=400;
short    Xangle=0, Yangle=0, Zangle=0;
short    VXpos=0, VYpos=0, VZpos=0;
short    VXangle=-0x900, VYangle=0, VZangle=0;
short    ShapeHandle;
char     Semaphores;

struct LookAtStructure16 mystruct;

void  main(void)
{
  dddInitAll();
  ShapeHandle = (dddShapeLoad("EXAMPLE.3D")); // Load the .3D data file.
  dddSetViewPos16(VXpos,VYpos,VZpos);         // Set the viewers angles in
the 3D world.
  dddSetDotGrid(159,99,160,100);              // Set up the dot grid para-
meters.
  while  (!dddkeycode)
  {
    dddCls();          // Clear the graphics screen.
    dddPrint6(1,0,0,"PRESS ANY KEY TO EXIT");
    dddClearObjects(); // Clear the viewing table.
    VYangle += 0x80;   // Rotate the shape in the Y plane.
    VYangle = VYangle & 0xFFC0;

    mystruct.Xpos = Xpos;
    mystruct.Ypos = Ypos;
    mystruct.Zpos = Zpos;
    mystruct.Xangle = VXangle;
    mystruct.Yangle = VYangle;
    mystruct.Zangle = VZangle;
    mystruct.Distance = 1000;

    dddQLookAt16(&mystruct);
    dddDotGrid();

dddInsertObject16(DRW_MOBILE,ShapeHandle,Semaphores,Xpos,Ypos,Zpos,0,0,0
);
                       // Insert an object to be rendered.
    dddDrawObjects();  // Render all 3D objects we have inserted.
    dddScreenSwap();   // Flip the real screen and the dummy screen.
  }
  dddRestoreAll();     // Bye.
}
```

Listing 2 - A sample program to display a rotating 3D object

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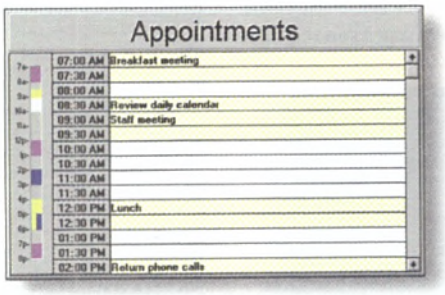

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for rocket engines. The Gouraud shading effect gives graduated fills within a facet. For more detailed colouring of shapes, bitmaps can be applied to the facet.

Effective use of *paint 3D* requires that the objects are made up of enough facets to allow you to colour them as required, but not too many, as otherwise the painting job becomes too difficult. Once again, advanced planning is essential to get good results.

The last of the major tools supplied with 3D-Ware, the *palette editor*, creates the colours used in 3D objects. Although modifications can be made at any time it is advisable to decide on at least an approximate palette before starting the design of the objects.

In a similar way to the *world editor* and *paint 3D*, the *palette editor* can load and preview an object using the palette currently edited, thus ensuring that the objects look exactly how you want them to. Colour editing is performed using the standard red, green and blue sliders with tools for copying, merging and swapping colours and for undoing changes.

Utilities and library

Several utilities are provided to make things easier. Three programs provide facilities for grabbing sprites, palettes and textures from bitmap files while a fourth remaps a shape, texture or sprite to a specified colour palette. Also, in addition to the .SH and .DXF converters mentioned earlier there are utilities to simplify a .SH file by precalculating any arithmetic calculation and transformation commands present in the file. All these tools have a simple command line interface.

In addition to the shape and world creation tools, 3D-Ware includes a library of over 150 functions for displaying and controlling the shapes created elsewhere. This gives a much more flexible approach than products which try to encapsulate the game design elements within the development tool. It also means that 3D-Ware can be used for just about any application that displays precalculated 3D objects on screen.

The core of the library provides functions for setting the position and viewing angles for the view position (which might be the view from the player's ship for example) and for the various objects which populate the 3D world in which the game takes place. Other functions provide facilities for initialising and drawing the display, and for moving objects. For example the `dddProjectForward(void far *pos, void far *ang, short speed)` function moves a given object a specified number of units in a given direction and might be used to move a missile towards its target or a logo into position.

The library is not limited to the 3D manipulation functions, it also provides 2D drawing and clipping routines to restrict the display of graphics in a similar way to a ship console type effect. Several fast maths and random number routines are included to help speed calculations required during the writing of a game. File functions include PCX bitmap and palette read/write code in addition to the standard file access facilities.

Very little required for writing a game is missing from the general functions. Everything is there from mouse, keyboard and joystick support for controlling your game right down to functions for timing and text output. For more advanced users, 3D-Ware includes support for the Cybermaxx, Forte VFX1 and Media Magic's virtual reality headsets.

A 3D-Ware shell

A very basic 3D-Ware application consists of four stages (see Listing 2). First the initialisation: a call to `dddInitAll()` is all that is required to initialise the 3D-Ware engine and mouse code. Then the loading of the world and of the objects used within the program is done with the `dddShapeLoad(char far* shape_name)` function. The third stage

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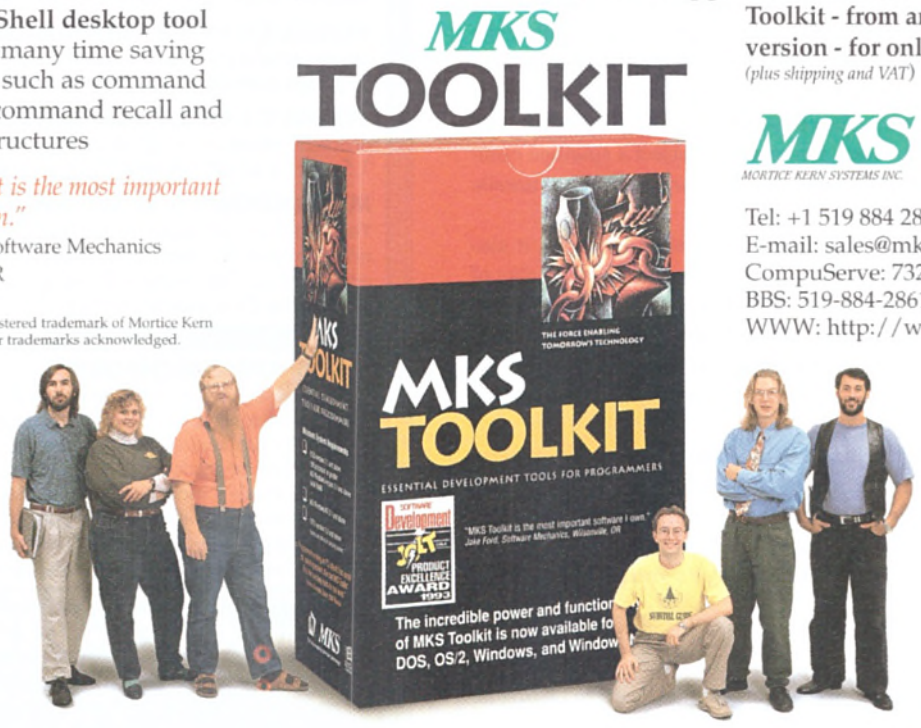

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Figure 5 - The world from Figure 4 as it would be seen in a game

is the main loop. For a simple game, it forms the core of the program. It can be subdivided in the following steps:

- Move the player depending on the position of the mouse or joystick.
- Set the player viewing position and angle.
- Remove any currently displayed objects.
- Insert the horizon.
- Insert each object in turn.
- Make a call to draw the objects.
- Make the scene visible.

The last stage is a call to `dddRestoreAll()` to reset the state of the computer before exiting the program.

The final verdict

Performance of the library is very impressive even on a low end 386, although the restriction to 320x200 can be extremely limiting and gives objects a very chunky feel, particularly when they are moving slowly. Shape creation is very unfriendly though, users without a modelling tool such as AutoCAD or 3D Studio will be at a definite disadvantage and even then it will take some tweaking to get the most out of the package.

3D-Ware is the sort of product that should attract shareware authors from around the world in the hope that it will enable them to write the next killer 3D game, just as they did when all the other games utilities came out. Unlike most other game development tools, though, 3D-Ware requires a C compiler and thus some degree of programming ability to get past the first few pages.

But 3D-Ware also has potential beyond games. Architectural walk throughs, even visualisation of scientific or business data are well within the capabilities of the library although the need to create objects before the program is run will limit its usefulness in these fields. At £99 the standard edition is an absolute bargain although at the time of writing there is no upgrade path to the more expensive professional version.

If you're looking for a quick and cheap way to get into 3D games programming, or you want to spice up that database you're working on, 3D-Ware is a perfect choice. Unless you really need the texture mapping, the personal version is the best choice.

■

Philip Harris is Technical Director of Digital Workshop a software house working on the PC. He can be contacted on the Internet at piharris@cix.compulink.co.uk. Digital Workshop will shortly be releasing the 3D game to beat all others.

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CIRCLE NO. 298

Type Cast

Feeling stuck in a bit of a rut with the old type casting mechanism of C++? ANSI C++ now provides four operators intended to replace the bug-prone **(T)e** syntax. **Roland Perera** explains the ins and outs (and ups and downs) of the new notation.

The C++ type system is, in Bjarne Stroustrup's words, concerned with 'the detection of *accidental* errors, rather than the prevention of fraud' (my emphasis). In other words, it's not the compiler's job to prevent the programmer from intentionally subverting the type system. The language provides the concept of a *type cast* for situations when the programmer wants to treat an object as though it were of a different type. As we all know, type casting is fraught with hidden dangers.

Implicit coercions

Traditionally, there have been a number of ways that type conversion can be achieved. Thanks to the legacy of the C programming language, there is a set of *implicit* conversions between built-in types. Narrowing or truncating conversions may result in loss of information; other coercions cause the bit pattern representing the value to be interpreted differently, or to be 'padded out' to fit the size of the target type, or both.

A conversion can be said to be 'safe' only if all values of the type to be converted can be represented as values of the target type, with no loss of precision or change of numerical value.

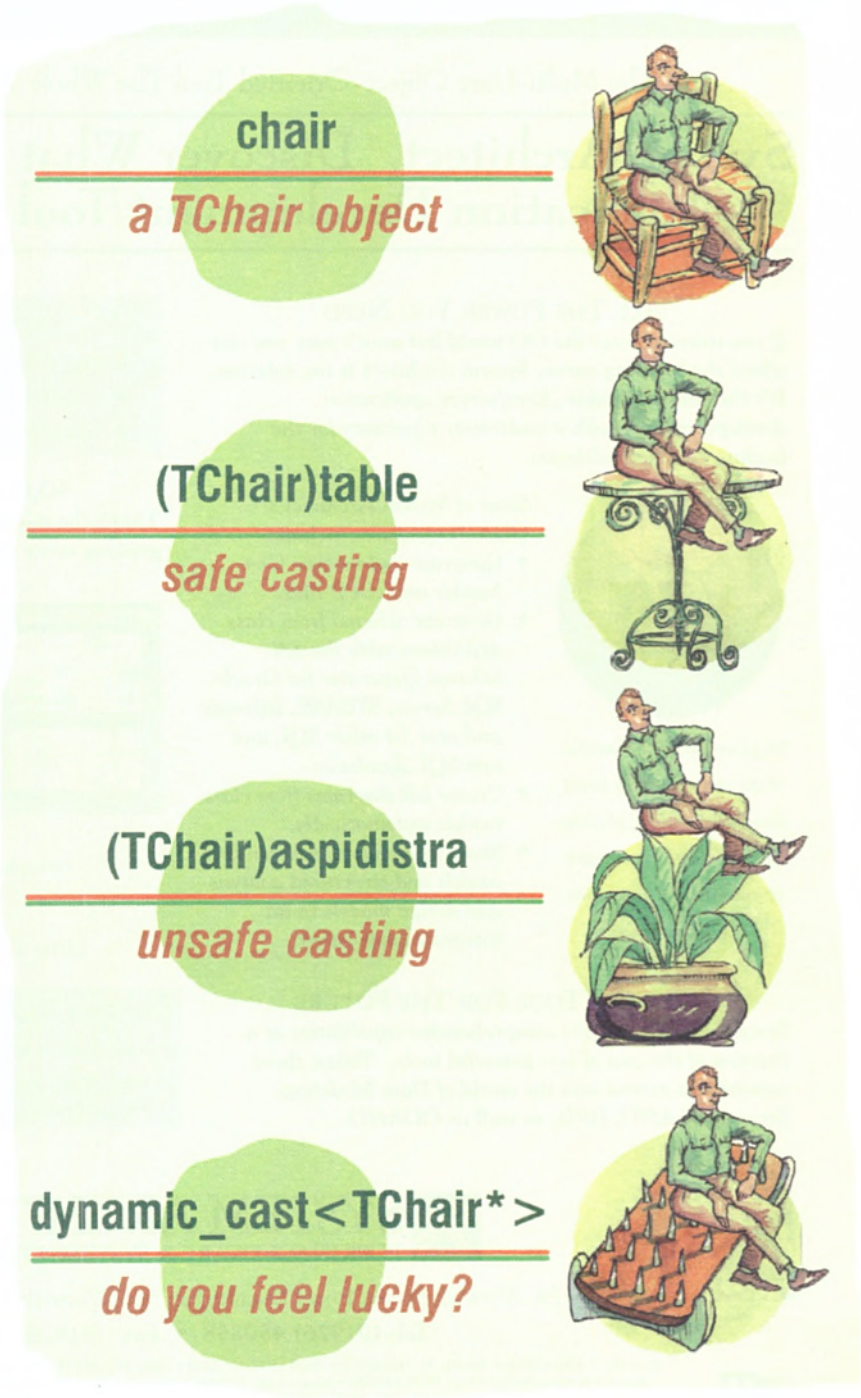
Explicit casts

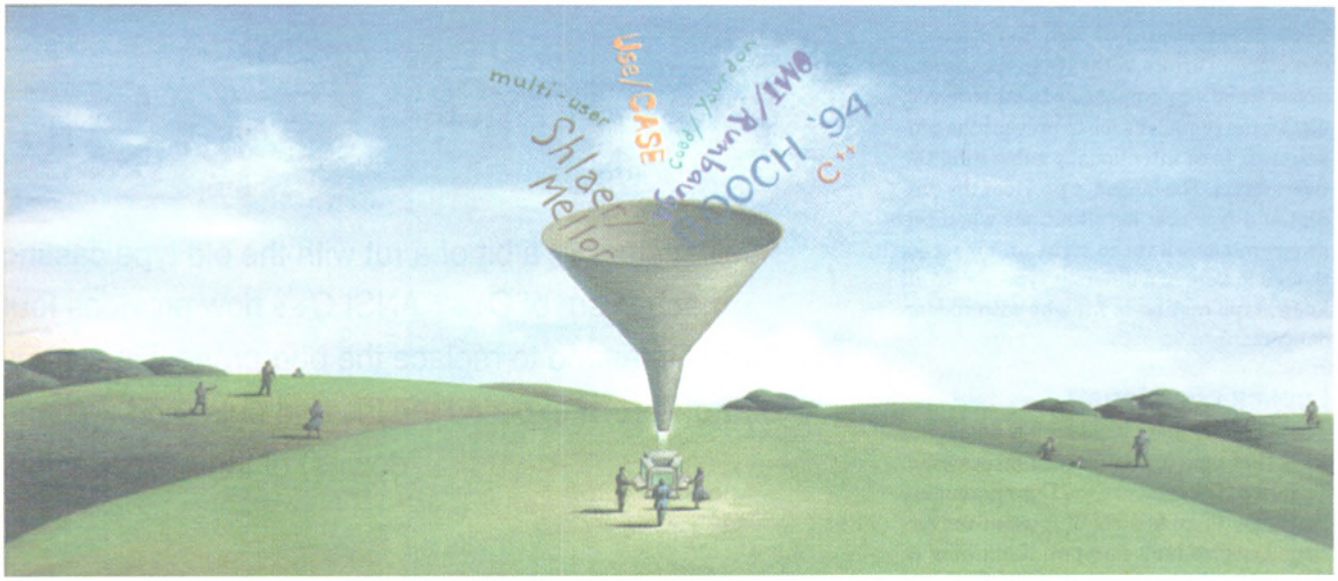
The second way that type conversion can occur is via the cast syntax with which most readers will be familiar. Certain conversions are allowed by the language; others can be defined by the user. A cast expression has the form `(type-name) expression`. Casting is more dangerous than implicit conversion, as it suppresses the type checking performed by the compiler.

A cast to a derived class pointer, is known as a *down-cast*. It has an undefined behaviour if the original pointer does not point to a derived class object but is subsequently treated as though it does. Also, down-casting from a `virtual` base is not supported by the language, as this would require base class objects to maintain pointers to their 'enclosing' derived class objects. Finally, a pointer-to-member may only be explicitly converted into a different pointer-to-member type if both types point to members of the same class, or if one type points to a class unambiguously derived from the other.

User-defined conversions

The implicit type conversions and casts that are part of the C++ language only work for built-in data types and pointers or references to user-defined or basic types. Type conversions to and from class objects can be effected by two means: constructors that accepts one argument, and user-defined *conversion functions*. The latter is useful for





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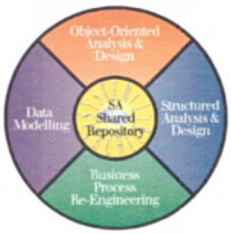

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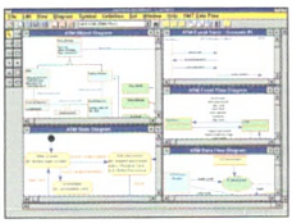

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```
class Vector
{
public:
    Vector (int s);
};

Vector f (const Vector& v)
{
    Vector w(10); // intended use of constructor
    w = 20;       // implicit construction of operator='s operand
    return 5;     // implicit construction of return value
}

void main ()
{
    f(10);        // implicit construction of argument}
```

Figure 1 - Implicit conversion by constructor

defining a conversion from a class to a basic type, which is not possible with constructors. In addition, no modification of the target class is required; with constructors, a new overload of the constructor is needed for each conversion.

Both single-argument constructors and conversion functions can be invoked implicitly, although their application must be unambiguous for this to happen. Only one implicit user-defined conversion will be applied to a single value - the compiler doesn't search through possible sequences of valid conversions until it finds one that ends up at the required type! Nonetheless, even *one* implicit conversion like this can be problematic - especially as they can be carried out on operands and function return values as well as function arguments. Figure 1 shows some examples of (possibly unintended) implicit conversion. Thankfully, most C++ implementations will soon provide the `explicit` keyword which can be used to flag a constructor as unsuitable for implicit invocation.

The new cast syntax

The main problem with the traditional cast syntax is that it lays your code open to programmer error. For a start, it's not possible to determine what the programmer intended by an isolated cast operation. Consider an innocuous example:

```
const X* px = new X;
// some code...
py = (Y*)px;
```

In this code snippet, did the programmer intend to cast away the `const`ness of `*px`, access a base class of `x`, obtain a pointer to a type unrelated to `x`, or what? Without knowledge of the relationship between `x` and `y` and of the application in general, it's unclear. As the same syntax is used to achieve a number of disparate ends, very little compile-time checking can be performed. The four cast operators `static_cast`, `dynamic_cast`, `reinterpret_cast` and `const_cast` were introduced into the language in 1993 to help remedy this situation. The new casting syntax is part of the forthcoming ANSI/ISO standard for the language.

With one exception, which I'll come to later, the new operators together subsume all the functionality of the old `(T)e` syntax. Let's look first of all at `const_cast`, as it has a very defined purpose and is immediately usable.

Const cast

The notation `const_cast<T>(e)` can be substituted for `(T)e` if the cast is only removing any `const` or `volatile` attributes of `e`. Indeed, using the new syntax, the only way of 'casting away `const`ness' is via this operator. Figure 2 shows `const_cast` being used to remove the `const` attribute of `this` so that a non-`const` member function can be called within a `const` one. While this might sound like a highly dubious intention, it is a technique often employed in object-oriented programming to maintain the distinction between the *abstract* state of an object and its *concrete* state. In this example, the `TextFile` class represents an ASCII text file. To the client, `GetNextChar()` is a `const` operation that does not modify the abstract state of the file - the fact that it calls a non-`const` method to alter the file's concrete state is an 'implementation detail'. This abstraction allows the client use the file without knowing (or caring) exactly how much of it is loaded into memory.

In fact, the concrete/abstract distinction is so often made that a special keyword - `mutable` - has been introduced specifically to support it. A `mutable` data member is modifiable even from within a `const` member function, allowing it to hold 'implementation-only', *variable* data even when all visible attributes of the object are `const`. Unfortunately, most compilers do not yet implement the `mutable` keyword.

Static cast

A `static_cast` is best thought of as the *inverse* of implicit coercions such as derived-to-`public`-base, `enum` to `int`, pointer-to-`void*`, and user-defined conversions. If a conversion `(T)e` can be done implicitly (ie without the `(T)` bit), then a `T` object can be cast to the type of `e` via `static_cast`: a typical use would be a down-cast from a base class to a derived class. Such casts are potentially unsafe and rely on the programmer's knowledge of the application logic.

Figure 3 shows `static_cast` in action. As the operator relies solely on static (compile-time) information, no run-time check is performed to ensure that the cast is valid. Cast 4 in the listing would have an undefined result as `255` is not within the range of the `enum` type being cast to. Similarly, if a `Stream` object rather than a `FileStream` were to be passed to the function `f`, a memory violation could occur.

Before we move on, there are some interesting points worth making. First, casting to `void` (*not* `void*`!) effectively discards the

```
class TextFile
{
    // ...
    char GetNextChar() const;
    void LoadNextPage ();
    char m_nNextChar;
};

char TextFile::GetNextChar () const
{
    if (m_nNextChar)
        return m_nNextChar;
    const_cast<TextFile*>(this)->LoadNextPage();
    return m_nNextChar;
```

Figure 2 - Casting away `const`ness

```
class StreamBase {
};
class Stream : StreamBase {
};
class FileStream : Stream {
};
enum Colour {Red, White, Blue};
void f (const Stream& stream)
{
    // some legal casts:
    const FileStream* pfstream;
    pfstream = &static_cast<const FileStream&>(stream); // 1. base to derived (ref)
    pfstream = static_cast<const FileStream*>(&stream); // 2. base to derived (ptr)
      void* p;
      pfstream = static_cast<const FileStream*>(p);       // 3. void* to class*
      Colour col = static_cast<Color>(255);               // 4. int to enum
      static_cast<void>(pfstream++);                     // 5. cast to void to throw away result!
      // some illegal casts:
      pfstream = &static_cast<FileStream&>(stream);      // 6. const to non-const
      char* pch;
      char buffer[] = static_cast<char[20]>(pch);        // 7. pointer to array
      int& i = static_cast<int&>(1 + 2);                 // 8. rvalue to lvalue
      i = static_cast<int>(pch);                         // 9. pointer to int
}
void main ()
{
    FileStream filestream;
    f(filestream);
}
```

Figure 3 - The `static_cast` operator

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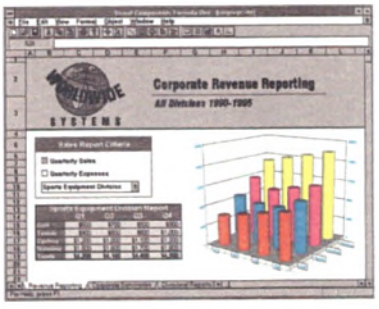

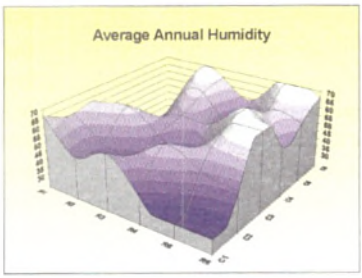

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value of `e` - think of the `void` type as similar to the 'null' device that operating systems often provide. Example 5 demonstrates this. Secondly, as with the old cast syntax, it's not possible to down-cast from a `virtual` base: this would require a change to C++'s object model. Finally, like `reinterpret_cast` and `dynamic_cast`, `static_cast` respects the `const`/`volatile` qualification of its argument.

Reinterpret cast

If `const_cast` and `static_cast` both fail to broaden the type of `e` sufficiently, the notation `reinterpret_cast<T>(e)` can be used. Generally, `reinterpret_cast` is meant to replace `(T)e` for inherently dangerous operations, such as casts between different function types or two unrelated classes. The result typically cannot safely be used without being cast *back* to its original type - though as a programmer, you may know better! Some example uses are given in Figure 4.

In conjunction with `const_cast` and `static_cast`, `reinterpret_cast` covers all casts that can be performed with the `(T)e` notation, with one exception. A cast to a `private` base class, a somewhat perverse operation which is legal using the `(T)e` syntax, cannot be performed by `reinterpret_cast`. If you find yourself wanting to exploit this hole in the type system, you're probably going about things the wrong way!

Dynamic cast

So what about the mysterious `dynamic_cast`? You'll probably have noticed that the concept of treating an object as though it were an instance of a derived class by 'down-casting' is closely tied to the idea of a *polymorphic* class.

A polymorphic object, in addition to whatever baggage it normally carries about, maintains a pointer to a *virtual function table* or `vtbl` - an array of pointers to the virtual functions for the object's class. Since all instances of a certain class share the same `vtbl`, it can be used to identify an object's type at run-time. A mechanism called *run-time type identification* (RTTI) allows the explicit querying of the dynamic (run-time) type of an object.

The operator can be applied to polymorphic objects in two ways. First, like `static_cast`, it can be used to perform a down-cast from a base class pointer to a derived class pointer. Unlike `static_cast`, `dynamic_cast<T*>(p)` will fail at run-time if `p` doesn't actually refer to part of a `T` (or class derived from `T`). If the cast fails, the result of the `dynamic_cast` is `0`; otherwise, a pointer to the `T` object is returned. The first cast in Figure 5 demonstrates this usage.

The other way in which `dynamic_cast` can be employed is to cast 'across' an inheritance hierarchy. This may sound a bit bizarre, but is in fact a more general case of the dynamic down-cast described in the previous paragraph. In Figure 5, the `FileStream` class inherits from both `Stream` and `Mixin`. The function `f` is passed a reference to a `Stream` object, but it has no way of knowing whether that `Stream` is actually part of a `FileStream` or not. If it *is*, it's possible to obtain a handle on the `Mixin` component of that enclosing `FileStream` object via a `dynamic_cast` of the `Stream`. If the `Stream` is just a `Stream` and nothing more, `dynamic_cast` will return a null pointer! Note that if the cast involves navigating a `private` inheritance path at run-time, it will fail. Casts 3 and 4 illustrate this behaviour.

A `dynamic_cast` to a *reference* type is also acceptable. If a reference cast fails, an exception of type `bad_cast` (defined in the standard header `typeinfo.h`) is thrown.

How does `dynamic_cast` work? As I said earlier, an object's `vtbl` uniquely identifies its class. In addition to the class's virtual function pointers, the `vtbl` also stores a pointer to a `type_info` object which provides run-time type information for the class. This object contains some implementation-dependent data for use by `dynamic_cast`, and the name of the class. An operator `typeid` is defined which returns a reference to its argument's `type_info` object; its argument can be either a type name (resolved statically), or an expression (resolved dynamically). By comparing `type_info` objects, a test for type identity can be performed like the one in Figure 5. You'll probably find yourself using `dynamic_cast` in preference to this method as there is no 'is-subtype-of' relationship defined for `type_info`.

Constraints and complaints

Maybe using these four operators seems like more trouble than it's worth. After all, apart from run-time type-checking, everything you can do with them can be done with the `(T)e` syntax. What's more, `(T)e` allows you to cast to a `private` base class! Doesn't using `const_cast` and its associated operations only place restrictions on the programmer?

The answer to this question is *yes*. But so do `const` variables, member functions, type-safe linkage and indeed 'types' at all! Adding reasonable constraints to our programming efforts - by giving our programming languages semantics - usually makes our life easier in the long run. By adding these operators to your C++ repertoire, you'll be making your intentions more obvious to the compiler, your colleagues, and most importantly yourself. ■

```
class Base {};
class Derived : Base {};
void f (int* pn, char* pch, void* pv, Derived* pd)
{
    // Some legal casts:
    pn = reinterpret_cast<int*>(pch);       // char* to int*
    pch = reinterpret_cast<char*>(pn);      // int* to char*
    pd = reinterpret_cast<Derived*>(pv);    // void* to Derived*
    pn = &reinterpret_cast<int&>(*pn);      // ...or use references
    // An illegal cast:
    Base* pb = reinterpret_cast<Base*>(pd); // Derived* to private base Base*
    // Break private inheritance:
    pb = (Base*)pd;                         // Unfortunately, this is legal!
}
```

Figure 4 - The `reinterpret_cast` operator

```
#include <typeinfo.h>
class Stream {
    virtual Stream& operator>> (char&) = 0; // abstract polymorphic type
};
class Mixin {
public:
    virtual ~Mixin () {};                   // polymorphic type
};
class FileStream : Stream, public virtual Mixin {
    virtual Stream& operator>> (char&) { /* some code */ return *this;}
};
void f (Stream& stream, Mixin& mixin)
{
    FileStream* pfstream = dynamic_cast<FileStream*>(&stream); // 1. down-cast with run-time check
    if (!pfstream)
        throw "Not a FileStream!";
    // 2. equivalent to:
    pfstream = typeid(stream) == typeid(FileStream) ? static_cast<FileStream*>(&stream) : 0;
    // casting 'across' an inheritance hierarchy:
    Stream* pstream = dynamic_cast<Stream*>(&mixin); // 3. fails - Stream is private 'sibling'
    Mixin* pmixin = dynamic_cast<Mixin*>(&stream);   // 4. succeeds - Mixin is public 'sibling'
    pfstream = dynamic_cast<FileStream*>(&mixin);    // 5. virtual base to derived
    pfstream = &dynamic_cast<FileStream&>(*pstream); // 6. cast to a reference (may throw bad_cast)
}
void main ()
{
    FileStream filestream;
    f(filestream,filestream);
}
```

Figure 5 - The `dynamic_cast` operator

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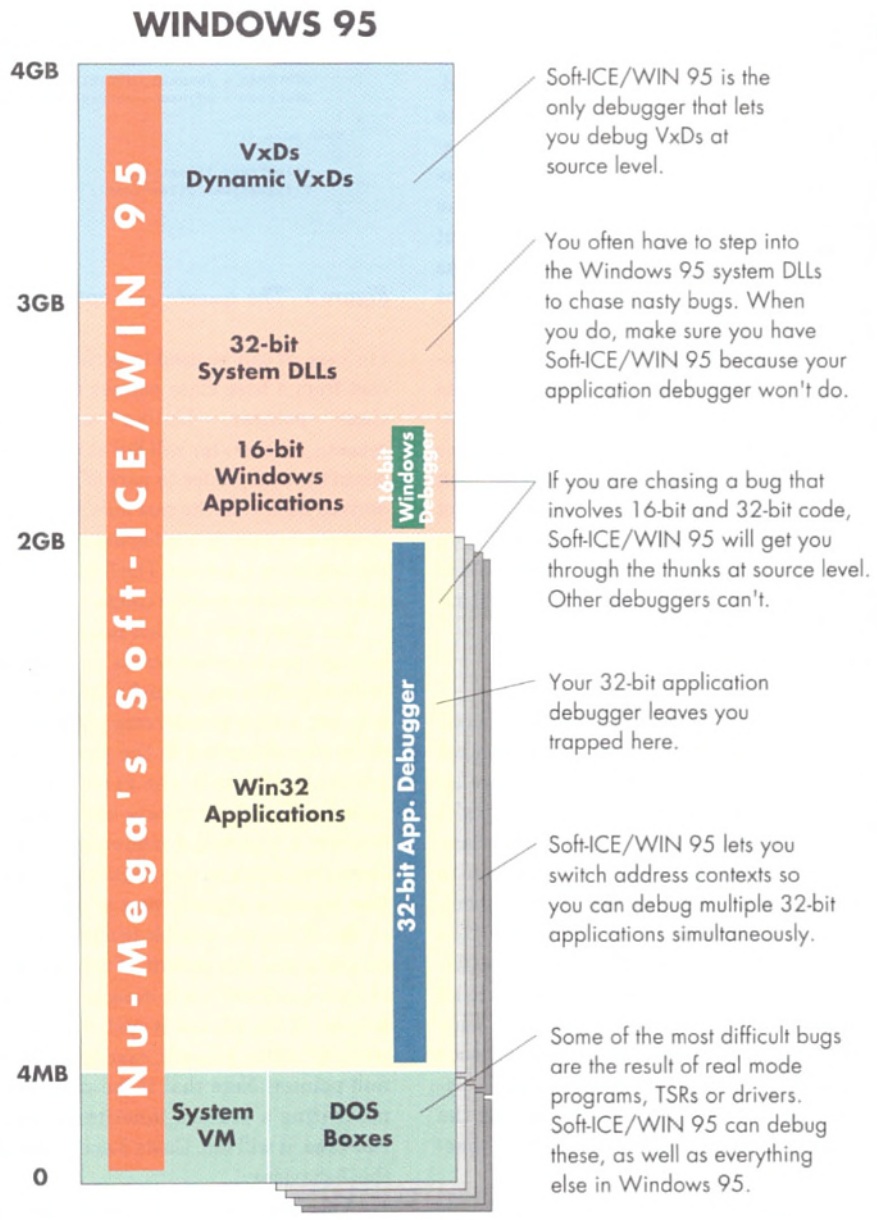

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CIRCLE NO. 301

Some thoughts about writing programs

Over the years one develops some habits when confronted over and over again with the same type of problems. **Peter Collinson** presents his way of dealing with most new programming projects.

WHEN people ask me what I do, I usually say 'I'm a computing person'. I think that the response to this has changed over the years. Twenty years ago, I used to get looks of incomprehension, some statement like: 'you must be very mathematical', followed by a change of subject. Ten years ago, I was not getting the blank looks but they still thought that I had to be a mathematician. Now, I often get a request for advice on some computing problem, asked about the best PC to buy or, more rarely, have some reasonable technical discussion. I no longer wear computing T-shirts when I travel with an airline, otherwise I get someone talking to me about their PC problems when all I want to do is sleep.

Well, as you know, being good at mathematics is not a pre-requisite for being a good programmer. I cannot remember when I last wrote a program that actually involved a maths algorithm that wasn't already coded for me as a library routine. In fact, I am numerically challenged and actively avoid any programming involving maths. Most of the programs I have written deal with text in some form.

Private library

Every time I approach a new programming project that will be more than one program I start a little library of routines. I rarely seem to take code directly from one project and use it in another. Instead I create new routines often based on some old ones, but tailored to the new environment.

All my programs have `error` and `fatal` routines which take a variable set of parameters mirroring `printf`. The `fatal` routine will call `error` and then simply exit from the program with a non-zero result code. Output from `error` will be made to the standard error channel of the program; this was the original motivation behind having the routine. I simply got fed up of typing: `fprintf(stderr,...)` all the time.

I also like to have the error routine print the program name, like: `progname: No more memory`. Sometimes I code the name into the routine. More likely, I use a set-up call from `main` that passes a massaged `argv[0]` into a local `progname` variable that `error` prints. The contents of `argv[0]` is stripped down to the last component of a pathname:

```
if (arg = strrchr(argv[0], '/'))
  arg++;
else
  arg = argv[0];
```

At one time, I had a global `progname` variable that was set in the main module and accessed in the error routines. These days, I avoid global variables for this kind of activity. I prefer to call a routine from `main` that registers the name in a static variable local to the error module.

On occasion, I have wanted the error routine to call a close down function to tidy things up on an error. I use the same registration technique. I have a routine called `onerror` or `onfatal` that is passed a pointer to a function. The pointer is stashed in a local variable and the function is executed when an error happens.

My next step is usually to establish some memory management routines. These days my programs rarely have statically allocated data structures. I've been writing programs for operating systems that support large virtual address spaces for about 15 years and tend to allocate all the data structures dynamically.

I usually have a set of routines that mirror the standard `malloc`, `realloc`, `calloc` and `strdup`. They will be called `Malloc`, `Realloc`, `Calloc` and `Strdup`, and their job is to call the corresponding routine and test for a failure to allocate memory. They will print a 'No more memory' message when this happens. This means that I don't have to sprinkle the code with these tests, a call to the mirror routine will always succeed or the program will die.

Why bother to worry about memory in a virtual environment? Well, the truth is that the address space is limited by the amount of swap space on the machine and sometimes this becomes exhausted. When this happens, it's better for the program to fail with an error message than to fail mysteriously sometime later when trying to access some memory through a null pointer.

Files in memory

The library module which holds the routines that guarantee memory allocation will also contain a routine that maps a file into memory. It's sometimes much easier and faster to deal with a file as chunk of bytes in memory than it is to read the file in line by line or byte by byte. It depends on the application. I talked about the `mmap` routine call eons ago in this column (*.EXE*, February 1992). Of course, you don't need to use the `mmap` call. You can `stat` the file to get its size, `malloc` an appropriately sized chunk and issue a `read` system call to suck the file into memory. The routine to map a file is something like:

```
char *
connectfile(char *name, int *bytes)
```

The routine returns the address where the start of the file resides in memory. It can return `NULL` on error, or perhaps will call `fatal` with some error message depending on the application. The length of the file is returned in the second parameter.

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I connect the file so that I am able to write into the allocated address space. Any writing is *not* mirrored to the file. This is convenient if I am using strings from the file as part of the data that controls the program. I scan the file looking for the strings and insert null characters to terminate them.

On a number of occasions, I have realised that I am dealing with a text file that is terminated by a newline character and I can signal the end of the file by setting this last newline to a null byte. Of course, if you read the file into memory, then you can allocate one extra byte and fill that with a `NULL`. It's not possible to do this if you map the file.

Configuration files

These days I rarely *burn* text data into programs. I prefer to provide configuration information from small files. This means that the programs become adaptable by mortals; all they need to do is edit a file to create some new data for the program or change the configuration.

For example, I recently wrote a suite of programs to provide a way of logging problems reported to a support help line. The idea is to log each problem in a system to track the steps being taken to find a fix. Each problem becomes an *event* with a unique number, stored in a file. This is being done on a UNIX system, and the storage file is plain text so the normal UNIX tools can be used to search and change the data. Further actions that represent work done on the problem can be added to the file. Finally, and hopefully, the problem is resolved and the customer informed.

In such a system, it's valuable to be able to provide information that characterises the event, so that analysis of the calls can be done. For example, problems can arrive at the help desk in many forms: they are logged from a phone call, from an email report or from a fax. The types provide a further source of analysis of the problems. We want to store these characteristics in a coded form so that it makes things easier to process automatically later.

Let's look at one of these characteristics. When the user logs the problem, he is asked to select from a number of options. Two different interfaces that can be used to create events. One is a TCL/TK based GUI with the selection made from a menu; the other is a command line interface supplying the user with prompts and taking a single letter response to make a selection. For the event source, the user is asked:

```
Source of event [t|e|f|?] :
```

It would be very possible to hard code some values for the event source and event type into all the programs, map the user input to the value and store a code as part of the data. But as I said, this means that adding a new value is not under the control of the users, unless they understand C and can recode the programs.

Instead, the data is stored in a couple of configuration files. Each line in the configuration file gives the data for one potential entry, the line is composed of three colon separated data fields: a letter used by the command line interface; a single word that is used as the code in the event storage file and also in the TCL/TK menu; and a help string explaining what the item does.

The help string is not strictly necessary but means that you can present some information to the user to explain what the single letter input means. This is what the user gets when they type in a question mark to the prompt shown above. Here's the event source file:

```
# Sample config file
t:Telephone:Phone call from user
e:Email:Email from user
f:Fax:Fax from user
```

The code that loads and accesses this type of configuration file is much the same every time I use one in a program. The module will contain an initialisation routine, a lookup routine using the first field as a key and also a lookup routine using the second field as the key. Both lookup routines will return a pointer to the structure that maps the lookup value, or NULL. The internal structure looks like:

```
typedef struct {
   char *abbrev;
   char *value;
   char *help;
} Config;
```

The `abbrev` field is a string because we might need to use two or three letter abbreviations to resolve a selection string.

The initialisation code is handed a pointer to a file that is opened to access the data. It will open the file and connect the data in memory. It counts the number of newlines in the file and uses that to allocate a vector of `Config` structures. It then scans the connected file looking for data.

If a '#' character is found in the input text, then it will skip to the character after the next newline. It's very useful to have a comment facility in a file like this. It means that you can use SCCS or RCS to provide version control on the file. The code will also ignore blank lines which some people like to put in to make config files more readable.

If there isn't a '#' at the start of the line, the line is data. The code uses `strtok` to split the line on the colon separators and stuff pointers to the text into the next available slot in the config array. I will code some validation of the data. After all, the user can change this file and will one day create an incorrect format.

Notice I don't worry too much about over-allocation of `Config` structures; all the comments and blank lines have space allocated in the `malloc`ed vector. To loop though the vector, I have either to count the number of used slots, or preferably to ensure that the last one has a NULL pointer in the `key` slot. I can then write loops like:

```
for (cp = config; cp->abbrev; cp++) {
```

when searching the table. The `config` variable is the base of the `malloc`ed table of data and will be passed to the routine so that we can search data from different files.

I generally use a straight linear search when coding the lookup routines. I zoom down the table doing a string compare, perhaps testing the first byte for equality to avoid doing unnecessary string compares:

```
for (cp = config; cp->abbrev; cp++) {
   if (*lkup == *cp->abbrev &&
     strcmp(lkup, cp->abbrev) == 0)
       return cp;
}
return NULL;
```

I hope that you can see that the code to do all this is fairly small and is easy to under-

stand. Various things drop out easily; for example, the prompt above is derived automatically from the `config` vector. The users can change the data simply by wielding an editor. They can also change the order of the items and the default. Pressing return to the prompt will select the first item in the list.

Data driven

Keen observers will have noticed that the programs above don't really do much with the data from the config files that I've talked about. The programs read in the config file provide a data selection and write the requested values out to the event file.

However, the basic idea of decoupling actions from data is beneficial when you do need to burn data into programs. In the event system I am talking about, event data is stored in a text file. The text file contains several sorts of data, and I like to adopt a line format like:

```
*key: value
```

for this type of stored text. The `key` is a text string used to describe the data which follows, like `*name`, `*telephone` or `*event-source`.

It's a good idea for the key field to start with a known character because this will allow you to pick up synchronisation problems in the file. The use of a colon and a space to follow the keyword is also intentional. The star, the colon and the space provide a good way to identify a keyword in a way that doesn't jar when the user looks at it with an editor. Also in the event system, I allow data to span several source lines, which is useful for addresses and use the star character of a subsequent command to terminate the data.

Ok then, I have a file that contains several keys and values. I want to read the file into a structure that looks like:

```
typedef struct {
   int event_no;
   time_t call_time;
   char *name;
   char *company;
   char *address;
   char *phone;
   char *fax;
   char *email;
   char *event_type;
   char *event_source;
   and so on
} Event;
```

By the way, the `event_no` value is also the name of the file. It's good engineering practice to store the event numbers with the data as well and not to rely on the file name as the definitive source of the id number of the event. This means that you can concatenate all the files together and still know the number that applies to the subsequent data.

Well, I could open the file and start scanning through it a line at a time, looking for keys and setting up the structure from the values that follow them. The code to do this would perhaps end up with a large number of `if` statements that test the keyword and load the structure. I much prefer to create a table that describes the data that I am dealing with. The code that defines the table looks a little like:

```
typedef enum {
   data_unknown,
   data_str,
   data_int,
   data_time
} Datatype;
typedef struct {
   const char
*text;
   int len;
   Datatype type;
   void *offset;
} Keywd;
```

The enumerated type `Datatype` allows us to type the value field. The data in the event file is stored in human readable form and we want to read the event number and the

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called time as strings, converting their values to an internal binary form automatically. Now we can go ahead and define a `Keywd` structure for the data on the file.

```
Event ev;
Keywd keywd[] = {
   { "event-no", 8,
     data_int, &ev.key },
   { "call-time", 9,
     data_time, &ev.call_time },
   { "name", 4,
     data_str, &ev.name },
   /* and so on */
   { NULL,
   }
};
```

This makes the program that reads the data from the file structure easy to write. The code is also completely independent of the data that is being read. We open the file and connect it in memory (or read it in line by line if we wish). The outer loop identifies a key/value pair by looking for a line starting with a star, it's a little tricky coping with the fact that data can span several input lines but that's not insuperable.

We now have a string starting with a star that represents the data we want to parse. We pass this string to a keyword decoding routine that uses the string length to find the appropriate entry in the `keywd` structure which maps onto the line we are decoding. One other structure helps us here:

```
Keywd unknown = {
   NULL, 0,
   data_unknown,
};
```

A pointer to this is returned if the keyword lookup routine doesn't find a match. Having found the keyword, we can skip over it using the string length and test for the presence of a colon and a space. The remainder of the line is data. It is passed into a data storage routine that uses the `keywd` structure to decide what to do. If the type is `data_str`, then the address of the data is simply stuffed into the pointer field in the destination structure. Other types are dealt with appropriately.

The last field of the `keywd` structure has to point to an offset to a static structure in memory because otherwise the compiler cannot create the offset address. If I want to create a dynamic copy of the data, I will allocate a new structure instance at the end of the routine and will simply copy the content of the static `ev` structure into it.

Notice also that I can use the same table to create the datafile. By loading the static `ev` structure, all I need to do is to scan the table printing the keyword:

```
printf("*%s: ", ky->text);
```

and then use the data type and offset to print the data to the file.

The main benefit of this approach is that it's simple to add new fields. All you do is add one line to the keyword table. You do need to provide some data conversion routines.

Removing lines for the `keywd` structure is easy too, but you must allow for old data files containing keys that you don't recognise. It may not be an error to find a keyword that you don't understand. Re-ordering the data in the text file is simple, all you need to do is change the order of keywords in the `keywd` structure.

I find the code to drive all this becomes very easy to write. There is a very small number of typed cases to deal with and it's easy to get this right. Ok, I hear you say, the table is burned into the program and this means that a programmer is needed when we wish to change the storage format. Well, I hope that you can see that we can read the `keywd` table from a file if we wish to, all we need to burn into the program is a knowledge of the data types.

■

Peter Collinson is a freelance consultant specialising in UNIX. He can be reached electronically as `pc@hillside.co.uk`, on WWW at `http://www.hillside.co.uk` or by phone on 01227 761824.

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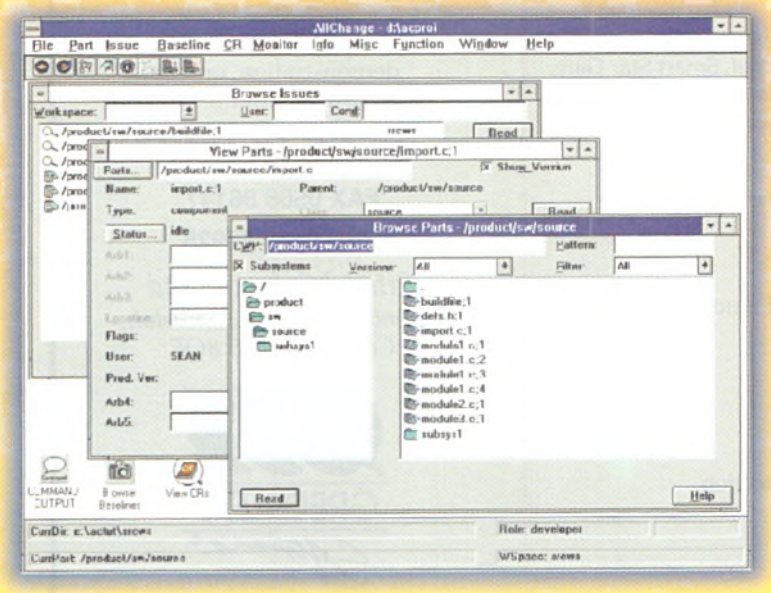

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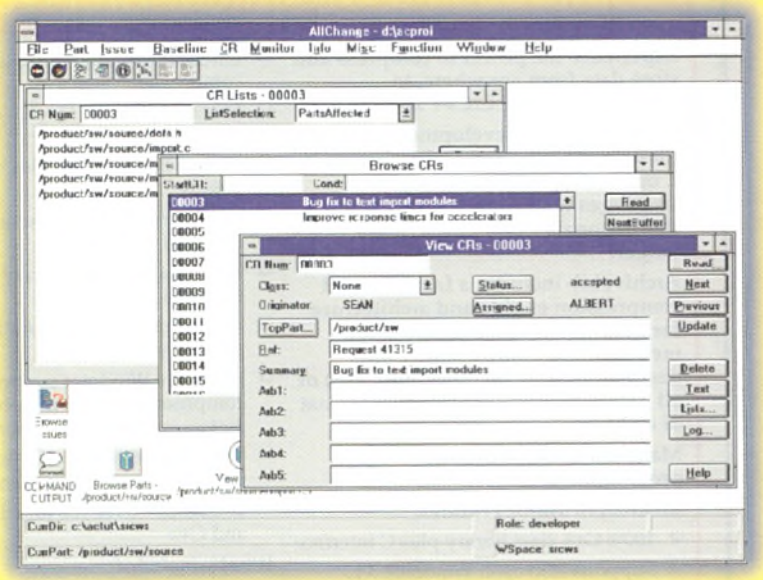

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DELPHI component writing Part 2

In this month's instalment, **Dave Jewell** begins the development of an enhanced Windows-95 style trackbar component.

Last month, as you may recall, we created a custom listbox control whose only purpose in life was to display the currently loaded list of Windows modules. While this served as a useful and gentle introduction to the art of component writing, there's only so much that you can do by deriving from an existing component, or perhaps I should say, from a relatively specialised point in the VCL family tree. This month, we're going to start the development of a completely new control type and in order to do that, we need to derive our component from a much less specialised position.

Introducing the trackbar

The control that we're going to build is based on the multi-media trackbar control, sometimes called 'volume control'. If you look at Figure 1, you'll see a dialog (taken from the Windows 95 Control Panel) which makes use of this type of component. Figure 2 shows an enlarged view of the same thing. Under both 16-bit and 32-bit Windows, Microsoft has implemented this control class in the so-called 'Common Controls DLL'. The DLLs are called COMMCTRL.DLL and COMCTL32.DLL respectively.

At the time of writing, I know of no VCL wrapper code which provides access to the trackbar control class. Having said that, it's a racing certainty that the upcoming 32-bit version of Delphi will provide support for the trackbar, as well as all the other common control goodies included with Windows 95. The 16-bit version of the Common Controls DLL has never been officially supported under Windows 3.1, which perhaps explains the lack of a 16-bit wrapper at the present time.

Rather than simply creating a wrapper which communicates with the Common Controls DLL, we'll re-implement the functionality of the trackbar controls from scratch as part of our custom control. There are many good reasons for doing this, principally:

- If we just used the common controls code, we'd be side-stepping important issues such as painting and event handling in a VCL component.
- It allows us to add extra functionality to the control which COMMCTRL doesn't provide.
- It makes our program independent of the COMMCTRL library.
- It means that we can use trackbars in our 32-bit and 16-bit applications, despite there being no official support for them on the 16-bit platform.

Figure 3 shows our new *improved* trackbar in action - this screenshot should give you some idea of the variation in appearance that can be achieved. Rather than go for the customary *grey on grey* decor which typifies modern Windows colour schemes, I've added the ability to change the colour of the tick marks, the *thumb* and the channel - the central track along which the thumb moves. By default, all the colours are grey (the small trackbar in the bottom, left corner shows the default appearance), but you can tweak the appearance of the control in many different ways.

Properties roundup

Before diving into the development of this control, take a brief look at the important trackbar properties in Table 1. This will show you where we're heading and make it easier to understand how the different parts of the trackbar code fit together.

As an additional, no-extra-cost option, if you set the `TickGraduation` property to a negative value, the tick scales will be inverted with the *flat* part of the scale

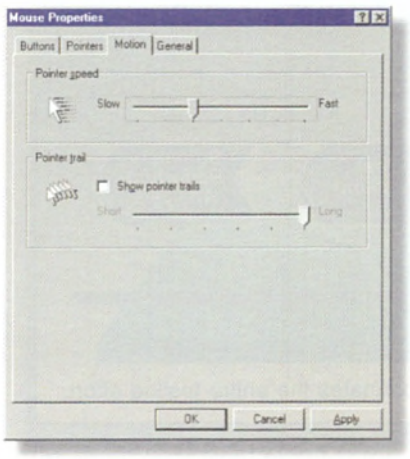

Figure 1 - This dialog - part of the Windows 95 control panel - shows two trackbar controls in action

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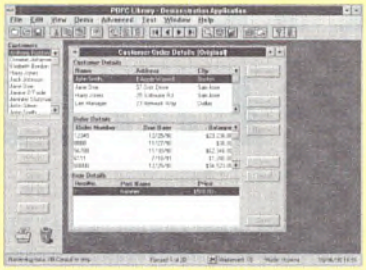

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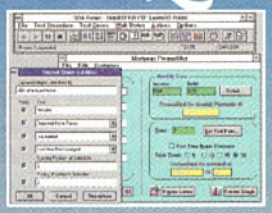

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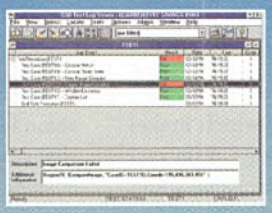

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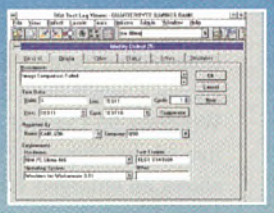

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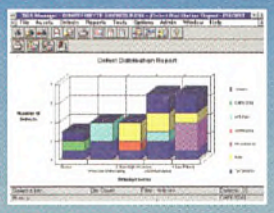

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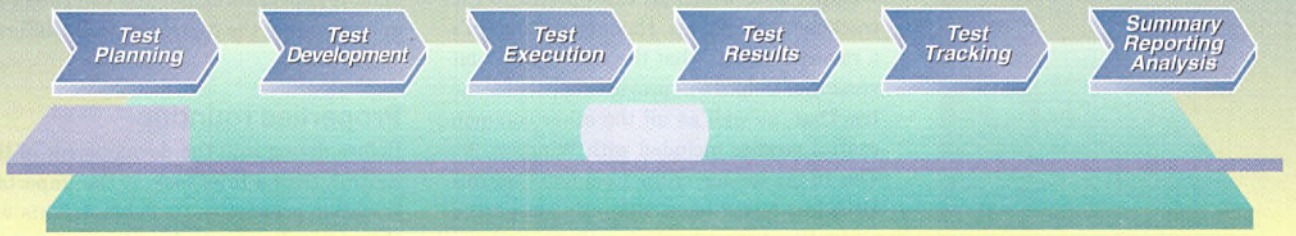

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towards the outside edge of the control, and the graduated part towards the channel.

Each property corresponds to a private variable (whose name, conventionally, is usually preceded by 'F') in the class definition. The property declarations are set up in such a way that reading a property will directly access the value of that private member. However, setting a property is generally associated with a private method such as `SetChannelColor`. This gives the control an opportunity to redraw itself when some change takes place. For example, here's the code for the `SetChannelColor` method:

```
procedure TCCTrackBar.SetChannelColor
                  (Value: TColor);
begin
   if FChannelColor <> Value then
   begin
      FChannelColor := Value;
      Invalidate;
   end;
end;
```

This code is absolutely typical. Firstly, it checks that the new property value isn't the same as the old. If it is, then the routine just terminates. This avoids any flicker that might be caused by a control redrawing itself unnecessarily. If the value has changed, then the new value is stored into the corresponding private variable and the `Invalidate` method is called to redraw the control. This same pattern is repeated for most of the other `SetXXXX` methods although you will find that sometimes I haven't bothered to check whether a new value is the same as the old and I just call `Invalidate` directly. This is pure laziness on my part!

Occasionally, changing some property value requires that the entire control be destroyed and recreated with the new property setup. This is the case with the `SetBorderStyle` method. The `BorderStyle` property corresponds directly to the `WS_BORDER` window style at the Windows API level. You can't *toggle* this style on the fly once a window has been created. Instead, you have to trash the control and start again. Fortunately, this is very easy thanks to another built in method - `RecreateWnd`.

```
procedure TCCTrackBar.SetBorderStyle
            (Value: TBorderStyle);
begin
  if FBorderStyle <> Value then
  begin
   FBorderStyle := Value;
   RecreateWnd;
  end;
end;
```

Having called `RecreateWnd`, you also need to override the `CreateParams` method so that you have the opportunity to apply the `WS_BORDER` style to the window immediately **before** the control window is actually created. I unashamedly filched this code from the VCL source, a strategy that I'd highly recommend to anyone who wants to get a head start on VCL programming!

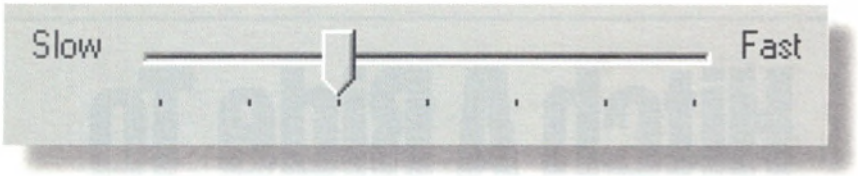

Figure 2 - An enlarged view of a trackbar. The important elements of the control are the thumb, the tick marks and the channel - the track along which the thumb moves. The labels aren't actually part of the control

```
procedure TCCTrackBar.SetPosition
                        (Value: Integer);
begin
   SetParams (Value, FMin, FMax);
end;

procedure TCCTrackBar.SetMin
                        (Value: Integer);
begin
   SetParams (FPosition, Value, FMax);
end;

procedure TCCTrackBar.SetMax
                        (Value: Integer);
begin
   SetParams (FPosition, FMin, Value);
end;

procedure TCCTrackBar.SetParams
          (APosition, AMin, AMax: Integer);
begin
   if AMax<AMin then
      raise EInvalidOperation.Create
            ('Max less than Min.');

   if APosition<AMin then APosition := AMin;
   if APosition>AMax then APosition := AMax;

   if (FMin <> AMin) or (FMax <> AMax) then
   begin
      FMin := AMin;
      FMax := AMax;
      Invalidate;
   end;

   if FPosition <> APosition then
   begin
      FPosition := APosition;
      Invalidate;
   end;
end;
```

Listing 1 - The `SetParams` routine checks that `Max` is greater than `Min`.

`BevelInner`	Specifies the style of the inner border (`bvNone, bvLowered, bvRaised`).
`BevelOuter`	Specified the style of the outer border (`bvNone, bvLowered, bvRaised`).
`BevelWidth`	The width of the bevel. Default value is 1.
`BorderStyle`	Optionally draws a black line around the control (`bsNone, bsSingle`).
`BorderWidth`	Distance between the border and the control innards. Large values can produce some bizarre effects.
`ChannelColor`	Colour of the trackbar channel. Default is `clSilver`.
`ChannelWidth`	Width of the trackbar channel. Default is 2.
`Color`	'Background' colour of the control itself.
`Max`	Maximum possible value of control (as for scrollbars)
`Min`	Minimum possible value of control (as for scrollbars)
`Position`	Current position of 'thumb' (Position is <= `Max` and >= `Min`)
`ThumbColor`	Colour of the thumb area.
`TickBorder`	Distance between tick marks and channel. Default is 4.
`TickColor`	Colour of the tick marks.
`TickFrequency`	Defines spacing of ticks.
`TickGraduation`	Some ticks are longer than others. This property defines spacing between the longer ticks as on a graduated scale.
`TickStyle`	Specifies whether ticks appear above the channel or below the channel. (`ccNone, ccLeft, ccRight, ccBoth`).

Table 1 - Tackbar's properties

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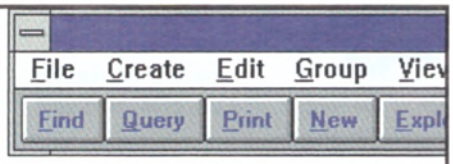

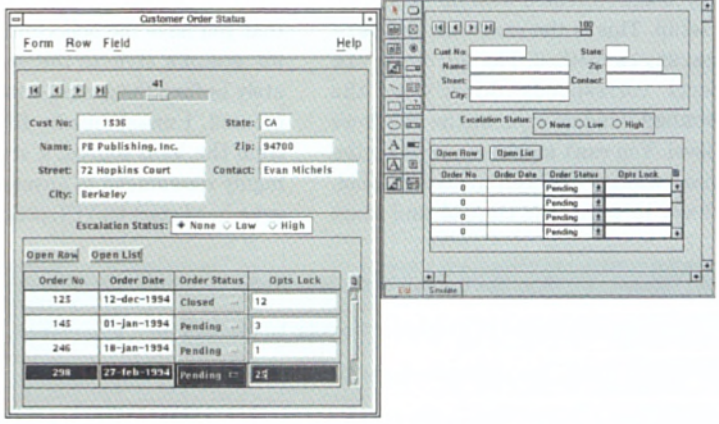

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```
procedure TCCTrackBar.CreateParams
      (var Params: TCreateParams);
const
   BorderStyles: array[TBorderStyle] of
            Longint = (0, WS_BORDER);

begin
   inherited CreateParams(Params);
   with Params do
   begin
      WindowClass.style :=
            WindowClass.style or
            CS_HREDRAW or CS_VREDRAW;
      Style := Style or
            BorderStyles [FBorderStyle];
   end;
end;
```

Because of the amount of common code involved, the **SetPosition**, **SetMin** and **SetMax** methods all call a common routine called **SetParams**. This is illustrated in Listing 1. The **SetParams** routine is responsible for ensuring that **Max** is greater than **Min**, that **Position** is somewhere between the two and for calling the **Invalidate** method if any of these three quantities gets changed. An exception is raised if an attempt is made to set **Max** less than **Min** - this will work in the form designer and at run-time.

The final bit of property support code is the component's constructor itself. As pointed out in previous months, anytime we specify the '**default**' value of a property, we're effectively making a gentleman's agreement with Delphi! Delphi doesn't bother storing the value of a property if it's value is equal to the **default** value, thus reducing the size of form files and executables. For our part, we have to set property values to the specified **defaults** in the component's constructor. *After* the constructor is called, Delphi then iterates over any stored, non-default values in the form and applies them to the component's properties.

```
constructor TCCTrackBar.Create
               (AOwner: TComponent);
begin
   inherited Create (AOwner);
   Height := (GetSystemMetrics
            (sm_CYHScroll) * 4) div 3;
   if Height < 4 then Height := 4;
   Width := Height * 6;
   BevelOuter := bvLowered;
   BevelWidth := 1;
   FBorderStyle := bsNone;
   FChannelWidth := 2;
   FChannelColor := clSilver;
   FTickColor := clBlack;
   FTickFreq := 10;
   FTickGrad := 10;
   FBorderWidth := 5;
   FTickStyle := ccBoth;
   ParentColor := True;
   FTickBorder := 4;
   Color := clBtnFace;
   FThumbColor := clBtnFace;
   TabStop := True;
   FMin := 0;
   FMax := 100;
   FPosition := 0;
end;
```

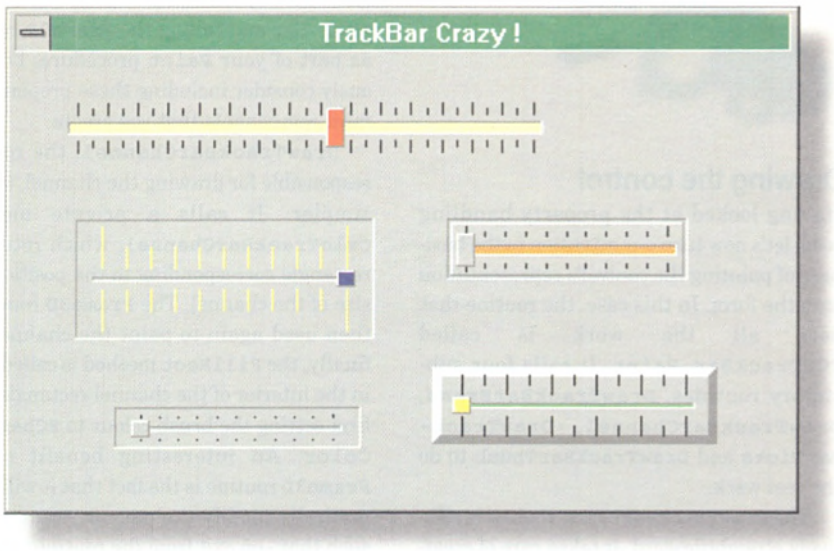

Figure 3 - Trackbar Crazy! This screenshot shows the diversity of appearance you can achieve using the Delphi trackbar component we put together

```
procedure TCCTrackBar.DrawTrackBarTicks;
var
   r: TRect;
   x, count, numTicks: Integer;
   channelLength: Integer;
   chanRect: TRect;

   procedure DrawTick (left, top, bottom: Integer; fLeft: Bool);
   var
      r: TRect;
      delta: Integer;
   begin
      SetRect (r, left, top, left + 1, bottom);

      { Apply mod-x 'graduation' to scales }

      if (count mod abs (FTickGrad)) <> 0 then
      begin
         delta := ((r.bottom - r.top) * 5) div 10;
         if fLeft then
         begin
            if FTickGrad < 0 then Dec (r.bottom, delta)
            else Inc (r.top, delta);
         end
         else
         begin
            if FTickGrad < 0 then Inc (r.top, delta)
            else Dec (r.bottom, delta);
         end;
      end;

      if r.bottom > r.top then
         ExtTextOut (Canvas.Handle, 0, 0, eto_Opaque, @r, Nil, 0, Nil);
   end;

begin
   if FTickStyle = ccNone then Exit;

   r := GetClientRect;
   chanRect := CalcTrackBarChannel;
   Inc (chanRect.left, ThumbWidth div 2);
   Dec (chanRect.right, ThumbWidth div 2);

   channelLength := chanRect.right - chanRect.left - 1;
   numTicks := (FMax - FMin) div TickFrequency;
   if numTicks >= 1 then
   begin
      SetBkColor (Canvas.Handle, FTickColor);
      for count := 0 to numTicks do
      begin
         x := (LongInt (channelLength) * LongInt (count) div LongInt (numTicks))
               + 4 + FBorderWidth + (ThumbWidth div 2);

         if FTickStyle in [ccLeft, ccBoth] then
            DrawTick (x, FTickBorder, chanRect.top - FTickBorder, True);
         if FTickStyle in [ccRight, ccBoth] then
            DrawTick (x, chanRect.bottom + FTickBorder, r.bottom - FTickBorder, False);
      end;
   end;
end;
```

Listing 3 - The most complex piece of drawing code!

Drawing the control

Having looked at the property handling code, let's now turn our attention to the business of painting the control's representation onto the form. In this case, the routine that does all the work is called `TCCTrackBar.Paint`. It calls four subsidiary routines, `DrawTrackBarFrame`, `DrawTrackBarChannel`, `DrawTrackBarTicks` and `DrawTrackBarThumb` to do the real work.

The `DrawTrackBarFrame` routine is relatively straightforward. It takes care of creating the visual effects specified by the various bevel and border options. This routine makes use of `Frame3D`, a handy little routine defined in the `ExtCtrls` unit. `Frame3D` makes it very easy to draw 3D shading rectangles onto the surface of a form.

The `DrawTrackBarFrame` code is essentially the same code used by the built in `TPanel` component. The implementation of the `BevelOuter`, `BevelInner` and `BevelWidth` properties is very simple and you can get a tremendous amount of variation in look and feel just from using these three properties and calling the `Frame3D` routine as part of your `Paint` procedure. I'd seriously consider including these properties in most components that you create.

`DrawTrackBarChannel`, the routine responsible for drawing the channel, is even simpler. It calls a private method, `CalcTrackBarChannel`, which returns a rectangle corresponding to the position and size of the channel. The `Frame3D` routine is then used again to paint the channel and finally, the `FillRect` method is called to fill in the interior of the channel rectangle after first setting the brush colour to `FChannelColor`. An interesting benefit of the `Frame3D` routine is the fact that it will automatically modify the passed `TRect` record such that - on exit from the routine - the rectangle contains only the area inside the shading rectangle. Judicious use of this information can greatly simplify the drawing of complex components - in the code here, it means that after drawing the outside of the channel, the rectangle is already set up to fill in the interior.

```
procedure TCCTrackBar.
                    DrawTrackBarChannel;
var
   r: TRect;
begin
   r := CalcTrackBarChannel;
   Dec (r.right);
   Frame3D (Canvas, r, clBtnShadow,
         clBtnHighlight, 1);
   Canvas.Brush.Color := FChannelColor;
   Canvas.FillRect (r);
end;
```

The `DrawTrackBarTicks` routine, shown in Listing 3, is the most complex piece of drawing code in our trackbar component. It first calls the `CalcTrackBarChannel` routine to get the bounding rectangle for the channel. This is then reduced at each end by half the width of the thumb. (The thumb in this implementation is hard-wired for a width of ten pixels, but it would obviously be better to turn this into another modifiable property - this is left as an exercise for the reader!) By chopping off half the thumb width at either end, we can position the thumb such that it's located centrally over the first and last tick marks, with the edge of the thumb flush with the ends of the channel.

The number of ticks to draw is then calculated using the `TickFrequency` property. For each tick, the '`x`' position of the tick mark is calculated (we could have simplified this slightly using the `MulDiv` routine here) and the local routine `DrawTick` is called to do the business. The `DrawTick` routine uses the `FTickGrad` property to determine which tick marks should be drawn full length and

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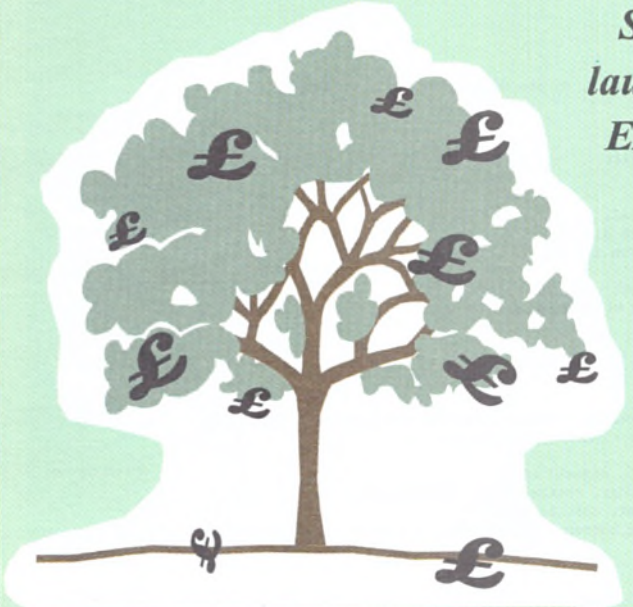

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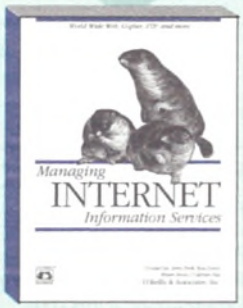

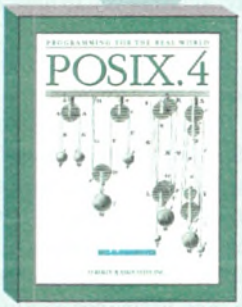

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```
procedure TCCTrackBar.DrawTrackBarThumb;
var
   r: TRect;
   pos: Integer;
begin
   r := CalcTrackBarChannel;
   { Make the thumb twice the channel height }
   InflateRect (r, 0, r.bottom - r.top);
   Inc (r.left, ThumbWidth div 2);
   Dec (r.right, ThumbWidth div 2);

   pos := MulDiv (r.right - r.left - 1,
                  FPosition, FMax - FMin) + 4
                  + FBorderWidth
                  + (ThumbWidth div 2);

   r.left := pos - (ThumbWidth div 2);
   r.right := r.left + ThumbWidth;
   Frame3D (Canvas, r, clBtnHighlight,
            clBtnShadow, 1);
   Canvas.Brush.Color := FThumbColor;
   Canvas.FillRect (r);
end;
```

Listing 4 - Draws the thumb at the right position

which should be truncated by the value of the delta variable. Finally, the `ExtTextOut` routine is called to blit each tick mark onto the canvas. Notice that although `ExtTextOut` isn't a Delphi method, we can easily obtain the Windows API device context by just referring to `Canvas.Handle`. The method `ExtTextOut` is used here because you'll find that it's a *lot* faster than BitBlt - this is important where there are a lot of ticks to draw!

The final routine, `DrawTrackBarThumb` (see Listing 4) calls `Frame3D` to draw the thumb at the position corresponding to the current value of the `Position` property. The `MulDiv` routine is called to do this calculation without loss of 32-bit precision. Of course, all four of these `DrawTrackBarXXX` routines could be amalgamated into a single routine, but I thought it easier to split them up for reasons of readability.

Until next time

In next month's instalment, we'll be adding the code to our trackbar component to enable it to respond to mouse and keyboard events. Until then, you might like to try adding a `ThumbWidth` property as mentioned earlier. If you're feeling really adventurous, you could try incorporating support for an `Orientation` property, allowing you to have either a horizontal or vertical trackbar. This isn't as difficult as it sounds, though there are a few pitfalls for the unwary. In particular, don't replicate **all** the trackbar drawing code for both the vertical and horizontal case! Instead, make the assumption that you're drawing a horizontal component and then - at the last minute - swap around the rectangle co-ordinates as needed. This will make for much simpler code. The basic idea is illustrated below:

```
procedure Swap (var x, y: Integer);
var
   temp: Integer;
begin
   temp := x;
   x := y;
   y := temp;
end;

procedure SwapRect (var r: TRect);
begin
   Swap (r.left, r.top);
   Swap (r.right, r.bottom);
end;

...

if FOrientation = ccVertical
   then SwapRect (r);
Frame3D (Canvas, r, clBtnShadow,
         clBtnHighlight, 1);
...
```

Dave Jewell is the author of 'Instant Delphi' published by Wrox Press and 'Polishing Windows' by Addison-Wesley. He can be reached as djewell@cix.compulink.co.uk.

Readers who wish a copy of the complete source code of the trackbar component should send a disk with an SAE marked TRACKBAR. Wired readers can pick up the code from the 'EXE' conference on CIX or from ftp://ftp.exe.co.uk/pub/exestuff/.

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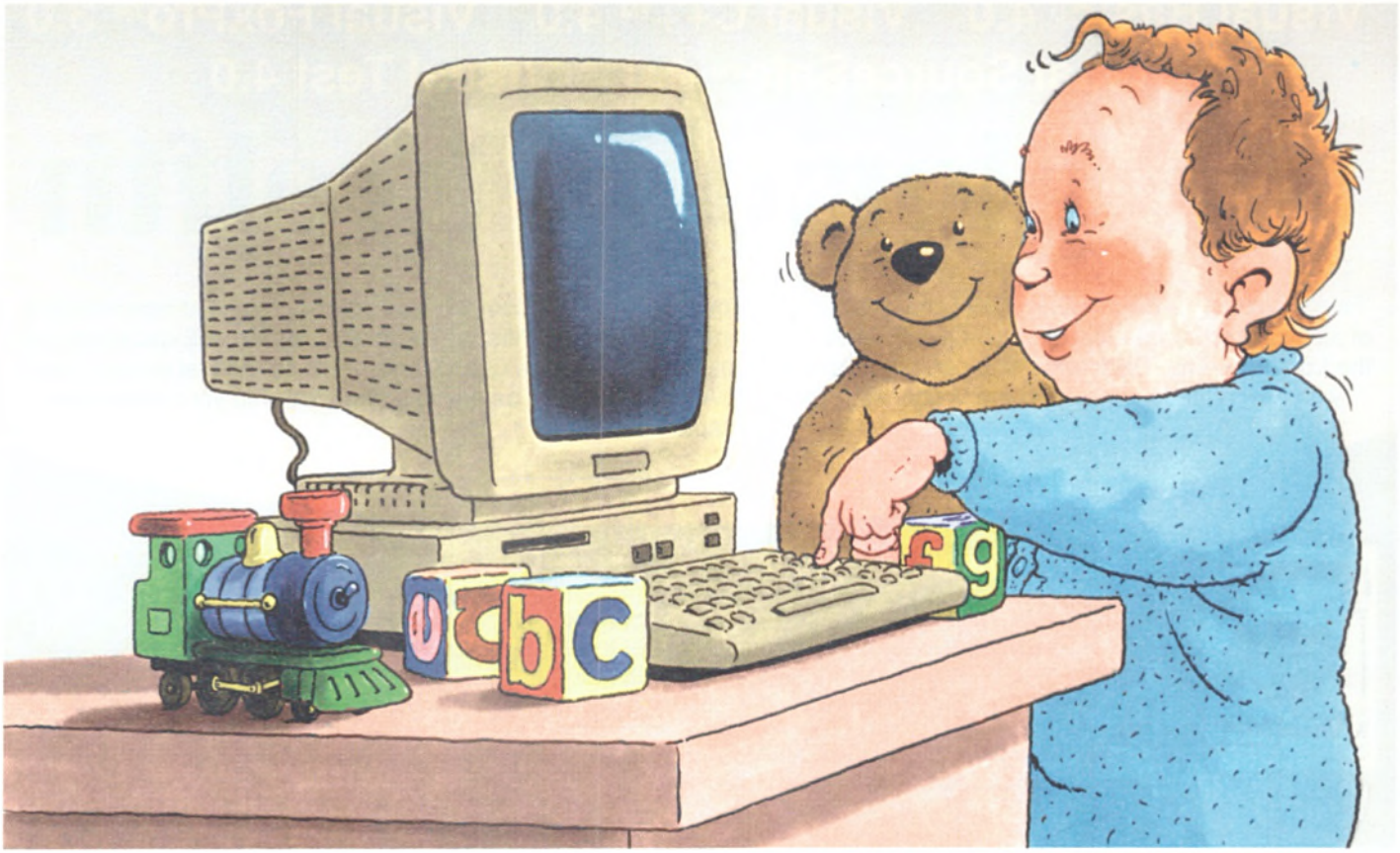

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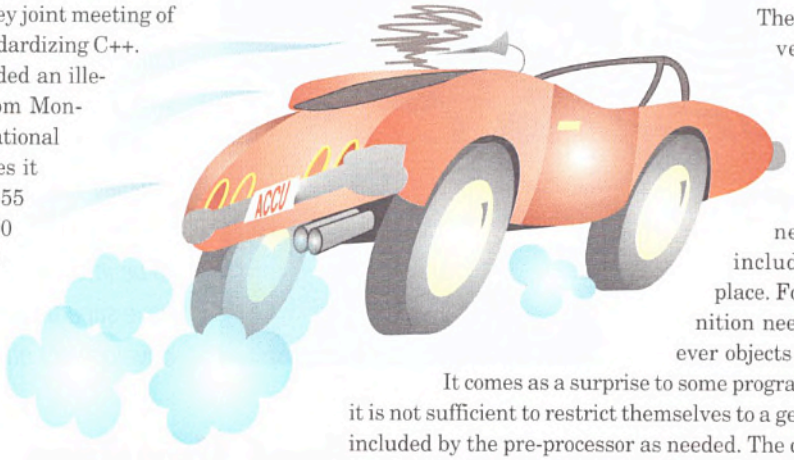

I have just returned from the Monterey joint meeting of the WG21/X3J16 committees for standardizing C++. It was an eventful week which included an illegal taxi journey (you cannot get from Monterey Airport to San Francisco International in two hours, let alone the 90 minutes it actually took - the US speed limit is 55 mph and the distance is just under 120 miles) and the problems of being separated from one's money by 6,000 miles (I left my dollars on my kitchen table). It was also eventful for C++, with much work being done, a few administrative wrists being slapped and a decision (well almost) that a second Committee Draft would need to be produced for a ballot sometime next year. Please do not go into panic mode, C++ itself is healthy and getting better, but an International Computer Language Standard needs to be right first time. After it becomes an IS (International Standard) change will be nearly impossible.

If I ever had any doubts about that, my recent experiences with C have banished them forever. Take the following and decide what is wrong with it - my answer is later.

```
void someFn(char thing[], char some[]){
  int order, count, my_order = 0;
  int length = MIN(strlen(thing), strlen(some));
  assert(length);
  order = strncmp(thing, some, length);
  for (count = 0; count < length; count ++) {
     if(my_order = thing[count]-some[count])break;
  }
  /* rest of code */
}
```

Will `order` and `my_order` have the same sign (or be both zero)? Before you answer this you may need to read 7.11.4 (including subsections) of the *ISO C Standard* very carefully.

By the way, as I constructed the above monstrosity I became conscious that `assert` can only be used after variables have been declared, another example of the C requirement for early declaration leading to extra complexity - potentially extra levels of nested blocks.

The One Definition Rule

One of the major achievements of the Monterey meeting was to get some words to express the ODR (One Definition Rule) sufficiently well that corner cases could be considered. We think we have already located all of them but such is the ability for mental contortions among language lawyers that someone is bound to find another pathological case.

The concept of the ODR is very simple: in a complete program, entities are only defined once. Unfortunately some definitions need to be textually included in more than one place. For example a class definition needs to be visible wherever objects of that class are used.

It comes as a surprise to some programmers to discover that it is not sufficient to restrict themselves to a genuine single definition included by the pre-processor as needed. The context of the inclusion can have serious consequences.

The first part of the ODR states, in carefully crafted language, that in any program, definitions must always be 'as if' there were only a single copy (even if some programmers create a maintenance nightmare by having more than one).

The rest of the ODR tries to provide a list of constraints which will ensure that a single definition will have the same meaning in all the places it is used. The Committees have decided to take the route that might exclude some possibly legitimate cases in the interests of greater safety.

The first constraint is that the definition must not use any entities that have the same names as those of local or static global entities, unless declarations of the names exist in the definition. Let me give you some sample code.

In file EX.H:

```
struct Ex {
  typedef int INT;
  enum {ten = 10};
  INT var1;
  CHAR var2;
  int fn (int i=ten);
  int gn (char c=eleven);
  int hn () {return ln ();}
  // other declarations
};
```

The names `INT` and `ten` are safe because they have declarations giving them meaning in the context of the definition of `struct Ex`. However `CHAR`, `eleven` and `ln` may be problems because any declarations giving them meaning will have to be provided by the context in which the particular definition of `struct Ex` occurs.

Let's now look at some problem contexts. Check the file CONTEXT1.CPP on top of page 65. Yes, I know you would not write anything that silly, but do not forget that the context of any included file is modified by any other previously included one.

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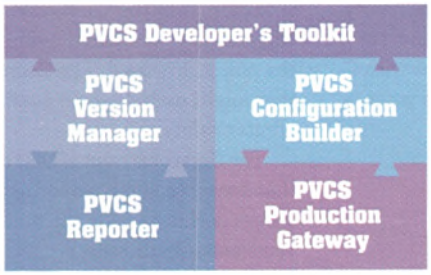

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CIRCLE NO. 316

```
static int eleven = 11;
inline int ln () { return 0;}
typedef char CHAR;
#include "EX.H"
```

Under the proposed ODR, the use of `static` (file scope) names such as `eleven` and `ln` are diagnosable breaches of the rule; more about that in a moment. The use of `CHAR` is a potential breach. As long as exactly the same `typedef` declaration precedes each inclusion of EX.H, the ODR will be satisfied. However, if in any case the `typedef` is different, the resulting definitions of `struct Ex` will differ and therefore constitute a breach of the ODR.

There are two special cases to tackle. The first is the problem of global `inline` functions because they are `static` by default. If you want to use such a function in any definition that is subject to the ODR then you must declare the `inline` function `extern` in all places that it is used. This is going to be another case of the default case being wrong (C has it with file scope names having external linkage by default). I am sure that future coding guidelines will state that global `inlines` should always be made `extern` (I can think of no **good** reason for it being otherwise).

Another case is that of `const`-qualified file scope variables. These also have internal `static` linkage. There are good reasons why we don't want to change this (it would break reams of code) and it does not seem politic to require the same solution as that for `inlines`. The result is that the ODR will allow the use of such non-class names as long as they are declared identically in all contexts.

If this was the end of the constraints and special cases all would be happy, but we managed to turn up another case so unpleasant that it turned the faces of some experts pale. It has started a debate about the correct way to solve it. Consider:

In file BASE.H:

```
struct Base {
  Base(int);
  Base(int, int);
//other items
};
```

In file CONTEXT1.CPP:

```
#include "BASE.H"
Base::Base(int=0) { /*constructor code*/}
Base b1;
```

and in file CONTEXT2.CPP:

```
#include "BASE.H"
Base: Base (int=0, int=0) {/*constructor code*/}
Base b2;
```

Now `b1` and `b2` have both been constructed with default constructors, but different ones. Possibly we could live with this, and some have argued that it is useful (like putting nitroglycerine in the hands of infants). The thing that really turns the screw is:

In file DERIVED.H:

```
struct DERIVED: public Base {
  // no constructors
  // declarations etc.
};
```

In file CONTEXT3.CPP:

```
#include "BASE.H"
#include "DERIVED.H"
Base::Base(int=0) { /*constructor code*/}
Derived d1;
```

and in file CONTEXT4.CPP:

```
#include "BASE.H"
#include "DERIVED.H"
Base::Base(int=0, int=0) { /*constructor code*/}
Derived d2;
```

And now we have the compiler generating different default constructors for `derived`. This is truly a mess of the first order.

The reaction of the group working on the ODR was to propose that we outlaw default arguments for parameters of member functions unless they are provided in the class definition. I think most of those at Monterey were in favour of this solution, but it is true that the ODR problem can be tackled with a lesser rule. One of the X3J16 members invoked the 'two weeks' rule which states that proposals for substantive change to the working paper may not be forced to vote unless directly and essentially tackling an issue raised more than two weeks prior to the meeting. So we are making do with a lesser, though more complex, rule *pro tem*.

There has been a considerable amount of email discussion about the value of providing default arguments in out-of-class definitions of member functions. I, for one, think they are a wart that should be surgically removed.

Changing a Standard Language

Now back to the C code near the start of this column. The important point is that whether the `char` type is an unsigned type, or a signed type is implementation-dependent. The prototype for the function `strncmp` is `strncmp(const * char, const * char, size_t )`, yet the standard specifies that the comparison be done by treating the `chars` as unsigned.

When I argue that C should come off the fence and declare that `char` is unsigned (after all, well constructed code should expect this as a possibility), I get howls from people who want to use `char` as a small integer. Proposals that we introduce a new type `byte` are met by more howls against new keywords.

Does this matter? Yes, quite apart from improving C, it is a clear warning about the difficulty of making changes - however desirable - to a standardised language. If for no other reason, this is a strong motive for taking just a little more time getting C++ right. Once we produce an international standard it will be too late to make refinements suggested by experience. C had vast amounts of existing practice to call on and still has rough edges and sharp corners. C++ is ten times as complicated and we have no experience of some aspects currently in the draft.

■

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CIRCLE NO. 317

bject Master

You may feel frustrated by the limitations of your compiler environment when browsing some code. **Barry Smith** reviews Object Master for Windows whose goal is to ease source navigation.

In many respects, modern Integrated Development Environments (IDEs) like Borland C++ or Microsoft Visual C++ provide vastly better environments for C and C++ than the old way of working with text editor and makefile. Yet there's one way in which even the dreaded *vi* was one-up on current IDE technology. Because of the *ctags* system, both *vi* and *emacs* understood enough about the source you were editing to jump directly to the definition of a given symbol. It didn't matter whether the symbol's definition happened to be in the source file you were editing, or in a different file, in a different directory. If you've ever wished that your current source editing tools understood enough about the language to provide, at minimum, the kind of symbolic source navigation that *vi* users have taken for granted for many years, then maybe you should take a look at Object Master for Windows.

Object Master has been around for some time in the Macintosh environment. It's published by a specialist Macintosh software house, ACI. known for the groundbreaking Mac database package, 4th Dimension. Visual C++ and MFC can now be used to build single-source Windows and Mac apps, and this will probably reinforce the trend for more Mac-based developers to move to Windows as their main development environment. ACI have clearly made the right move by launching a Windows version of their package.

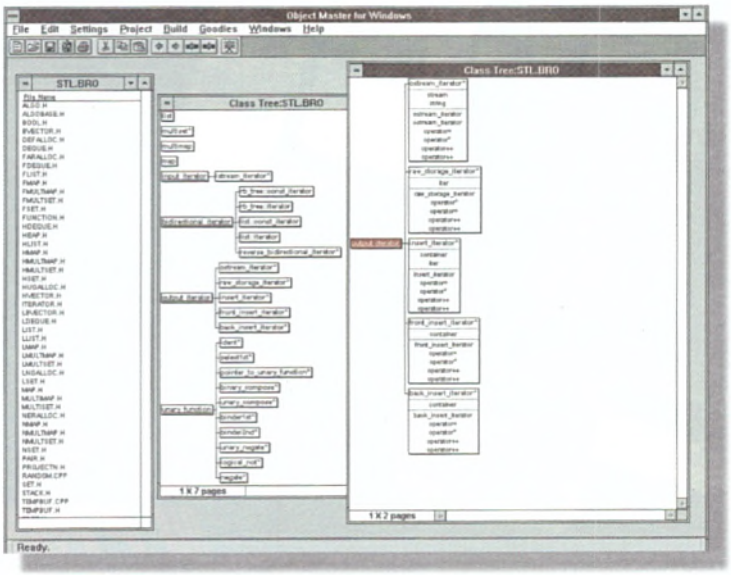
Object Master for Windows (OMW) is a 16-bit Windows 3.1 application. At the moment there's no Win32 version, but the package will run under Windows NT. Under evaluation, it was stable under both NT and Windows for Workgroups.

Cohabitation

OMW won't replace your compiler, because it can't produce executables by itself. But it can serve as your main programming environment. In addition to a rich set of browsing tools, it includes both object-oriented and file-based text editors. If you want to, you can configure OMW to invoke your command line build tools, so that the whole edit and build cycle can be managed from within the one program. You'll probably also want to set up a project within your compiler's IDE and switch to that at various points in the development cycle.

I found it's generally not worth the trouble to configure OMW to invoke the build. I maintained parallel projects in OMW and in my compiler IDE, and switched between the two as needed. OMW, like Visual C++ and Borland C++, will tell you if you have a file open and that file has been changed by another program, so providing you always save any IDE edits before returning to OMW, switching between the two environments works fine. Once a project is mature, though, and large parts of it are known to be buildable, it could easily make sense to drive the compiler directly from OMW to validate minor changes.

OMW's great strength is in presenting an object-oriented view of your source files independently of the ability to compile them. With the Borland or Microsoft IDEs, if you can compile your C++ project into an executable, you can then browse through symbolic representations of your source in the form of class hierarchy diagrams and object browsers. You can jump directly from those symbolic representations to the implementations. If you can't compile the source, though, the IDE doesn't give you any help; you must fall back on that other venerable command-line tool, *grep*. That's unfortunate, the time you most need some kind of symbolic view of a large set of C/C++ sources is exactly when it *doesn't* compile, and you don't understand enough about it to start fixing the problems. This is where a source-level browser like OMW comes into its own.



Project window for the STL `iterator` *classes. The first class tree view just shows class names, the second contains data member and method information*

Bye, bye files...

The historical notion of a development project as a collection of source files with some build instructions, usually called a makefile, is still very much alive, under the thinnest of dis-

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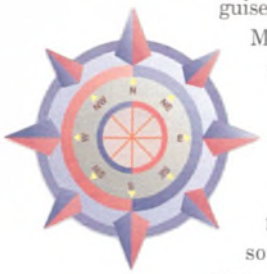


guises, in Borland's and Microsoft's IDEs. A C++ translation unit is still conceptually a stream of bytes produced by nested inclusion of source files which map one-to-one with operating system files. Even though you have object-level browsers, the whole development environment is rooted in the file metaphor. To edit a class declaration, you have to know what the header is called and what directory it lives in. To edit the implementation of a class member function, you must know which source file contains the method - and of course a complex class may be split across several source files. Once you have the right source file open you have to search through the source to find the actual code for the method you want to look at.

Personally, I find this file-orientation in current IDEs an anathema. When I'm working on a C++ class, the last thing I want to be concerned with is how it's packaged for the compiler. I just want to see the class in its place in the hierarchy, as an interface specification and a set of corresponding implementations.

OMW takes you several steps away from the old file metaphor. Add your source files to an OMW project and (for a while at least) you can forget that they are files at all. When you create a new project, the program parses your source and builds its own symbol table. It understands standard C++ and also ANSI C, and can handle most recent extensions to the language, including templates. For example, Microsoft's Visual C++ 1.x and 2.x compilers are currently unable to compile the Hewlett-Packard reference implementation of the Standard Template Library, but you can easily import the STL source into an OMW project. OMW handles the leading-edge code without any problems, and shows the STL hierarchy correctly.

What did you say?

Non-standard keywords, particularly the kind of ugly stuff we have to add to programs to manage memory models, calling conventions and DLL importing/exporting, can cause OMW to complain. So can macros that permit (or force) you to write source that, from a C/C++ parser's point of view, is syntactically incorrect until preprocessed. To handle this situation, OMW provides for a kind of poor-man's preprocessing. In each project, you can set up lists of macros to ignore or treat as symbols.

In one way, it's a pity that OMW can't perform any true preprocessing, because this means that those macros that declare and implement whole groups of routine class members (the DECLARE and IMPLEMENT macros in MFC for example) are not understood by the tool. These standard macro-generated methods never appear in the class-browser windows. On the other hand, preprocessing would add significantly to parsing overhead and could make the tool more cumbersome to use.

The key thing for source-level browsers is error recovery. A browser should get over a syntax error within a line or two, and then continue, making the best possible sense of the remaining source. Here, OMW performs only moderately well. When it can't make sense of a program, it sometime gives up on the rest of the file. Its syntax error reporting (as you'd expect) is not as good as that produced by a professional compiler, but OMW goes beyond that by sometimes reporting that a file has syntax errors while refusing to tell you even which line is in error.

On the plus side, OMW can see the relationships between identically named symbols in different source files even though the correct headers have not been included. It's enough that the symbols exist in the same project. This is invaluable for working on a large group of related classes before all the interactions between the classes are finalised and the circular dependencies in the headers are all resolved.

Tree navigation

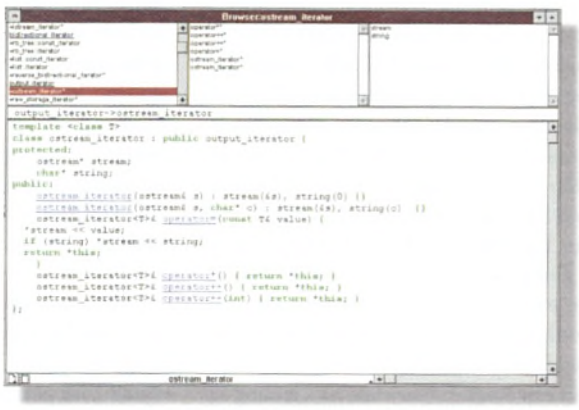
Once OMW has parsed your source, you can then start to ignore the files themselves and work in a more object-oriented way. You can see the class hierarchy graphically in a *Class Tree* window. This shows each class as a small box linked to its super and subclasses, with all the base classes aligned vertically at the left edge of the diagram. This view is a very useful overview of the project. What it lacks is a way of navigating to a particular class by name: if the project is a large one, you can spend a lot of time using the scroll bars and peering at the tree to find your chosen class. If the hierarchy is deep, you also have to pan horizontally as you scroll down through the tree.

By default, the class tree just shows the name of each class, but you can make it show methods or member data as well, either globally or just for particular classes. You can control whether multiple-inheritance is displayed or disguised as single inheritance with multiple occurrences of derived classes. You can expand and collapse display of subclasses at any point in the tree, and you can focus on a given class and its descendants, removing unrelated classes from the tree altogether. This facility is particularly useful given that you can have several different class tree windows active, each displaying different sets of classes.

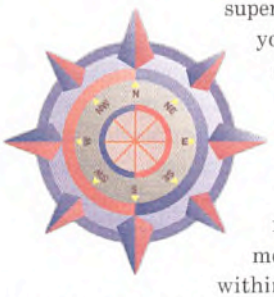
Once you've located the class in the tree diagram, you can open the class up by double-clicking. Depending on how you've configured OMW, this will normally bring up a Smalltalk-like *Class Browser*. The class browser window is really the heart of OMW. As in Smalltalk it is normally arranged with a set of small panes in the top half of the window, and a source-editing area in the bottom half. The layout is very easy to configure. You can switch to an alternative vertically-arranged layout, and you can adjust the relative sizes of the panes by dragging. The panes at the top of the browser show, from left to right, an indented outline representing the class hierarchy, a list of the methods of the currently selected class, and a list of data members. By double clicking on a method or data member name, you cause OMW to bring up the source for just that item in the bottom half of the window.

The ability to jump straight to the implementation of a method by double clicking is the crucial productivity benefit of OMW. If you're working on several classes at once, you can have several class browsers open, and you can edit the text in the source pane freely. If you edit the signature of a method, OMW will politely offer to propagate the change back to the header.

An OMW class browser can show you only methods declared and implemented at the current level in your class hierarchy, but it can also show you inherited methods and data members, with highlighting and colouring to indicate inherited members, virtual members and so on. If you turn on display of



Class browser showing the declaration for `ostream_iterator`



superclass members, you can jump to superclass method implementations just as easily as to implementations of methods defined within the current class. You can easily spot inherited pure virtual functions not overridden at any level in the hierarchy. Where a hierarchy contains a number of different implementations of a given method, you can see lists of different implementations of the currently selected method.

File access

Sometimes, of course, you need to work with more than one method of a class at the same time. Perhaps you want to use one method implementation as the starting point for implementing another, or you want to copy lines from one place to another. In this case, you'll want to get to the files themselves. There's a standard file editor window that works more or less like the source editing window of a conventional IDE. Like the source pane in the class browser, the file editor supports syntax highlighting. To some extent, you can control the colours used for highlighting.

If you want, you can open files into an editor window via a normal file-open dialog. But because OMW knows about the relationship between classes, methods and files, it can also help you to get the underlying file from one of the other views. For example, you can get to your source files via OMW's *File Map* view. A file map shows you the relationship between symbols and the files in which those symbols are defined and declared.

So far, we have looked mainly at OMW as a class browsing and editing tool, but OMW can also show other types of program entity. You can see `enums` and `structs` in the same way as classes. You can see symbols in the global namespace, represented by a slightly curious notation using exclamation marks. For C modules within a project, OMW supports a notion of a single C module as a kind of pseudo-class. Among the other productivity features are macros to generate chunks of skeleton code, and pop-up menus containing method lists for rapid navigation within file editors. I particularly liked the ability to perform global search and replace across an entire project, although this feature was marred by not supporting a replace-with-confirm option.

You can create a new class as a sibling or child of a selected class, and OMW will create a skeleton header and implementation file for you. You can include non C/C++ source file types in a project, and get at them from the project file list. Here, it's a pity you can't associate these additional file types with external programs so that OMW can in effect co-ordinate your toolset for you. The program supports printing of tree diagrams and source from the various browsers, although it has to be said that the printing feature is somewhat rudimentary.

Limitations

OMW betrays its origin as a toolkit-port of a Mac application at various points, and has a fairly rough-and-ready approach to Windows user interface conventions. It's resolutely black-on-white and takes little account of your own colour setup.

The keyboard support is poor. For example, holding the control key down and pressing the arrow keys will move the cursor by words, but each space is treated as a word in itself, so you have to hit the arrow key twice as often as you expect. Holding the shift key down allows you to extend selections, but only with the arrow keys. Where you would expect to be able to paste text from the clipboard into an edit field (for example, in the search and replace dialog) you find that pasting into the control is not supported. Editor settings are erratic: you can configure the tab handling, but OMW appears to lose your settings between sessions. Some buttons clip their own text label.

More seriously, OMW has a performance problem. It's supposed to run on 4 MB Windows machines or 16 MB NT machines. I found that performance approached acceptability under NT only on a 120 MHz Pentium with 32 MB RAM. On anything less, the editor was slow in handling cursor movements and repaint messages. Saving files imposed a significant overhead on productivity, probably because of reparsing. After a save, you are often positioned at the end of file, and you can sometimes get spurious syntax error warnings (with no associated line number) even for files that will build without error. Syntax highlighting is not maintained correctly as you edit; it's based in the underlying parser, and so is updated only on a reparse.

Given these limitations, I found it frustrating that I couldn't configure an external text editor, such as my normal IDE, to act instead of or in addition to the file editor window. OMW bills itself as a complete programming environment, but I found after a while that I wanted it more than anything for its class browsers. For heavy text editing, builds and debugging I fell back to my normal toolset.

I'm still looking for the ideal source browser. I think that when I find it, it will be integrated tightly with my main IDE, either because it's actually part of the IDE (see the box on Browsers) or because it's essentially an IDE add-on. It will probably be a package built for the Windows environment, rather than a toolkit-port. But until then, there's no doubt that I will be returning to Object Master's excellent little class browsers again and again. ■

Barry Smith can be reached as bksmith@cix.compulink.co.uk.

Object Master (Windows and Macintosh versions) are distributed by Full Moon Software (01628 660242). Its email is sales@fullmoon.com. Object Master for Windows is sold £195.

Browsers

Source-level browsers have been around for a long time. The original Smalltalk system had class browsers and editors integrated into the environment. In fact, in typical Smalltalk fashion, Smalltalk browsers were presented in the system as first-class Smalltalk objects, with their own methods.

Nearly all subsequent class browsers have adopted a multi-pane design cribbed from Smalltalk. Unix-based developers have access to development environments like the oddly-named Sniff+ or ObjectCentre. Sniff+ has a particularly good fuzzy-parser that recovers from syntax errors normally within a line or two. It offers very powerful source cross-referencing as well as object-oriented source browsing and editing. Sniff also integrates very well with other tools, such as external text editors and source code control systems, an area that is neglected by Object Master.

Users of the latest version of Symantec's Windows-hosted compiler, Version 7, have excellent source browsing tools integrated into the IDE, including a hierarchy view and Smalltalk-style class browsers. From a class browser window, the Symantec IDE will allow you to edit source for the currently selected item in the source pane, or jump to a file editor to work on either the header or the implementation file. You can control both builds and source-parsing from the same project window. Unlike OMW, the Symantec class browser displays macro-generated method and instance variable declarations correctly, and it offers better error recovery and error reporting. For users of the mainstream Borland or Microsoft compilers, though, Object Master currently has the field to itself.

Sniff+ (for various Unix platforms) is available from Power Software, 01224 622201. Symantec is on 01628 592222.

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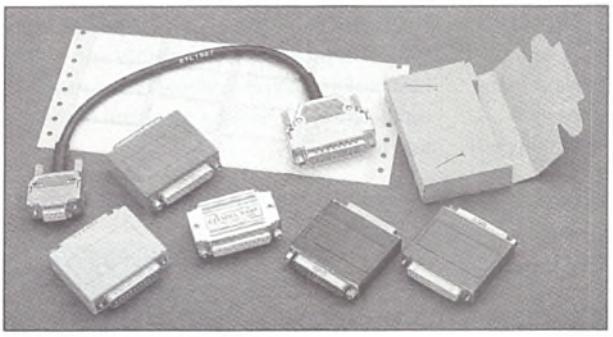

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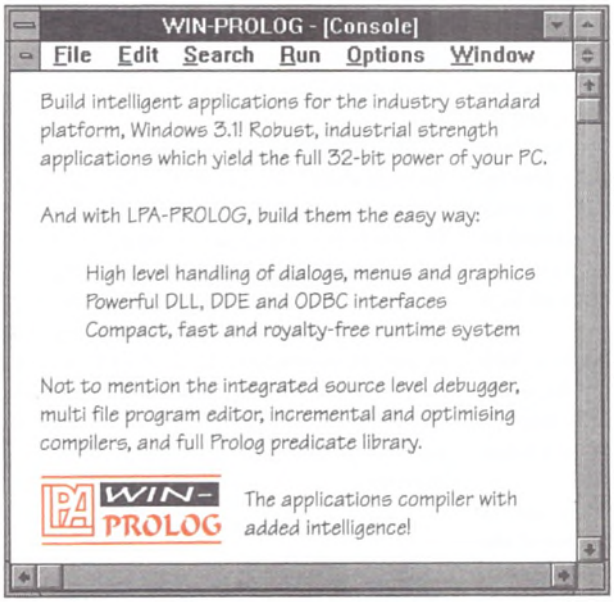

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All the tips, tricks and techniques you need to survive in a 'warped' world! Written in a direct, fresh and controversial style, this book is truly an education in OS/2, starting with the basics like installing and customizing Warp, and moving all the way to providing insights on more advanced topics like using multimedia objects and REXX programming.

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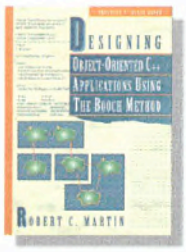
Book review

Designing Object-Oriented C++ Applications Using the Booch Method reviewed by **Roland Perera**



The OO analyst, designer or programmer who would not benefit from reading this book is a rare breed. The author's main theme is that of abstraction - a design and implementation strategy that is at the heart of object orientation, but seems largely to be ignored by 90% of OO 'experts'.

In the 'OOverview', he describes OOD primarily as a tool for organising large programs, its goal to manage dependencies between parts of the program. A key principle is that a client class need not depend on a server class directly, but on an *interface* (typically an abstract class) which defines the behaviour required of the server. This situation Martin calls an 'inversion' of dependencies, as rather than the server *defining* the interface, it has to *conform* to it (ie derive from it) in order to serve the client class. The decoupling allows the client class to be reused with different servers.

A strong theoretical understanding means that Martin's insights are often enlightening. After a brief overview of C++'s object-oriented features, he dives straight into nitty-gritty technicalities. The Booch notation is used to capture designs, and the mapping between C++ and Booch's semantics explored. Recent C++ features such as templates and namespaces are also mapped to Booch designs.

The book's strength is its coverage of many issues not discussed elsewhere. One of Martin's favourite concepts is what he calls the 'open-closed' principle - the idea that a well-designed class is *open* to extension (via polymorphism) yet *closed* to modification (via abstract interfaces to its servers). The idea of extension itself isn't new: hooks and call-backs are good examples of 'dynamic' selection of a function to call. However, C++ provides direct support for this in the form of virtual functions.

In this short space it's hard to convey more than the gist of the intriguing and valuable ideas presented in this book. It's not without fault - Martin likes coining his own jargon (try saying 'functional cohesion' or 'closure main-sequence' with your mouth full). Despite this it's certainly one of the best books on object-oriented techniques I've come across. A healthy amalgam of theory and pragmatics.

Verdict: Very interesting and useful

Title:	*Designing Object-Oriented C++ Applications Using the Booch Method*
Author:	*Robert C. Martin*
Publisher:	*Prentice-Hall*
ISBN:	*0-13-203837-4*
Pages:	*528 (hardcover)*
Price:	*£31.95*

PGP: Pretty Good Privacy reviewed by **David Ross**

This book has everything. It's a novel, full of political and legal wrangling. It's an introductory text covering all aspects of cryptography. And finally, it's a hands-on guide to a particular encryption package, PGP. This is that rare species, a book that delivers more than its title promises (see Peter Collinson's *Unix Boox* in the May 95 issue).

PGP the novel. Just under half of this book is devoted to the history of encryption, covering the theory behind each of the methods and their practical uses. The personalities behind the theory of encryption, its commercialisation, the legal quagmire of software patents, and the continuing role of the US Government are also covered. This history, interspersed with the key text, makes what could be a dry subject quite entertaining.

PGP the introductory text. The book concentrates mostly on public key encryption, but also covers digital signatures and private key encryption. The tricky problems of distribution and authentication of these public keys are discussed in depth. The mathematical sleight of hand which allows the apparent *folly* of broadcasting your key is described in clear, understandable English, and backed-up with a more rigorous mathematical appendix. Also covered are the algorithms used by PGP to implement the public key in practice.

The author clearly believes that any encryption algorithm must be public, and his argument that only then can its strength be tested does have some weight; several apparently good algorithms have already been proved to be flawed when reviewed by other experts. However, I felt that often such views were, at least partly, motivated by a loathing of software patents.

These first two sections make a both interesting and readable introduction which I'd recommend to anyone keen to explore this area. The second half of the book takes the theory and puts it in to practice.

PGP the user guide. The main purpose of the book is to cover the practical use of the now famous encryption tool, PGP. Again, this provides a very good description of all aspects of the package. Each of the various encryption methods available is covered in depth with step by step examples. The book also covers the availability of PGP and, in particular, the various legal versions available in the different areas of the world. My only concern is that since PGP seems to be evolving quickly, and in different directions (to cope with international legal issues), this section may date quite quickly. While the command-line interface to PGP seems pretty stable across its numerous versions, the newer Windows shells are not covered at all.

When reading the hands-on section it becomes clear that, rather than just padding out the book, the subjects covered in the earlier sections are necessary reading. Without understanding how encryption works, it would be easy to choose the wrong mechanisms, or to use the tools in such as way as to render them useless. As Garfinkel points out, poor use of encryption is dangerous, since the user falsely believes his data is secure, and then fails to take any other precautions.

Verdict: Highly recommended

Title:	*PGP: Pretty Good Privacy*
Author:	*Simon Garfinkel*
Publisher:	*O'Reilly & Associates*
ISBN:	*1-56592-098-8*
Pages:	*390*
Price:	*£18.50*

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Visual Basic 4 arrives on September 12th! You can get your upgrades from QBS as normal or in person from QBS at our stand at the Microsoft Visual Tools '95 launch party on the 12th at the London Arena, Docklands. To attend, call Microsoft on 01276 674411.

Microsoft Visual Basic 4 now comes in three flavours: Standard, Professional and Enterprise. The latter is a client server version with team development capability and direct connections to SQL Server and Oracle. Call QBS for full details.

You can upgrade to the Professional version for just £89.00. Again, this is for both standard and competitive upgrades. It's on CD and all docs are on disk. You can get the Visual Basic 4 Pro docs in hard copy from QBS for £50.00. The upgrade to the Enterprise version costs £379.00 including docs and comes on CD. Again, no proof required - it's self-checking.

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They are available separately also from Aardvark. Pretty Printer v2.1 is shipping now. List price is $79.99 ($40.00 s/h). Pretty Printer v2.1 for Visual Basic (20-user license) $995.00. The Polisher for Visual Basic (single user) $129.00 each. The Polisher for Visual Basic (20-user license) $995.00 20-user. For further information, contact Aardvark Software at Aardvark Software Inc., 972 Sheffield Road, Teaneck, NJ 07666 (201) 833-4355, 0544.1372@compuserve.com

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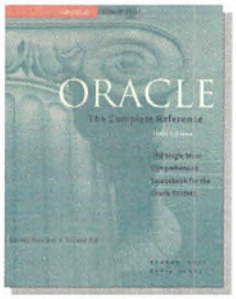

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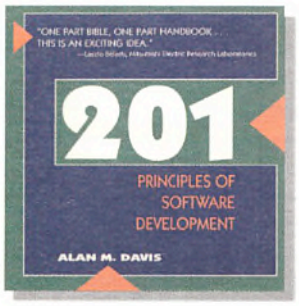

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Software projects are often late and over budget because developers and managers are not always aware of all the fundamentals. This book will give you a firm understanding of software engineering principles that will help you improve processes no matter what type of development tools you use. Many illustrative examples show these development principles in action.

Selection	*RRP*	*Your Price*
201 Principles of Software Development	£20.95	£16.80
Oracle: The Complete Reference, Third Edition	£25.95	£20.80

Descriptions of all books below can be found in EXE Magazine, issues from February to August.

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REAL TIME OPPORTUNITIES

W/Mids	Software Engineer	C/PC Development/Networks	to £27K
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Kent	Software Engineer	Fortran/RDB/VMS/OO	to £30K
W/Mids	Software Engineer	C/C++/M68xxx/Leisure	to £24K

NEW CLIENT REQUIREMENTS ARE COMING INTO OUR OFFICE DAILY. WE NEED TO HEAR FROM PROFESSIONAL AND EXPERIENCED REAL TIME ENGINEERS NOW TO DISCUSS THEIR NEXT CAREER MOVE.

Contact Steve Digby at:-
ASC Connections Ltd
601-602B The Big Peg
120 Vyse Street
Hockley
Birmingham
B18 6NF
Tel: 0121 624 4343
Fax: 0121 624 3212
Email: steve@ascit.demon.co.uk

ASC CONNECTIONS

OO & Notes in Oxfordshire

The historical University City of Oxford and its surrounding rural areas which house many Science Parks are bursting with excellent opportunities for OO developers at all levels. Oxfordshire is served by an excellent motorway network making it easily commutable from neighbouring counties. This is just a small selection of our current vacancies:

OO DESIGNER/CONSULTANT c£40,000 + car

This high profile professional services company is implementing client/server solutions using OO development languages and tools. They are seeking an OO specialist with substantial analysis, design and coding experience to act as an OO facilitator throughout the company. Rumbaugh's OMT highly desirable.

C/C++ PROGRAMMERS to £27,000 + car

Our client is creating a specialist Object Oriented development team and is seeking to recruit talented programmers. Candidates must be educated to degree level and be fluent in C or C++. Other desirable skills include GUI design; use of cross platform development tools, client/server development and Windows 95. Excellent career prospects.

DEVELOPERS: C/C++, UNIX, WIN95 to £25,000

Software house producing tools for scientific research have several superb opportunities for graduate Analyst Programmers with a minimum of 2 years software development experience. Fluent C and ideally any of the following: Unix, C++, GUI design tools, Networks, Windows 95, Client/Server development are required.

LOTUS NOTES DEVELOPERS to £24,000 + car

Do you enjoy variety, challenge and have at least 6 months' Notes experience? Our client has a strong order book for Notes applications and is seeking additional developers to work on interesting and varied applications. Excellent opportunity to gain full life-cycle experience. Foxpro, Clipper or Powerbuilder desirable.

Please send your CV to: Haybrook Appointments, Suite B, Regal Court, 112 London Road, Headington, Oxford OX3 9AU. Tel (01865) 742456. Fax: 742459.

Haybrook APPOINTMENTS

MS WINDOWS

HOT OFF THE PRESS...!

Milton Keynes — **to £24,000 + Bens**

This very successful company who's systems are relied upon by many of the worlds leading newspapers are looking to recruit software engineers to work on their next generation of press control and business critical management solutions. You will need to be experienced in Visual C++ and have some experience in MSWindows and/or OS/2. This is an excellent opportunity to work in a position that allows you to be involved in all stages of the product life cycle.

Ref: JJ/19E

A BRIGHT FUTURE IS ASSURED HERE!

Cambridge — **£15,000 to £21,000**

This company develops control and imaging applications on MSWindows and UNIX systems for astronomical, microscopy and X-ray cameras. The development environment is 'C' & C++ so experience in either of these would be required as would good interpersonal skills. A degree education and possibly any experience of developing MSWindows applications using scientific data or image processing would be highly beneficial to this position

Ref: DL/19E

VISUAL C++ & MSWINDOWS (SDK, MFC)

Cambridge — **£20,000 to £30,000**

Our client, a leading technology based software company, requires the best developers to work on varied projects from MSWindows applications, Multimedia through to real-time programs. A good degree is required and over 2 years experience of programming in C/C++ is required and any exposure to MSWindows, SDK and/or MFC would be highly desirable.

Ref: PH/19E

WINDOWS NT/95

MULTI-MEDIA COMMUNICATIONS

Slough — **to £32.000**

Video conferencing uses the most state of art technology available at present, utilising Microsoft's new operating systems, WindowsNT & Windows 95. Our client is currently recruiting developers at all levels to work on new and exciting state of the art video, audio and data conferencing solutions designed for 32 bit operating systems. We are welcoming applicants from an MSWindows background with development skills in C++ and/or Visual/Borland C++, a knowledge of communications an advantage although not essential.

Ref: JJ/29E

NEW DEVELOPMENT PROJECTS

London — **£16,000 to £30,000**

As a subsidiary of one of the world's largest computer companies this development arm is currently building up a new division solely for the purpose of producing Windows NT, and Windows 95 multimedia applications. These client server based systems are being developed using Visual Basic, C and C++; a minimum of 2 years experience in either of these is required along with any networking.

Ref: DL/29E

WINDOWS NT IN THE MIDLANDS

Birmingham/Coventry — **£18,000 to £28,000**

This leading financial organisation, closely associated with the City is offering exciting Windows development work away from the hustle and bustle of London. If you have skills in any of the following and are keen to progress your career towards Windows NT and 95, contact us without delay: Visual C++, C, MSWindows, MFC, Visual Basic. This is a real opportunity to gain first class exposure to NT.....

Ref: PH/29E

OBJECT C++

TELEPHONY DEVELOPMENT

Surrey/Kent Border — **to £32,500**

Our client is a well established systems house specialising in the development of Telephone solutions to work under new multi tasking environments. Work will be varied and include the involvement in Windows operating systems, along with other environment. We are looking for developers, Senior Team leaders who can offer their skills in Telephony or communication development rather than actual specific development skills. Any knowledge of 'C', C++, Visual Basic, Foxpro, under MSWindows, MSDOS, OS/2 or UNIX would be an advantage.

Ref: JJ/39E

FINANCIAL MANAGEMENT SYSTEMS

Sevenoaks, Kent — **£20,000 to £45,000**

One of the largest investment management organisations is currently looking for the best software engineers to develop their own MSWindows based global financial applications. The design of these systems will be undertaken using object orientated design methods, experience in this area would be beneficial but not necessary as training will be provided. You also need to be degree qualified and possess at least 2 years experience of C++ (preferably Visual C++) on MSWindows. Any other experience would also be useful.

Ref: DL/39E

TRAVEL WITH 'OO' DEVELOPMENT

London — **£24,000 to £28,000 + benefits**

This leading supplier of complex communications and applications for the travel industry has some interesting opportunities to work in Object Orientated development. If you have experience of Visual Basic, MSWindows and some Visual C++, then this opportunity has great scope for career and technical development.

Ref: PH/39E

VISION COMPUTER RECRUITMENT

These are a small selection of our current vacancies. Please call or send/fax a CV for more information.

VISION Computer Recruitment, 70A High Street, Stony Stratford, Milton Keynes MK11 1AH.

Telephone: 01908 260910 Fax: 01908 260098

VISION

To advertise, call Kathryn Tracey 0171 287 5000 x3402
email: kathrynt@dotexe.demon.co.uk

REAL-TIME

We have an increasing number of excellent permanent vacancies throughout the UK for young Software and Firmware Engineers with a good degree and at leat one year's experience in any of the following:

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* Embedded Software
* UNIX or MS-DOS to Kernel
* Bus-based systems/interfaces
* Windows Programmers/SDK/OWL
* ADA
* LANs WANs/ATM/SDH/ISDN
* Signal/Image Processing
* GUIs X-Windows/Motif
* Intelligent N/W Mngt. Sys
* Mobile Comms
* RF Engineers (1GHz)

SALARIES TO 35K

Telephone: 0181-447 1143 for details of many other NEW technical vacancies and/or send CV:
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Tel: 0181-447 1143 Fax: 0181-449 9248

WIN 32/VISUAL C++/VISUAL BASIC/OOD

West Yorkshire £17-21k

Working as a leading member of this newly formed Client-Server team, you will have strong design and programming skills in Visual C++/Visual Basic, coupled with experience of Insurance, Quotation or P.O.S. systems. Self-motivation and good communication skills are essential.

ORACLE/RDB/VISUAL C++/VISUAL BASIC

South Yorkshire £Neg

This software house is a market leader within the Education and Catering Industry. Boasting a strong alliance with Oracle UK and impressive order book they now have the need to recruit a number of IT professionals with experience in the following areas: Oracle/Visual C++/Visual Basic/MS Access. Excellent career prospects.

VISUAL BASIC/C/VISUAL C++

West Yorkshire £15/16k

A min of 12 months Visual Basic and C or Visual C++ will form the foundations for a new generation of software being developed by this market leading organisation. Excellent people skills and a thirst for new technology are essential. Exp of Insurance/Quotation systems beneficial.

ORACLE V6/7/SQL/PL*SQL

North Yorkshire £16-20k

This major Manufacturer/Distributor who has sustained its growth now has a position available for a strong Oracle V6/7 database designer/programmer with experience of performance issues and ideally a knowledge of Cobol/MS-Windows.

VISUAL C++/SQL/VISUAL BASIC

West Yorkshire £15/16k

Strong Visual C++ skills are sought by a successful software house who are embarking on a major Client-Server development to provide 'added value' desk top applications to existing mainframe systems. You will have experience in the complete development life cycle and be confident in your ability to develop robust state of the art applications.

STOP PRESS

VISUAL BASIC DEVELOPER - WEST YORKSHIRE - £11-14k
INGRES ABF DESIGNER/DEVELOPER - WEST YORKSHIRE - £Neg CONTRACT
VISUAL C++/VISUAL BASIC - WEST YORKSHIRE - £MR

SUPPORT SERVICES

Contact Joanne Law Tel: 0113 271 2591/279 7842
Fax: 0113 277 3403
or post your CV to DP Support Services Ltd, Suite 22
Concourse House, Dewsbury Road Leeds LS11 7JL

the soft corporation

Specialists in Software Development Staff Recruitment

OOD/OOP, C, C++, VISUAL C++ **ALL LEVELS**

As the market for Object Oriented skills gathers pace we have a number of clients designing systems in diverse application areas including: **Multi-media, DTP, Telephony, LANs, Electronic publishing, On-line information Feeds, Finance and Banking** in both a UNIX and DOS environment.

Positions available vary from traditional Programmer/Software Engineer and Analyst/Programmers to Designers/Senior Software Engineers in the overall strategic direction for end-user organisations.

£17-£35K + benefits **REF: SC/01/EXE**

WINDOWS OR X-WINDOWS/BANKING **ALL LEVELS**

Three city clients require windows skills at any level. Other relevant skills are SQL server, Transact, SQL, UNIX, VMS or MS-DOS, C, C++, Open Client (DB and Net library), MFC, Open interface and APT. Exposure to analysis, developing user interfaces and rapid development techniques. Full training in Middle Office/Production and Front Office Systems including: Financial and Management Accounting, Treasury, Equity, Fixed Income and Derivatives.

£20-£25K + Banking benefits **REF SC/02/EXE**

C AND C++ PROGRAMMERS **ANALYST PROGRAMMERS**

Excellent opportunities exist for bright graduates with one year + experience. Personal background requires a solid understanding of the project life cycle and a commitment to high quality coding. You will be trained in all aspects of Investment Banking, relational databases, 4GLs and Object Orientated Design. A good opportunity for a second career move.

£17-£25K + Banking benefits **REF: SC/03/EXE**

CAMBRIDGE - MANY, MANY EXCITING OPPORTUNITIES

A wide variety of specialist, leading edge IT companies in areas as diverse as: **ROBOTICS, TELECOMMUNICATIONS, MULTI-MEDIA, GIS, BUSINESS MODELLING, FINANCIAL/TREASURY, EMBEDDED SYSTEMS** and **SOFTWARE/GUI RESEARCH/ MANUFACTURING** require high calibre software development staff at junior and senior levels. Technical skills required include: **C, C++, VISUAL C++, VISUAL BASIC, X-WINDOWS/MOTIF, GUI's, NT, TCP/IP/X25/X4000, PROGRESS, SAP, Relational Databases, INTERNET CONNECTIONS** and **ATM** (Communications not ATM machines). **REF:/04/EXE**

INGRES/ORACLE/SYBASE/GUPTA/OOD AND OOP **ALL LEVELS**

Additional experience of: SQL, Forms, C and C++ required. We currently have client companies including Management Consultancies, Systems Houses, Systems Vendors, Bank and Finance clients looking for candidates with: Relational Database design, Database tuning, Systems Administration, DBAs, Pre/Post Sales and solid programming knowledge and expertise. Please call to discuss your particular requirements.

£18-£40K + benefits **REF: SC/05/EXE**

C/C++/VISUAL BASIC - UNIX OR MS-DOS **DEVELOPERS**

Software House and End Users in Finance, Banking, Manufacturing, Commercial, Scientific and Government application environments require excellent C skills. Both Windows development skills W/3, SDK, NT, X-Windows and Visual Basic or strong C, C++ solid operating systems and good application knowledge are again much in demand. Software development experience is the key, and being able to deliver high performance, high quality, well specified software incompetitive time scales. Opportunities vary from small to large software companies involved in expert systems, GUIs, Image Processing, GIS, EIS, Communications, Networking and Object Orientated Databases. Graduates through to senior software engineers/team leaders are required. Please call to discuss.

£14-£35K + Benefits **REF: SC/06/EXE**

UNIX/VMS/MS WINDOWS/NT MFC/C/C++ **ALL LEVELS**

A degree in computer or natural science, two years solid C/C++ programming experience and a sound understanding of UNIX, VMS or MS-DOS are required to work on large scale programs with user interaction. You will need an intelligent problem solving approach to work and be a quick learner to programmer software in an X-Windows, Windows SDK or NT environment, port software to different systems and liaise with customers to drive through product improvements. Excellent career opportunities for the right candidates.

£16-£28K **REF: SC/07/EXE**

LONDON/HOME COUNTIES WINDOWS SDK/NT DEVELOPMENTS

Senior Development Engineers **Analyst Programmers**
To £30K + benefits **To £27K + benefits**

Strong programming skills in C or C++ and Windows NT are pre-requisites for these positions. Experience in some of the following areas is also required: MS-DOS 5.0, MS Windows 3.1, Windows NT, Windows SDK, MS C 7.0, MFC, Visual Basic, Visual C++ and Microsoft NT. Also desirable are Windows XVT libraries or networking skills. **REF: SC/08/EXE**

SOFTWARE ENGINEERS-SENIOR SOFTWARE ENGINEERS

Various Client/End Users, Software Vendors and Software Houses dedicated to strategic implementation of leading edge technology and integration of applications across different hardware and operating systems platforms require candidates to degree level with a scientific/technical development bias and 1-3 years experience. There are two main options:

TECHNICAL DEVELOPMENT: Continued use of UNIX, VMS, MS-DOS, C, C++, MFC, Windows (SDK, NT or X-Windows and Toolkits), Networking and Communications with companies offering technolgy based careers and management responsibility.

COMMERCIAL DEVELOPMENT: Using technical based skills already developed, but offering opportunites to apply analysis and design skills rather than remain 'a technical guru' in various environments including finance. Please call to discuss your particular career, growth and potential.

£12-£25K + benefits **REF: SC/09/EXE**
VISUAL BASIC SKILLS MUCH IN DEMAND - PLEASE CALL TO DISCUSS **REF: SC/10/EXE**
LEEDS - LOW LEVEL C++ WINDOWS COMMS DEV ALL LEVELS **REF: SC/11/EXE**
LONDON COMMS SPEC X25, X400 £40-60K **REF: SC/12/EXE**
C, C++/MFC - Countrywide **REF: SC/13/EXE**

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Tel: 0171 833 2772 Fax: 0171 833 2774
email: jmcb@softcorp.demon.co.uk

CAREER DEVELOPMENT

To advertise, call Kathryn Tracey 0171 287 5000 x3402
email: kathrynt@dotexe.demon.co.uk

JOB
MULTIMEDIA DEVELOPERS

LOCATION	SALARY
Surrey	To £40K

This worldwide provider of advanced multimedia systems is seeking to fill a number of positions to join an exceptional project. Developers with at least one years experience of Visual C++ and the Microsoft Foundation Classes, preferably in a multimedia environment, are required to fill programmer, senior programmer and technical manager roles. Candidates with experience of Borland's Delphi will also be considered. These excellent positions attract a highly competitive salary and offer the chance of overseas travel.

REF: JK/11

JOB
'C'/C++/UNIX/FINANCE

LOCATION	SALARY
London	£20K-£28K

These positions will appeal to candidates interested in developing systems for the trading room environment. Ideally a graduate, you should have strong 'C' and/or UNIX programming skills gained in a financial environment. Additional experience with relational databases (particularly Oracle or Sybase) or Powerbuilder, whilst not essential, will be of interest. Working in a challenging development environment, there will be some client contact, so candidates should be articulate, presentable and confident.

REF: LC/12

JOB
VISUAL C++/MFC/MEDICAL

LOCATION	SALARY
Surrey	£22K-£30K

Our client, a leader in the manufacture and supply of medical equipment and software, is setting up a new MSWindows project. They are looking for a number of Developers and a Project Leader with Visual C++ skills ranging from six months to an MSWindows guru! Opportunities exist to write applications or low level device driver software. Strong design skills, imagination and innovative ideas are of particular interest as contributions to the design of the product will be welcomed! There is also an additional requirement for two real-time 'C' Software Engineers who will have the opportunity to cross train to the MSWindows platform.

REF: DE/13

JOB
C/C++/TELECOMMS

LOCATION	SALARY
Cambs/Hants	£18K-£30K

Our client is searching for highly professional and committed Software Engineers with a minimum of one years experience of writing 'C' code under MS-Windows or UNIX. Any experience of C++ and OOD would be advantageous. The ideal candidates will have experience of working in a large, well structured development environment. There are also opportunities for those Software Engineers with experience of real-time embedded software systems. However, the most important factors for all candidates are a sense of humour, team spirit and a strong commitment to the production of quality software.

REF: DE/14

JOB
MULTIMEDIA DEVELOPERS

LOCATION	SALARY
City	To £30K

Europe's leading CD-ROM publishing company is seeking to recruit Windows development and testing staff at all levels of experience to work on a number of new titles to be released into Europe. Ideally you will have worked in a multimedia environment developing software under either MS-Windows or on the Apple Macintosh. Any experience of writing or using graphics software, sound or animation would be useful but is not essential. There are openings to be fully trained for those with the right interpersonal skills and previous multimedia, CD-ROM or publishing experience.

REF: FS/15

JOB
VISUAL C++/MFC/OOD

LOCATION	SALARY
Herts	£30K + bens

Our client, an international company which is a pioneer in the data networking industry is searching for a Software Engineer with excellent Visual C++ skills. The ideal candidate will have worked with Windows Network Management systems using Winsock or TCP/IP connectivity. For the successful candidate this is an excellent opportunity to work for a dynamic organisation which welcomes new approaches and ideas. There is also an excellent benefits package available.... 'phone us now and launch your career with one of the leaders in the field!

REF: DE/16

CONTRACT VACANCIES - UK WIDE

City	**Windows NT Consultant**	3 months
City	**Apple Macintosh Developers**	6 months
London	**Visual C++/MFC Programmer**	6 months
Cambs	**Visual C++/MFC Programmer**	3 months
Surrey	**Visual C++/MFC Software Engineers**	3 months
London	**Windows System Tester**	6 months
London	**Visual Basic Programmers**	4 months
Surrey	**Visual C++ Developers**	3 months
Herts	**Visual C++/DLL Programmer**	4 months
London	**Windows NT Developer**	6 months
Middx	**Windows NT/'C' Programmer**	6 months
W. London	**MS Windows/SDK/'C' Programmers x 3**	3 months
Kent	**Visual C++/MFC Software Engineer**	6 months
City	**MS-Windows/Banking Consultant**	6 months
City	**C++/VB/Finance Developers**	6 months
London	**Visual C++ Analyst Programmer**	4 months
W.London	**Visual C++/MFC Soft.Eng x 2**	6 months
London	**Windows/C++ Project Leader**	6 months
City	**Sybase SQL Server Consultant**	6 months
London	**Visual C++/SDK Software Engineer**	2 months
Surrey	**Oracle 6/Forms*3 Programmer**	6 months
W.Midlands	**UNIX/'C' Programmer**	3 months
London	**Apple Macintosh Developers**	6 months
Yorks	**Visual C++/MFC Developer**	3 months
Herts	**'C'/Embedded/Real Time Systems Soft. Engs. x 2**	3 months
W.London	**'C'/DOS Programmer**	3 months
Surrey	**C++/Visual Basic Developers**	3 months

Logistix Recruitment Limited
Lamb House, Church Street
Chiswick Mall, London W4 2PD
Tel: 0181-742 3060
Fax: 0181-742 3061
email: logistix@atlas.co.uk

We have a large number of PERMANENT and CONTRACT opportunities throughout the UK. Please call one of our consultants for further information or, alternatively, post/fax/email a CV to us and we will contact you at a convenient time.

Logistix

Ctrl Break

Please send your rants, raves and competition entries to:

Ctrl/Break
EXE Magazine
50 Poland Street
London W1V 4AX

MGM hacks itself in the foot

As a promotion for their forthcoming movie, *Hackers*, production company MGM United Artists invested in a Web page to 'tantalise' Netsurfers across the globe. Only to find, oh wry twist of fate, that the site itself had been hacked... with crayon-style scribbles, parody of the text and links to Web sites for Defcon III and other hacker 'hangouts'.

'MGM was asking for this', commented the chief exec. of MGM Web site creation. 'On the site we actually invite hackers to tell us about their favourite hacks'.

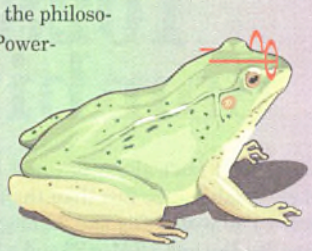
A hacker released a net-statement claiming responsibility for the hack on behalf of the Internet Liberation Front. He sent this press release from an account with the id of Jack Devlin, the name of the main character in the movie!

Ctrl-Break heard rumours that hackers were considering the film to be of no interest. MGM UA, which managed to restore the original Web page after a few days, is now featuring the prowess of the hacking with a link to the hacked page. Was this just a publicity stunt? Check it out at http://www.digiplanet.com/hackers.

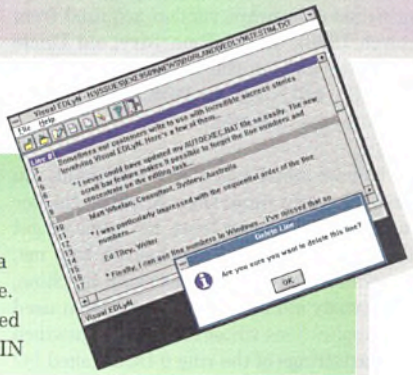
Shameless Toady

We quote the following (without permission) from an article entitled 'An Afternoon with Mitchell Kertzman' in the July 1995 edition of the PowerBuilder Developers' Journal:

'It was my distinct pleasure to interview Mr Kertzman [Powersoft CEO], and to gain some insight into the philosophies that drive Powersoft. One of the rules I adopted early in life is that we hold our leaders to a higher standard than we hold ourselves. By every standard it is clear that Powersoft is a leader because of the astuteness of Mitchell Kertzman as a businessman, and his integrity as a human being.' Pass the sick bag, Alice.



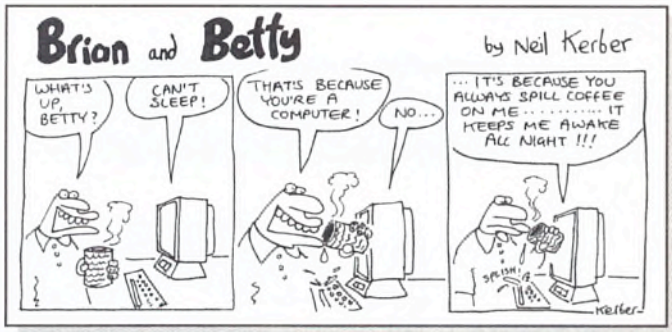
Visual Edlyn



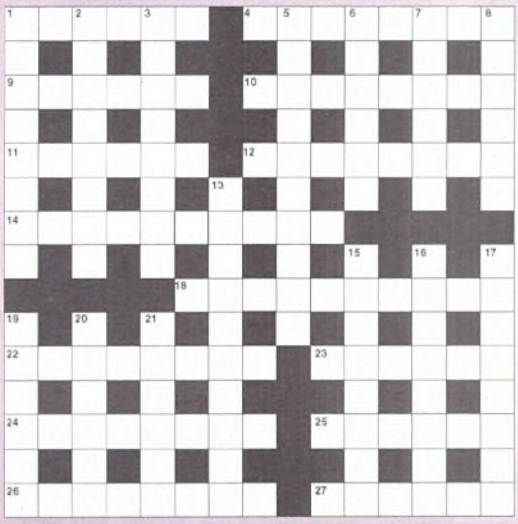
Bill French, well known for his xBase extensions to the Brief and Multi-Edit programmers' editors, has released a new product. Visual Edlyn, a Windows port of the famous MS-DOS line editor EDLIN, addresses the needs of those who feel that they have been left behind by the GUI revolution. It boasts a clumsy user interface, complete with line numbers, a limited capacity text buffer and poor performance. *EXE* caught up with French at the Borland Developers Conference in San Diego. 'We are all very excited about the product. Microsoft ignored a large and important constituency when it failed to include EDLIN with Windows. We are just filling a need. Stupid people have rights too.'

Tech support needs have not been overlooked. Bill French added: 'By solving a complicated Mensa-style puzzle included with the product, Edlyn users can obtain the User Support hotline number, which can be called any time of day or night to hear the recorded message: "If you are so smart, how come you need tech support?"'

French refuses to confirm rumours of a new 32-bit version, but a mole tells us that fans should look to early November for a special Windows 95 edition. 'We expect to qualify for the Windows 95 badging scheme', said the insider, 'because the product runs just as badly under NT.' For a copy of the shareware version, Web to http://www2.csn.net/~bfrench/visual_edlyn/. No, really.



PRIZE CROSSWORD



ACROSS

1. Use red hat to carry beads (6)
4. Background work on the tape deck? (8)
9. Guides to word processor layout are on top (6)
10. Send data across in Fortran's mitigation (8)
11. Somehow sortin' the first blocks (6)
12. Fascinate by use of <ENTER> (8)
14. Tiny mark of remark (10)
18. Getting things going on their own (10)
22. Rufus round a central part of the drive (4,4)
23. Pale sounding chunk of data (6)
24. Exciting source of system power (8)
25. I leave strange Martian with a code for success (6)
26. Using 22 fast to input data? (8)
27. Even without <CTRL> and <ALT> can lose data (6)

DOWN

1. Station at the point of death? (8)
2. Family link in modern db (8)
3. Interfaces for fast travellers? (8)
5. State about 1dn node (10)
6. End users rather new in gates (6)
7. In short, I am menu driven to be virus proof (6)
8. Place for yellow press between the columns (6)
13. Putting on accent on carrier (10)
15. Quite forbidden for one dead to use array (8)
16. Large floppy strangely (8)
17. Start program into the mysteries (8)
19. Specifications for underware, I hear (6)
20. In 2D scanner is in secret (6)
21. Smallest unit of data in a fibre (6)

SOLUTION TO AUGUST'S CROSSWORD

ACROSS: 1. IF THEN 4. ASSEMBLE 9. VERIFY 10. BASTILLE 11. RECYCLES 13. SAMEDI 15. ENGINEERING 19. ANNOTATIONS 22. TALENT 24. IDENTIFY 26. REGISTER 27. SIGNAL 28. DREADFUL 29. SLICES

DOWN: 1. INVERT 2. THRICE 3. EFFICIENT 5. STAR 6. EXTRA 7. BULLETIN 8. EVENINGS 12. EIGHTS 14. UNLOAD 16. ESSENTIAL 17. CAPTURED 18. ANALOGUE 20. BIONIC 21. CYCLES 23. NOSED 25. MENU

Efficient C/C++ Programming is the great book prize for the winner of this months crossword. Send your entries to the address above, marking your envelope 'Prize Crossword'.

102839486 combinations

'Game requires 540 KB, available DOS memory 541 KB, happiness. Game requires 540 KB, available DOS memory 539 KB, time to get tough.' - Thoughts of Confucius, Sybex Edition.

Look. Look! Isn't she a beauty? Isn't she a honey? Yeah course Zoe (like the name?) is a Pent, a P90 with a Gig and 32 Meg and a four times See-Dee and a 2 Meg S3 and a 17 inch television and a... What? A 16.99945 inch TV, oh ha ha ha, you are so witty, yes I have run the test and she's clean, and look at the sound I SAID LOOK NOT TOUCH THANK YOU.

Just doing the configuration now. Got all the bits in: ASPI, CD-ROM driver, mouse, network ODI with VLM, dear old KEYBUK (lean, mean unregistered shareware version acquired from CIX circa 1988), 4DOS, Smartdrv, old Uncle Tom Cobbley and, on the reboot, here we are, take a MEM, 440 KB at the DOS prompt, that's 417 KB after tax deductions.

Hmmm.

No I will not install bleeding Warp, thank you very much for your input there Michael. No, nor NT, nor Ninety Five - at least, not until we get the first upgrade patch - nor, heaven help me, Linux. This is going to be a *working* machine, running crusty old applications like Mom used to bake, applications whose fingers are entwined in the heartstrings of the ring 0 DOS-naked I/O ports, applications built to exploit the DOS 4.0's Int 21h double FAT writeback bug. Yes, ok, applications like that pinball emulation I'm rather fond of.

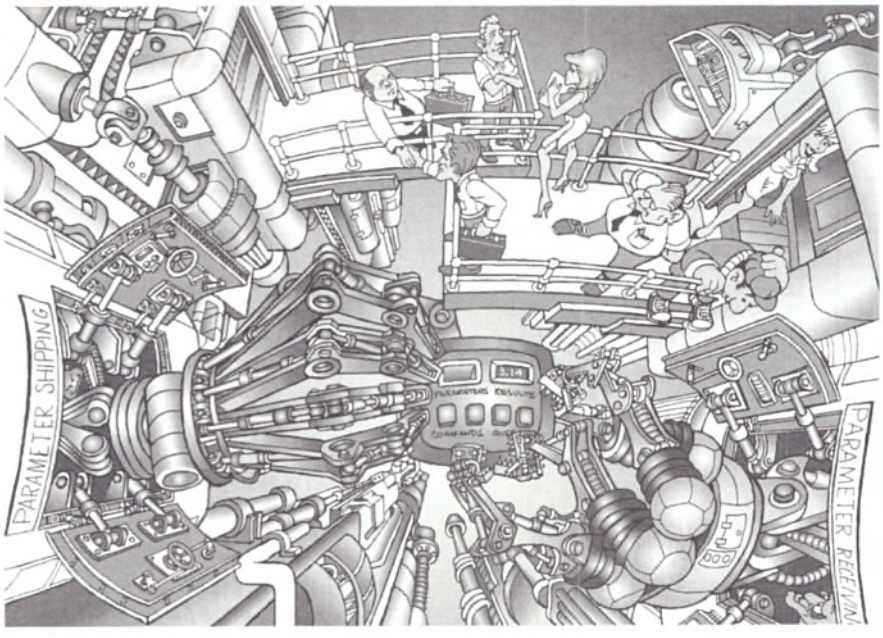
Yes, that *is* the pinball emulation that wants 540 KB at the DOS prompt. No worries. That is not going to be a problem in a machine set up by me. Prepare to watch the mistress of PC configuration at work. The person who can get Moderately-Dim-Drive to load into 25 KB as easily as, as, as changing the plugs on a 1969 Deux Chevaux. You may like to take notes, I don't mind.

Watch. If you run IPXODI with a /D switch, you eliminate the Diagnostic Responder, whatever that means, thus saving 3 KB at one fell stroke. There, 420 KB. We're really motoring. Whip out fat old MSCDEX, slot in the Corel driver (which lives nearly entirely in EMS), three finger Zoe and here we are, 350 KB. Don't be like that, I haven't got the memory manager in yet. DEVICE=QEMM, make with the LOADHI, round we go again, there: 535 KB.

What, put a multi-boot option in CONFIG.SYS? Do me a favour. We'll wind this machine up to 580 KB and still have time to defeat the Spaniards. There's a great big 10 KB slot in upper memory - I say 'slot', it's more like a chasm - and ODIHLP is going to live up there if I have to poke it in with a screwdriver.

Time to run QEMM's Optimize. You'll like this: it works out how many combinations of there are loading TSRs into high memory - there you go: 102839486 - and then it simply adjusts CONFIG.SYS and AUTOEXEC.BAT so that... Yes, I *am* sure that it is still supposed to be rebooting, it does a thorough test on all the hardware, you know, and... Oh look. That's not a problem, stop sniggering, I have the CMOS settings written down on this bit of paper here. Look, booted up clean as a whistle, 517 KB, sod.

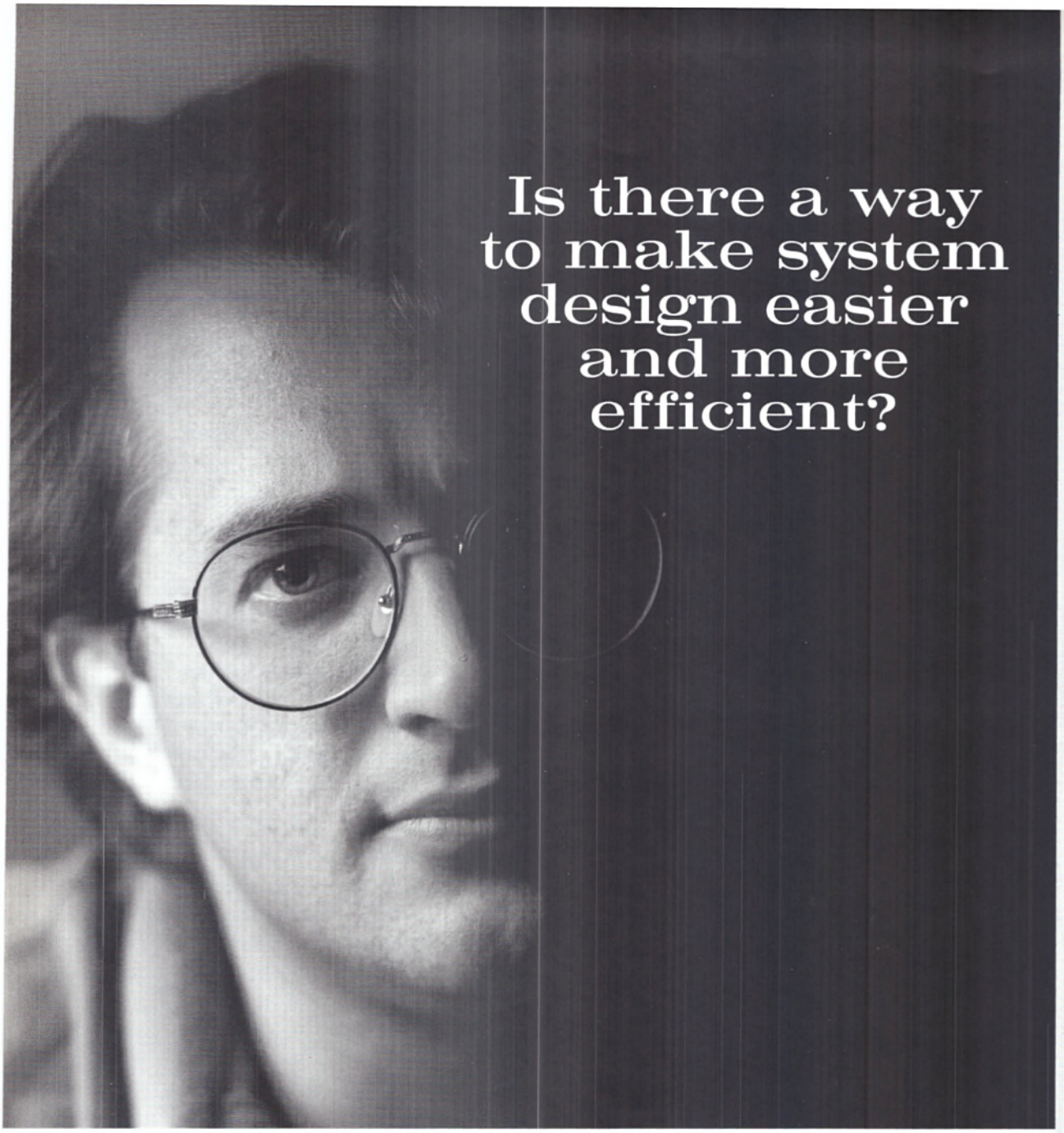
Tell you what, though, if I load the mouse driver first then that'll give QEMM a better shot at leaving region 2 clear for VLM, so then I'll be able to... Off already? Oh ok, I expect I'll just be a few more minutes. Just one thing before you go, though; not that I'll be using it or anything, but, for the record, where do we keep that Warp CD?



PROGRAMMING BY CONTRACT involves assertions that define runtime validity criteria for objects passed as command parameters or returned as query results.

Preconditions define acceptable command parameters. Post-Conditions define acceptable query results. Invariants define acceptable values for the internal state of an object. Ordinarily assertions are enforced only during program development (aka debugging).

It is wise to disable assertions before delivering an application to the user.



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