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Losing Our Religion

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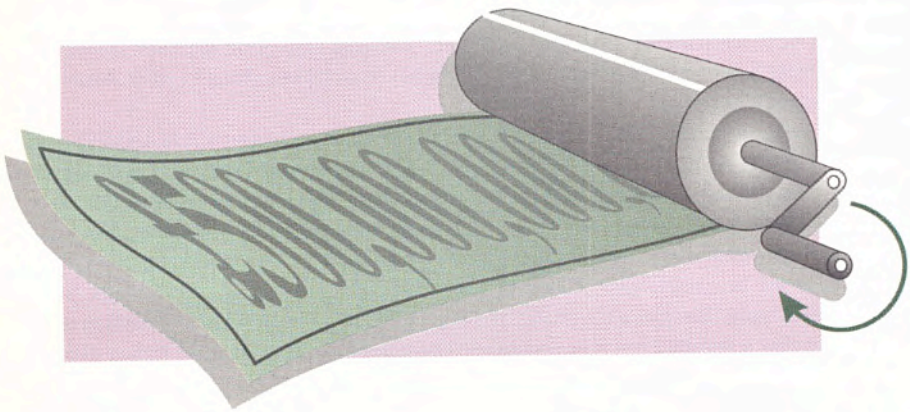
Licence to print money

Why spend £100 on a product if you could spend £1,000? That's exactly what the computer consultants would like to know...

A large number of companies today are still uncomfortable with personal computer technology. To them, computers cause more problems than they solve. They were stung once. Inevitably, they will be stung again. So many companies today throw serious money at inefficient, outdated IT departments. They are happy to put up with monolithic code. In years past they were deceived into believing it would model their businesses. Maybe it would have then, had it been working properly. But surely, not now?

So, they employ specialists to pamper their antique systems. Thus their IT department are more concerned with looking after the legacy software than looking into ways to improve the computing potential of the company as a whole. Personal computing in such companies is frowned upon. IT has always meant spending big money, often with precious little improvement. The thought that a machine costing less than a thousand pounds could offer more, in terms of productivity, than a multi million pound mainframe, is discarded as ludicrous. IT departments have immense budgets. They are accustomed to spending millions of pounds. How could they stoop so low as to buy a PC?

PCs are being deployed in these companies. Unfortunately, the sad fact is that these PCs are not being used to their full extent. No one would consider connecting the machines together so that they could share data. Or better, connect them to the corporate wide network so that information could be exchanged with the company's mini or mainframe or server machine if the company has evolved that far. The truth of the matter is that these companies believe the rightful place for the PC is on a desk, preferably standalone. Because the IT department lacks even rudimentary understanding of personal computing, the machines are hardly ever connected to LANs. Heterogeneous networks are unheard of. Who would consider connecting a PC and Mac and a Unix workstation to *the same* file server? No way. It's preposterous!



Such ignorance in an IT department simply begs to be exploited. These people want to spend their company's money. Why buy a 486 when a Pentium word processor will work just as well, and interestingly enough, plays Myst a darn sight better. Why have a Mac when a PowerMac beckons? So what if it costs a thousand pounds more. At least they won't be cutting the IT budget next year. The bigger the budget the greater the ignorance, or should that read 'ego'?

Perhaps that is why one development tools company decided the best way to get a sale was to speak to the financial director. Fancy slide show, a demo and a few choice phrases: 'improves productivity', 'empowers the developer...' True, by going to the top the decision to buy will happen that much quicker. But, honestly, how much can a financial director be expected to know about software development. It is the developers that must be convinced. Aren't they the ones who will be using the tool in the end?

The reason why people can get away with this is that companies don't trust their development teams. If they bothered to ask the development team they would quickly separate the trash from the genuine benefits of Client/Server, object orientation or the Internet or whatever the latest fad happened to be. Companies fear *real* software developers. Presumably they are worried that such talent would be used maliciously to hack into their precious systems. In the opening sentence of *Hackers*, Steven Levy defines the eponymous heroes of his book as 'computer programmers and designers who regard computing as the most important thing in the world.' He describes how such people changed the shape of computing through sheer energy and personal fulfilment. Today's definition is a perversion of the original meaning. These original hackers spawned a generation of skilled software developers and a lifestyle where signing off at 10.00 pm is considered a luxury because 3.00 am is the norm. Corporate mentality prefers to snub these people as being of the malignant variety hell-bent on cracking their system.

They don't trust their in-house developers but are happy to work with strangers. Consultancy is an odd profession, but it seems a sure way to succeed is to charge unrealistically high fees. The IT department doesn't want to hear how cheap the job can be done. Add an extra zero or two and everyone's laughing. ■

Cliff Saran

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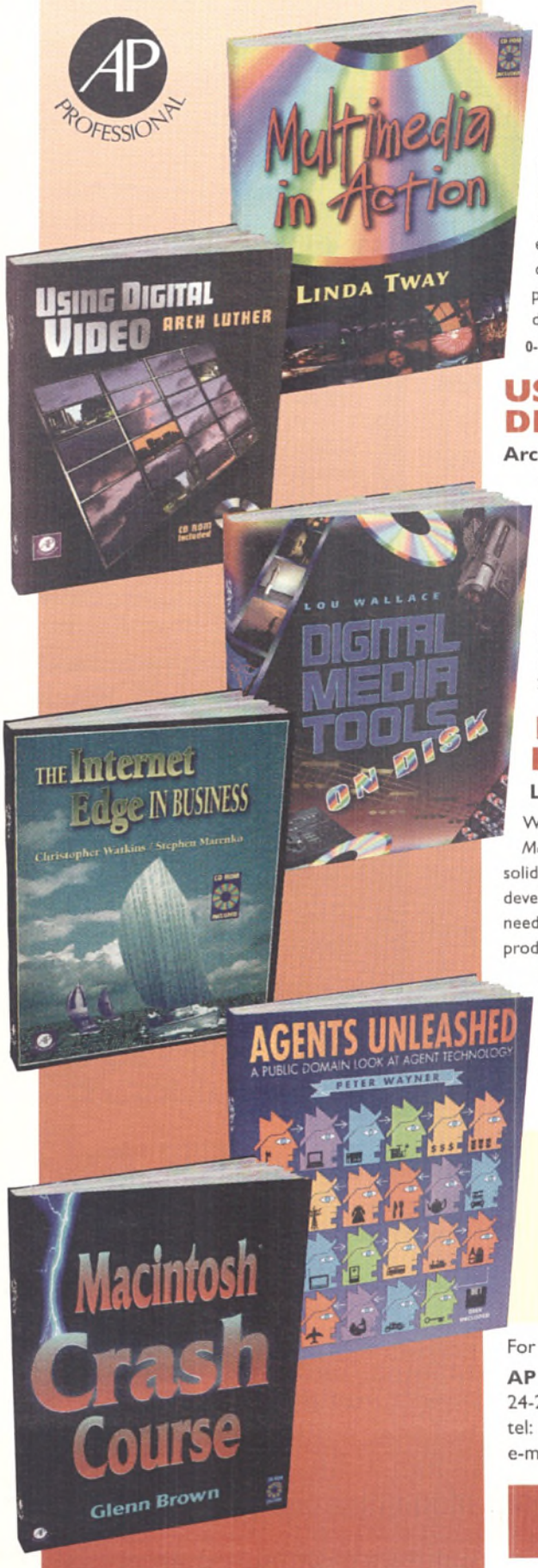

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CIRCLE NO. 033

SOAPBOX

Dave Morton muses on the search for a cross platform development method that really works.

From a development manager's point of view, the platform independent programming tool represents the closest thing we're ever likely to see to the mythical 'Holy Grail'. Nobody ever wants to have to say to a potential client, 'Very sorry, but our application runs under Windows. If you want to use it you're going to have to put a Windows PC along side each of your Workstations'. And whilst quoting a nice round figure to port said application may well please your financial director, it certainly won't impress theirs. What most developers would really like to do is hit a button in a dialog box which says 'compile for Mac System 7.5' and have the executable appear as if by magic.

I'm not sufficiently *au-fait* with the legend of King Arthur, to know if the Knights of the Round Table finally gave up on their search for the Holy Grail and decided to go down the boozer instead. However I'm becoming ever more suspicious that this particular search could end the same way. I know that it's far from easy, because I've seen an awful lot of utterly dreadful products. Take, for instance, GUI builders which achieve 'platform independence' by throwing away all of the good points of the GUIs they attempt to support, producing applications which embody the worst aspects of each target environment. We've all seen database generators which claim to support Macintosh and Windows. They achieve this by abandoning all of the UI conventions of both environments, to produce dreadful applications.

Were I a cynic, I would abandon my quest as evidently impossible: no one achieved this when things were relatively simple, so why expect it when operating systems offer a vast range of ever more diverse features? Microsoft seems to be having quite enough difficulty producing a complete suite of applications which run native on Windows and Windows NT. An application development environment which would target both environments, while supporting Apple's latest OS and the various flavours of Unix, seems like an impossible task.

The trouble is that no developer wants to pay the penalty of an intermediate code-layer. Apple's Newton has been criticised for many things: the handwriting recognition is unimpressive and the built-in applications are mediocre. However, where the Newton's design demonstrates admirable committment, is precisely where it fails the user. NewtonScript was designed to be portable across many platforms, as the original Newton was to be the progenitor of a family of machines, using a variety of processors. Sadly, that quest for portability made the machine painfully slow.

So what about the alternatives? For example, employing separate teams of interface developers and integration specialists, to build the 'core code' which your principle programming team can then turn into individually crafted versions for different target platforms? At first sight this sounds frighteningly expensive, after all, 'cheap expert programmers' are about as common as 'elephants of negligible mass'.

But a rather more circumspect analysis might be more positive. Many, if not all, cross platform development environments drag you off into non-standard proprietory code, even if they act as a front-end to a standard language. This means that, once committed, you're at the whim of the environment developer. And even if this doesn't happen to be a handful of hippies in the Bay Area, who's going to gamble their career on that kind of deal? Novell is effectively pitching Visual Appbuilder up against Microsoft Visual Basic. If Visual Appbuilder doesn't succeed, are we really sure that Novell will continue to support it for the lifetime of the applications we're developing... And if it will not, will it provide us with the means?

Any substantial application development effort will involve a core-code team working with integration specialists and target-machine experts. So supporting more than one platform will increase the size of the team. At the very least you're going to need to add front-end designers for each additional target platform. It's also likely that you'll need to add specialist programmers for the 'low level' code which talks to the network, or to specific hardware components of the target machine.

Unless you're a software house the size of Microsoft, then it's unlikely you'll be able to source these skills in-house. Of course if you are Microsoft, you'll just buy a company with the necessary skills. However while the cost of out-sourcing specialists like this may seem expensive on a daily basis, the production of a custom front-end for your application can be comparitively cheap, provided that yours is a well specified and documented program.

The real difficulty will surround your integration team, which will need to be larger, and a good deal more versatile. They will no longer be undertaking the relatively simple job of integrating one set of core-code with one front-end. Rather they will be combining the job of integrating your core code with several front-ends, with the task of identifying those elements of the core code which are platform specific.

But the benefits are hard to ignore. Your application will 'look right' on each platform and you won't be tied-in to proprietory development environments. Most importantly, your application will be as fast as your 'single platform' competitors on each target.

Seems like that 'Holy Grail' just turned into a chipped mug from the motorway services... ■

Windows

SWAPPER.DAT, the swap file, is no longer treated as a normal file. This happens in two ways. First, when increasing the size of the swap file, the kernel allocates the largest free contiguous space. Then, since memory page size is fixed at 4 KB, the system now always allocates a minimum of 4 KB for the swap file. This effect systems where SWAPPER.DAT is located on a FAT partition of less than 128 MB. On such partitions, the cluster size is only 2 KB.

One for all, all for one

The way kernel functions are spread over system DLLs has been changed. The old DLLs are still there for compatibility but they are mainly empty shells calling the new ones. Many of these DLLs have been combined in PMMERGE.DLL and DOSCALL1.DLL (see Figure 2). This change has the effect of reducing the working set's size. Most of the calls between system DLLs which used to be external are now in the same DLL so that they can be placed in the same memory page. Load time for some system DLLs has also been improved by basing them. This means that they are fixed to an absolute address so there is no need for fixups to be applied. In addition they are prepaged since loading a page from SWAPPER.DAT is faster than from a file.

Another goodie for developers is EXEPACK2, a new option to the linker which compresses EXEs and DLLs by a factor of 20 to 30%. However, programs packed with this option can execute only on Warp since they need the new loader included with the OS. The reduction in size means that applications are loaded slightly faster.

Other speed improvements include a new COM.SYS, fast FAT and HPFS format and data file read ahead in HPFS. Work has also been done in the support of specific subsystems such as DOS and Windows. To mention the more important ones: these are support for Win32s applications, a new VASPI device driver for DOS and Windows ASPI applications, ability to save and load DOS and Windows session settings to and from a file and improved audio support. So Warp, when installed on top of Windows, provides a very secure environment to run Windows and DOS applications. The main limitations concerns Win32s support. The current version supported is V1.15. Only 512 MB of virtual memory is available instead of 4 GB. Also applications using based addressing may fail since Warp and Windows have different memory allocation strategies.

The list of improvements from OS/2 2.1 to Warp is too long to study completely in details in this article but what I have described above should give you a good understanding of the type of work IBM has done in putting Warp together.

Piling on the features

OS/2 2.1 didn't succeed in attracting the crowds even though it was a stable 32-bit system. Warp performs better on a similar machine but that alone wouldn't be enough to make it the big seller that IBM expects. So in addition to improving the performance, IBM has also bundled many applications and added new features to OS/2. Some of these are minor but do make life easier when using the OS everyday. Others are more substantial. As a developer you have to be sure to chose a target OS that will be accepted and appreciated by end user. For the first time, IBM is really making an effort in that direction.

With Warp, in addition to the OS, you get a second CD-ROM (or plenty of floppy disks) containing a full bundle of applications. Warp comes with a 'BonusPak' which includes among others: IBM Works (a small suite) IBM Internet Connection, CompuServe Information Manager, FaxWorks for OS/2 and Multimedia Viewer. Warp also integrates MMPM2, a complete multimedia package (supporting MPEG, Photo CD and Win/TV). So right out of the box, Warp can be used. For instance you can write and send a fax, download some more software from the Internet and watch an MPEG movie.

One of the novelties immediately visible after starting Warp, is the Launch Pad feature. This is a toolbar giving direct access to some kernel functionality (such as shutdown) and providing an easy access to applications frequently launched. Some features were desperately needed, as in BACKUP being able to backup files in use. That's done. Another must is the 'Undo Arrange' option. If after carefully arranging the icons on your desktop you inadvertently clicked on 'Arrange', previously all was lost. Warp allows to go back one step.

One minor improvement that developers should appreciate, is the addition of the two environment variables, `BeginLIBPATH` and `EndLIBPATH`. As their names suggest, these allow dynamic changes to the `LIBPATH`. It should save numerous rebooting!

There are many more cosmetic changes like the two colour palettes. The mixed colour palette supports 256 colours; the solid one only 16. The number of standard schemes in the scheme palette has been increased to 28. If necessary a palette-aware checkbox forces the Workplace to display bitmaps in their true colour shifting the palette when needed. Of course the different pointers can all be changed to whatever bit-

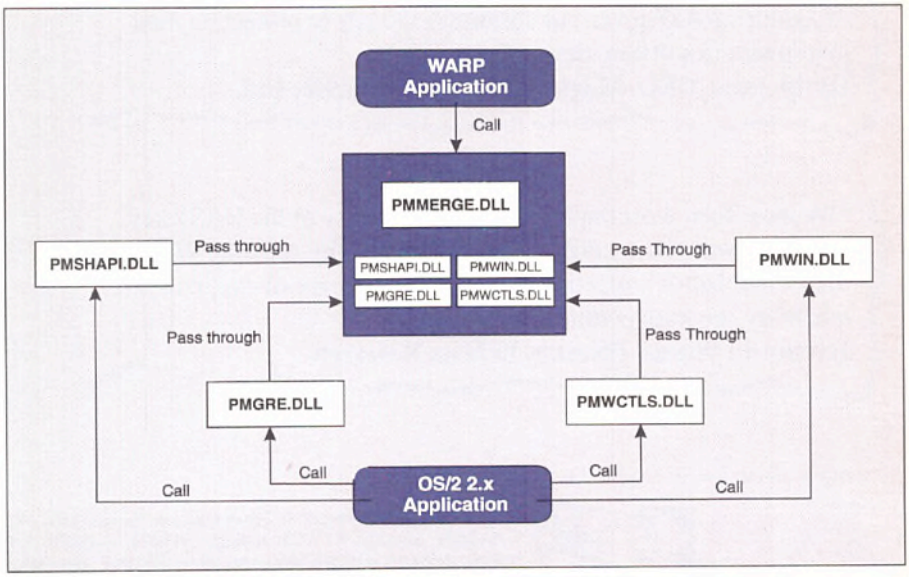


Figure 2 - How the combined DLLs work for Warp and non-Warp apps

map you like. Icons also have a lifting effect. Most standard icons are represented by 3D bitmaps. For folders IBM has designed what it calls 'animated folder'. I find this feature a con. You expect fully animated icons when in fact it just means that the icons change when the folder is open, ie two different bitmaps per icon. I don't see where the animation is.

For laptop users the *comet cursor* is of particular interest. When the mouse cursor is moved around the screen it leaves a trail of blobs. The size of the blobs and the number of them can be set. It is often difficult on a laptop to move the pointer and keep the mouse (or whatever equivalent) button pressed at the same time. 'Pickup' and 'Drop' are two new options added to the popup menu which solve just that problem. On the hardware side, Warp supports Plug and Play PCMCIA.

A maintenance desktop

Warp will install on a machine with at least 4 MB of RAM and either OS/2 2.1 for Windows, DOS 3.3 or higher, Windows 3.1 or 3.11, Windows for Workgroups 3.1 or 3.11 or no OS installed at all. Other configurations are not supported, so if that's your case you might be better off starting from scratch. Windows support can be installed at a later stage if necessary. As usual 4 MB is a 'recommended figure' meaning that it will work with that amount of RAM but performance will be poor as soon as you start loading a few applications. IBM admit that 6 or 8 MB is a better minimum. The HPFS file system for instance is automatically disabled when there is not more memory. We installed it on top of MS-DOS 6.2 and Windows for Workgroups 3.11 on a 486 DX2-66 with 16 MB of RAM. Depending on what you want, Warp takes from 25 to 50 MB of hard disk real estate. Add 30 MB extra for the BonusPak.

One major innovation is that after the sixth disk has been installed on the system, Warp creates a *maintenance desktop*. This is a minimal Workplace shell. What happened before is that if you had a weird piece of hardware or a non standard driver, you had to install OS/2 completely to discover that there was a problem. Now problem detection is done much earlier, so problems can be fixed more easily or deinstallation can be performed before the OS has cluttered your hard disk with hundreds of files.

Many error messages have been updated so that they give advice on how to solve problems instead of only indicating the cause of them! Also the tutorial has been completely rewritten. I found it quite impressive. There is an option which guides you through different tasks. So you learn by practising how to use the system. In a way it's similar to what Microsoft, and now a good part of the software industry, call *wizards*.

Isolated

What is missing from this release is network clients. None are present. That doesn't mean that Warp can't connect to an existing network. It means that it's much harder and costly to install. There is a TCP/IP and a LAN Server package available from IBM, a NetWare client from Novell, a Lantastic client from Lantastic and supposedly a Lan Manager client from Microsoft. But all these clients need to be sourced and bought independently.

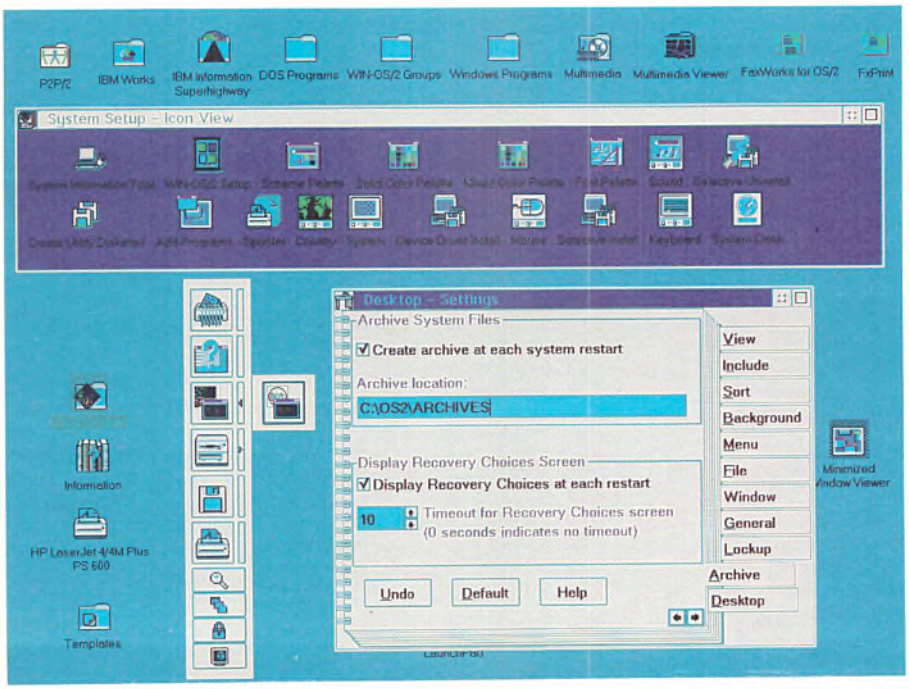


Figure 3 - Archive options in the Desktop settings, the Launch Pad and some setup programs.

A LAN version of Warp equipped with a raft of network clients is promised but not yet available today. Even though OS/2 is built to be scalable from a single processor workstation to a multiprocessor server and Warp will be available for the PowerPC, IBM has kept very quiet regarding network server options for Warp. But there will also be versions of the OS which include a modified Windows kernel.

Kill the myth

As I described above, with Warp, IBM has refined OS/2 into a very mature OS. But is it technically excellent enough to guarantee success? On the negative side, one piece of software desperately missing in the current Warp product is LAN clients.

It has been said for a long time that OS/2 needs a 'killer app' to rival successfully against Microsoft Windows. There might be one. A game no less! It is OS/2's Galactic Civilizations which has won some user awards as the game they find best. Even if widespread, that reasoning doesn't convince me since OS/2 is today a platform very capable of running Windows' best-sellers and in addition, the few OS/2 applications present.

There seem to be two other more fundamental problems. One is the hype surrounding Windows 95. Quite a few users are waiting for this new version of Windows to be available before deciding which OS they will upgrade to. This is a very tricky situation since so far the only thing really available is the name itself. The product is at the second iteration of its beta program and no one knows when it will be available, if ever. According to some rumours Microsoft may scrap Windows 95 altogether in favour of a Cairo Lite. Only the future will tell, but is it fair to compare an available operating system, namely Warp, to concentrated marketing hype?

The other problem concerns the distribution mechanisms of OS/2 and Windows. Until recently Microsoft forced OEMs to pay a Windows licence for every machine they sold even if another OS was installed instead. So, few were tempted to install OS/2 and pay two licences. This situation has changed and IBM has already won some new OEM contracts. But if the current version of Warp is installed on a bare machine, it can run only OS/2 applications, no DOS or Windows ones.

These two problems are linked. And this may bring a solution to IBM's marketing. So far most users got Windows with their machine. One day Microsoft will launch a new operating system which will be an upgrade to Windows. Computer users will have to buy and install this new OS. Then the situation will be fair *vis-a-vis* OS/2. But this day might take long to come. ■

impact Windows 95 will likely have on some Independent Software Vendors (ISVs):

'A system equipped with nothing more than Chicago can be used to perform really useful work right out of the box. For the providers of yesterday's solutions, this should be a loud wakeup call. Product developers must begin taking Chicago seriously right now to determine how best to leverage their opportunities in this new area of Chicago. Those who don't, face sure and certain extinction.'

Most of the functionality Microsoft is putting into Windows 95 isn't built into the operating system. Bundled, yes. But built in or integrated? Not really. Microsoft has outsourced much of the work on these extra features to third parties.

Lessons from history

If the PC software business as we know it is toast, Microsoft started slicing the bread (so to speak) back in June 1991, when it released MS-DOS 5.0. That version of DOS included 386 memory management, somewhat similar to what Quarterdeck and Qualitas had been selling as third-party add-ins to DOS It also added a number of disk utilities that Microsoft 'licensed' from Central Point Software (now part of Symantec). I put licensed in quotation marks because apparently all Central Point received in exchange for its software was a license from Microsoft allowing use of the DOS shell's 'look and feel' (*Newsbytes*, June 12, 1991).

Central Point has since been bought by Symantec. Meanwhile, Symantec lost $11.5M in sales in 1993. As for memory-management suppliers such as Quarterdeck and Qualitas, there were hopes that DOS 5 would help them by legitimising the markets for their products. Contrary to the rosy predictions in 1991, Quarterdeck is seriously hurt today.

Let's now turn the clock forward to MS-DOS 6.0 when Microsoft added disk compression to the operating system. Stac Electronics laid off 40 people, or 20 percent of its work force, in May 1993.

Makeup of an operating system

Now, I'm not asking you to cry over the difficulties that will confront companies such as Symantec and Delrina as their core functionality is bundled for free with Windows 95. When Microsoft put disk compression into MS-DOS 6, leading to nearly immediate layoffs at Stac, the response of most developers (myself included) was 'Heck, disk compression belongs in the OS. Stac had a nice ride for a while. Let them find another line of business.'

Indeed, perhaps everything Microsoft is putting into Windows 95 and everything Mr. Gates wants to see in a future version of Windows really does belong in the OS. As word processors, databases, spreadsheets and graphics packages all converge toward the same basic well-defined set of standard features, perhaps this software belongs in the OS either as bundled programs or as reusable components in the form of dynamic link libraries (DLLs). Does the world really need so many different word processors? How about C++ compilers? Telecommunications programs? Disk repair utilities? If you're an ISV, wouldn't the world be a better place if the functionality of your product were provided free with every copy of Windows 95? Your product may be a Microsoft DLL just waiting to happen.

Microsoft Office seems more and more like part of Windows. Or is it the other way around?

But one reason behind this expansion of Windows has to do with an early aberration of the PC software market. Microsoft's operating systems started out supplying users with the bare minimum necessary to use their PCs. A large third-party industry formed to fill the many holes Microsoft left in DOS and later in Windows. All sorts of programs, such as shells, file managers, disk-repair programs, debuggers and memory managers, that would on most other computers have simply been part of the OS from day one, were on the PC sold as separate products by third-party vendors.

This aberration played a large part in the explosion of the PC market. As one example, competition over who could produce the best disk-compression software undoubtedly led to the production of better disk-compression software than would have occurred if it had simply been bundled with the OS from day one. The flipside to 'you get what you pay for' is that, if you don't pay for something, you probably won't get much either. Software bundled with the OS is likely to suffer from complacency. (Well, the software isn't, but you know what I mean.) The high quality and low price of most PC software is largely due to the fact that it wasn't bundled with the operating system.

For Microsoft, the question of whether something belongs in the OS is not an entirely technical issue, but also a business decision. Windows is sold as a retail product; Microsoft continuously needs major new features to display on the outside of the box. In addition, as we'll see later, Microsoft is not above adding features to DOS and Windows that will make it into better platforms for the Microsoft Office applications suite.

Commenting on the utilities bundled with MS-DOS 6.0, *PC Magazine* (September 14, 1993) noted that, 'by adding these utilities, Microsoft has clouded the definition of exactly what an operating system should be.' If Microsoft's definition of the OS was clouded at the time of the DOS 6 announcement, certainly by the time Windows 95 is released there will be few doubts: Microsoft not only has a near-monopoly on the operating system but is also constantly expanding the definition of what belongs in the operating system. Maybe it's just 80 percent today, but ultimately Microsoft wants 100 percent of the market.

Windows 95 Compatible logo

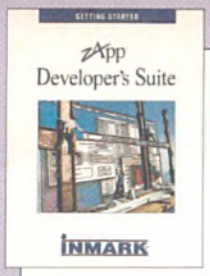
In Windows 95, Microsoft is quite literally raising the ante to stay in the Windows application development game. Microsoft has published new guidelines on what applications must do to qualify for the Windows 95 Compatible logo on its product and ads. As spelled out in an article on 'How to adapt an app for Chicago' *(Microsoft Developer Network News*, July 1994), the requirements are quite strict. There are too many to quote in full here, but some highlights follow:

- The application must be a Win32 executable.
- The program must run successfully on Windows NT 3.5 in addition to Windows 95.
- If the program deals with files, it must have OLE 2.0 support.
- If the program deals with files, it must be mail enabled, supporting at least a Send or Send Mail command on the File menu.

According to the manager of the Windows logo program at Microsoft, 'we are raising the stakes by saying not only do these products [with the Windows 95 logo] work, but they create a valuable synergy with the operating system' (*InfoWorld*, August 29, 1994, p. 27). The question is, valuable for whom? Most of the requirements seem to have more to do with Microsoft's desires than with the potential end-user's...

Office or operating system

Besides the expansion of Windows to include some of the functionality that once were the domain of third-party applications, a similar trend is represented by the increasing integration between Microsoft Office and Microsoft Windows. Most PCs



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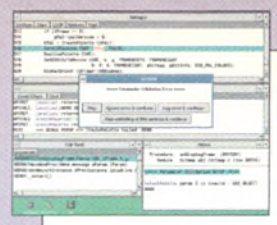

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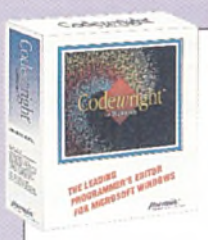

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HTML forms

A form starts with a <FORM> tag and ends with a </FORM> tag. We specify fields with one of the <INPUT>, <TEXTAREA> or <SELECT> tags, interspersed with other HTML if required. Note that we should put double quotes round any parameters if they contain white space. We can have more than one form in a Web page.

The tag <ISINDEX> provides a simple query form - this is described separately in the main text.

Here are most of the available options:

- **FORM**
  <FORM METHOD=GET|POST ACTION=**URL**>
  where **URL** normally points to the program that you want to run to receive the form data. The use of GET or POST is discussed in the main text.
- **INPUT**
  This specifies a simple text input field, a checkbox, radio button, submit button, reset-to-default button, hidden field or an image. For text, check boxes and radio buttons, you will want to put prompt text beside the input fields.
  <INPUT TYPE=**type** NAME=**name** [VALUE=**default**] [CHECKED] [SIZE=**size**] [MAXSIZE=**maxsize**]>
  where **type** is one of TEXT, PASSWORD, CHECKBOX, RADIO, SUBMIT, RESET, HIDDEN or IMAGE; **name** is your field name; **default** is the value initially displayed; **size** is the display box size and **maxsize** is the maximum field length. PASSWORD fields are text but with all the characters echoed as asterisks.
  For checkboxes and radio buttons no text is displayed, so follow the tag by the text that you want for the input field. The VALUE is only returned as a result. Specify CHECKED if the type is CHECKBOX and you want it initially checked.
  A SUBMIT field is a button with its text given in the VALUE parameter. Pressing this button completes the form and sends it off to the ACTION URL. A RESET field similarly is a button which resets all the fields to their defaults.
  PC Mosaic currently does not support the IMAGE type, where the GIF file is given in a SRC=file.GIF parameter. Clicking on the image completes the form with the image name returned.
- **TEXTAREA**
  This tag specifies a multi-line text area.
  <TEXTAREA NAME=**name** ROWS=**rows** COLS=**cols** **default contents** /TEXTAREA>
  where you can specify any **default contents** that you need.
- **SELECT and OPTION**
  This tag specifies a list box, where the users selects from one (or more) options from your given list.
  <SELECT NAME=**name** [SIZE=**rows**] MULTIPLE>
  Series of :
  <OPTION VALUE=**...** [SELECTED] **text**
  </SELECT>
  If SIZE is missed out or **rows** is one then a pull down box is shown; otherwise a list-box of the specified number of rows is shown. If MULTIPLE is given then more than one option may be selected.
  The given text of an option is put in the list. As far as I can tell, the option VALUE is ignored, unless Mosaic has a bug. If you specify SELECTED then the option is initially selected.

```
HTTP/1.0 200 OK
Date: Wednesday, 26-Oct-94, 14:05:30 GMT
Server: NCSA/V1.3Pre/MSWin
Content-type: text/html
Last-modified: Wednesday, 26-Oct-94, 14:05:30 GMT
Content-length: 1123
<HTML>
..
</HTML>
```

Figure 2 - HTTP data can be returned direct to the web browser

Waiting to end

`httpd` has to know when the program finishes. The author, Rob Denny, says that `httpd` waits for a notification hook to deliver a task exit message. My first cut C++ program simply wrote to an output file and stopped. But this caused `httpd` to hang up. My second attempt had a small message loop which issued a `WM_CLOSE` to itself straight away. Although Rob thought that it should work, `httpd` still hung up. My final working code sets a small timer delay. It only issues the `WM_CLOSE` when the timer has tolled its bell. So far this has been solid.

All this code is in `DoTinyMessageLoop()` and its associated `WndProc()` in Figure 3. Note that the normal calls to `ShowWindow()` and `UpdateWindow()` are not necessary, especially as `httpd` runs `WinMain()` with `nCmdShow` set to `SW_SHOWMINNOACTIVE`.

Key is in the gateway

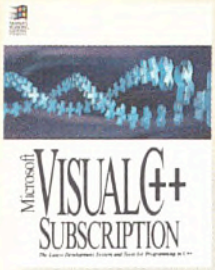
The CGI data file has lots of information which is useful for our program to run. It is in the Windows profile file format (normally used for .INI files), so we can use `GetPrivateProfileString()` to retrieve the relevant strings. We can call `GetPrivateProfileString()` with a `NULL lpszEntry` to enumerate all the keys within a section.

The [CGI] section contains all the *Common Gateway Interface variables*, as listed in Figure 1. Note that for DOS executables, these are passed as environment variables to the program. The Logical Path and Query String are the most immediately useful variables, as discussed earlier. I found that both DOS and Windows programs did not receive any of the authentication variables.

[Accept] lists the MIME types that the user's browser can accept, for example `audio/wav=Yes`. I presume that the entry `*/*=YES` at the end of the list provided by `httpd` means that we can send any type. However, note carefully that we have to set up `httpd`'s MIME types file in order to be able to send different file types successfully. The [System] section has a copy of the Output File path and the Content File path. And [Extra Headers] lists extra information that was provided with the request such as `UserAgent=whatever`.

Return to sender

The other sections of the CGI data file contain the values sent from the form, assuming we used the POST method. If a '`key=value`' string is less than 255 characters long then it is decoded and put directly in the [Form Literal] section. If it is a bit larger than, or if there are any control characters,



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then it is decoded into an external temporary file. In this case the [Form External] section lists '`key=pathname length`'. Finally if the string is more then 65535 bytes long then it is not decoded. However the [Form Huge] section lists '`key=offset length`' giving the offset of the raw value string in the Content File, together with its length. Note that the contents files should be read in binary mode.

In the example code of Figure 3, the `GetFormValue()` searches for a key in one of these sections. It always returns a huge pointer to the retrieved value (even if the string is short). `ReadBuf()` is used to read data from a file. It can cope reading huge amounts of data. For [Form Huge] keys, `DecodeValue()` is called to decode the raw value string. For debugging purposes, `EnumerateFormKeys()` simply lists the available keys as HTML to the output file. `EnumerateKeys()` lists the Query String and Logical Path variables and calls `EnumerateFormKeys()` for each of the three [Form] sections.

Output file format

One of the command line parameters to the program gives the Output File name. We should write results here in the required format. There should be one or more special header lines, followed by a blank line and then optionally the data.

To return HTML, we would write just one header line containing '`Content-type: text/html`'. The data would be the HTML that we want displayed. Optionally we can include a `Status: special header`, but `httpd` assumes a '200 OK' status if it is not given.

If our special header line is '`Location: URL`' then the given URL is displayed instead.

Finally, we can return HTTP data directly to the browser, though this is not for the faint-hearted. We may have to begin our executable's name with '`nph-`' to make `httpd` realise that it should not package the data. Figure 2 lists some examples of data.

We should be able to return other data types apart from HTML, but my brief attempts to do so have not worked.

An example program

Figure 3 is a working Windows CGI program which could be the basis of something useful. It was compiled with Microsoft Visual C++ 1.5, though any C or C++ compiler would do. Although some of the Microsoft

```
/*----------------------------------------
  WINCGI.CPP
----------------------------------------*/
#include <windows.h>
#include <fcntl.h>
#include <io.h>
#include <sys\types.h>
#include <sys\stat.h>
#include <string.h>
#include <stdio.h>
#include <time.h>
#include <stdlib.h>
#include <ctype.h>
typedef char __huge *HPSTR;
void LogError( char*, LPSTR);
void HandleComments( int);
void HandleOrder( int);
void HandleUnrecognised( int);
void EnumerateKeys( char* INIfile, int
hOF);
int DoTinyMessageLoop(HANDLE,HANDLE,int);
const short MAXARG = 10;
char* argv[MAXARG];
int argc = 0;
char* pszCmdLine = NULL;
int GetArgs( LPSTR lpszCmdLine)
{
  int len = _fstrlen( lpszCmdLine);
  char* pszCmdLine = new char[len+1];
  _fstrcpy( pszCmdLine, lpszCmdLine);

  argc = 1;
  argv[0] = NULL;
  char* pCmdLine = pszCmdLine;
  while( *pCmdLine!='\0')
  {
    char ch;
    if( argc==MAXARG) break;
    argv[argc++] = pCmdLine;
    do ch=*++pCmdLine;
    while( ch!=' ' && ch!='\0');
    if( ch=='\0') break;
    *pCmdLine++ = '\0';
    do ch=*pCmdLine++;
    while( ch==' ' && ch!='\0');
    pCmdLine--;
  }
  return argc;
}
////////////////////////////////////////
// WinMain called with parameters
// <<cgi-data-file>> <<content-file>>
// <<output-file>> <<url-args>>
static char* FormComments  = "/Comments";
static char* FormOrder     = "/Order";
int PASCAL WinMain (HANDLE hInstance, HAN-
DLE hPrevInstance, LPSTR lpszCmdLine, int
nCmdShow)
{
  // Get arguments
  GetArgs( lpszCmdLine);
  if( argc<4 || argc>5)
  {
    LogError( "Server calling with wrong
number of parameters",
              lpszCmdLine);
    return DoTinyMessageLoop
           (hInstance, hPrevInstance,
            nCmdShow);
  }

// Open output file
  char OutputFile[80];
  strncpy( OutputFile, argv[3], 79);
  OutputFile[79] = '\0';
  int hOutputFile =
    _open(OutputFile,
          _O_TEXT | _O_WRONLY | _O_CREAT |
          _O_TRUNC, _S_IREAD | _S_IWRITE);
  if( hOutputFile==-1)
  {
    LogError( "Could create output file",
              pszCmdLine);
    return DoTinyMessageLoop
           (hInstance, hPrevInstance,
            nCmdShow);
  }
  // Get logical path: see what to do
  char Buf[80];
  GetPrivateProfileString
  ("CGI", "Logical path", "", Buf,
   sizeof( Buf), argv[1]);
  if(strnicmp(Buf, FormComments,
              strlen( FormComments))==0)
    HandleComments(hOutputFile);
  else if(strnicmp(Buf, FormOrder,
                   strlen( FormOrder))==0)
    HandleOrder(hOutputFile);
  else
    HandleUnrecognised(hOutputFile);
return DoTinyMessageLoop(hInstance,
                         hPrevInstance,
                         nCmdShow);
}
////////////////////////////////////////
// DoTinyMessageLoop: Necessary to
// allow httpd to sync with us
HANDLE hInst;
long FAR PASCAL _export WndProc (HWND,
                                 UINT,
                                 UINT,
                                 LONG);
int DoTinyMessageLoop(HANDLE hInstance,
                      HANDLE
                        hPrevInstance,
                      int nCmdShow)
{
  hInst = hInstance;
  static char szAppName[] = "wincgi";

  if (!hPrevInstance)
  {
    WNDCLASS wndclass;
    wndclass.style = CS_HREDRAW |
                     CS_VREDRAW;
    wndclass.lpfnWndProc  = WndProc;
    wndclass.cbClsExtra   = 0;
    wndclass.cbWndExtra   = 0;
    wndclass.hInstance    = hInstance;
    wndclass.hIcon = LoadIcon (NULL,
                               IDI_APPLICATION);
    wndclass.hCursor = LoadCursor (NULL,
                                   IDC_ARROW);
    wndclass.hbrBackground =
             GetStockObject (WHITE_BRUSH);
    wndclass.lpszMenuName = NULL;
    wndclass.lpszClassName = szAppName;

    RegisterClass (&wndclass);
  }

  HWND hwnd = CreateWindow
              (szAppName,
               szAppName,
               WS_OVERLAPPEDWINDOW,
               CW_USEDEFAULT,
               CW_USEDEFAULT,
               CW_USEDEFAULT,
               CW_USEDEFAULT,
               NULL, NULL, hInstance,
               NULL);

//  ShowWindow (hwnd, nCmdShow);
//  UpdateWindow (hwnd);

  MSG msg;
  while (GetMessage (&msg, NULL, 0, 0))
  {
    TranslateMessage (&msg);
    DispatchMessage (&msg);
  }
  return msg.wParam;
}
////////////////////////////////////////
#define ID_TIMER 1
long FAR PASCAL _export WndProc
                        (HWND hwnd,
                         UINT message,
                         UINT wParam,
                         LONG lParam)
{
  static UINT timer = 0;
  switch (message)
  {
  case WM_CREATE:
    // Set timer for 50ms
    SetTimer(hwnd, ID_TIMER, 50,
             (TIMERPROC)NULL);
    return 0;

  case WM_TIMER:
    // Timer gone off: die
    KillTimer(hwnd, ID_TIMER);
    PostMessage(hwnd, WM_CLOSE, NULL,
                NULL);
    return 0;
  case WM_DESTROY:
    PostQuitMessage (0);
    return 0;
  }

  return DefWindowProc (hwnd, message,
                        wParam, lParam);
}
```

Figure 3 - A working Windows CGI Program

Foundation Classes might have been useful, we cannot easily use some classes without bringing in the whole lot; as most of the classes are to do with displaying information, this seems a bit unnecessary. So the code is just a plain old Windows application.

My `GetArgs()` routine has no real surprises, but it does split up the passed `lpszCmdLine` into `argc` and `argv` globals. If there is a wrong number of arguments, or if any other errors occur, then `LogError()` is called. This appends an error message to a log file, together with a copy of the given `lpszCmdLine`.

The example is designed to cope with being called from different links, differentiated by the extra path information which is added to the URL. So I check the Logical Path parameter in the [CGI] section of the CGI data file and switch accordingly. Whatever happens, the message loop has to be run so that `httpd` can keep up with us.

The program expects to be called with one of two settings for the Logical Path, either '`/Comments`' or '`/Order`'. For the latter case, `HandleOrder()` receives user entries from a form which contains Name, Fax, Card, Contact and Address keys, as well as a hidden ProductCode key. The Address key is a TEXTAREA, so `TidyMultiLine()` is called so that newline '`\r`' characters are removed. `HandleOrder()` builds a suitable response HTML page for the user and calls (an empty) `StoreOrder()` to file away the order details.

Image maps

Image maps allow a user to click with the mouse on an image, perhaps to select a location from a map. The XY coordinates of the click are passed to the specified URL as a query; for example, '`?100, 23`' could be added to the original URL. Note carefully that the border coordinates can be returned, ie the range is from -3, -3 to MaxX+3, MaxY+3.

An image map is a special type of hypertext link, so we should use the following HTML:

```
<A HREF=url> <IMG SRC=file.GIF
ISMAP> </IMG> </A>
```

The given URL will point to our program which can decode the query coordinates.

In the `httpd` configuration directory, the file IMAGEMAP.CNF has entries for maps which pick up circles, rectangles and polygons and call a given URL. I have not found any documentation for this. However a good project would be to make these maps work with C.

```
////////////////////////////////////////
// LogError: Log an error message,
// together with given command line
void LogError(char* ErrorMsg,
              LPSTR lpszCmdLine)
{
//  PlaySound( "C:\\WINDOWS\\DING.WAV");
  int hLogFile = _open("FAXBACK.LOG",
                       _O_WRONLY|_O_TEXT|
                       _O_APPEND|_O_CREAT,
                       _S_IREAD|
                       _S_IWRITE);
  if( hLogFile==-1) return;
  char HeaderBuf[50];
  time_t now;
  time( &now);
  wsprintf(HeaderBuf, "--- WINCGI error on
%s",
           (LPSTR)ctime( &now));
  _write(hLogFile, HeaderBuf,
         strlen( HeaderBuf));
  int len = strlen(ErrorMsg) +
            _fstrlen( lpszCmdLine);
  char* MsgBuf =
                new char[strlen(ErrorMsg)+
                _fstrlen(lpszCmdLine)+50];
  wsprintf(MsgBuf, "Error:    %s\nCommand
line: %s\n\n",
           (LPSTR)ErrorMsg, lpszCmdLine);
  _write(hLogFile, MsgBuf,
         strlen( MsgBuf));
  _close( hLogFile);
  delete MsgBuf;
}
////////////////////////////////////////
// DecodeValue: Decode a huge value
// string: + to space, %XX to char code
void DecodeValue(HPSTR hpValue,
                 long& length)
{
  HPSTR hpDest = hpValue;
  HPSTR hpSrc = hpValue;

  for (long srcCountUp=0;
       srcCountUp<length; srcCountUp++)
  {
    char ch = *hpSrc++;
    if( ch=='+')
    {
      *hpDest++ = ' ';
      continue;
    }
    if( ch=='%')
    {
      ch = *hpSrc++;
      char ch1 = toupper(ch);
      ch = *hpSrc++;
      char ch2 = toupper(ch);
      if(isxdigit( ch1) && isxdigit( ch2))
      {
        int dig1 = (ch1<='9') ? ch1-'0' :
                                ch1-'A'+10;
        int dig2 = (ch2<='9') ? ch2-'0' :
                                ch2-'A'+10;
        *hpDest++ = (dig1<<4)+dig2;
        length -= 2;
        continue;
      }
      hpSrc -= 3;
      ch = *hpSrc++;
    }
    *hpDest++ = ch;
  }
}
////////////////////////////////////////
// ReadBuf: Read a file into a huge
// buffer, 256 bytes at a time
const short ReadBlockSize = 256;
void ReadBuf(int hF, HPSTR hpValue,
             long len)
{
  long txd = 0L;
  char block[ReadBlockSize];
  while( txd<len)
  {
    int totx = ReadBlockSize;
    if( txd+(long)totx >> len)
      totx = (int)(len-txd);
    _read( hF, block, totx);
    _fstrncpy( hpValue+txd, block, totx);
    txd += totx;
  }
}
////////////////////////////////////////
// GetFormValue: Get a value for a key,
// from one of the CGI data file sections.
// Return a huge pointer.
HPSTR GetFormValue(char* INIfile,
                   char*ContFile,
                   char* KeyName,
                   long& count)
{
  char INIline[300];
  // Is key in LITERAL section?
  count = GetPrivateProfileString
          ("Form Literal",
           KeyName, "\x1A", INIline, 300,
           INIfile);
  if( *INIline!='\x1A')
  {
    // Copy INI string into value string
    short len = strlen( INIline);
    HPSTR hpValue =new __huge char[len+1];
    _fstrncpy( hpValue, INIline, len+1);
    return hpValue;
  }

  // Is key in EXTERNAL section?
  GetPrivateProfileString
  ("Form External", KeyName,
   "\x1A",INIline, 300, INIfile);
  if( *INIline!='\x1A')
  {
    char* pLen = strchr( INIline, ' ');
    if( pLen)
    {
      *pLen++ = '\0';
      int hExt = _open(INIline,
                       _O_RDONLY |
                       _O_BINARY);
      if( hExt!=-1)
      {
        // Read external file into
        // value string
        unsigned int len = atoi( pLen);
        HPSTR hpValue =
                  new __huge char[len+1];
        ReadBuf( hExt, hpValue, len);
        hpValue[len] = '\0';
        _close( hExt);
        count = len;
        return hpValue;
      }
    }
  }
  // Is key in HUGE section?
  GetPrivateProfileString
  ("Form Huge", KeyName, "\x1A", INIline,
   300, INIfile);
  if( *INIline!='\x1A')
  {
    char *pLen = strchr( INIline, ' ');
    if( pLen)
    {
      // Open raw content file
      *pLen++ = '\0';
      long offset = atol( INIline);
      long len = atol( pLen);
      int hExt = _open(ContFile, _O_RDONLY
                       | _O_BINARY);
      if( hExt!=-1)
      {
        // Read content file part
        // into value string
        _lseek( hExt, offset, SEEK_SET);
        HPSTR hpValue =
                    new huge char[len+1];
        ReadBuf( hExt, hpValue, len);
        hpValue[len] = '\0';
        _close( hExt);
        // Decode from raw form
        DecodeValue( hpValue, len);
        count = len;
        return hpValue;
      }
    }
  }

  count = 0;
  return NULL;
}
////////////////////////////////////////
// TidyMultiLine: Tidy a TEXTAREA
// multi-line string so that \r
// chars removed.
void TidyMultiLine(HPSTR hpValue,
                   long& length)
{
  char __huge *hpDest = hpValue;
  char __huge *hpSrc = hpValue;
  long skipped = 0L;
```

Figure 3 - A working Windows CGI Program

```
  for(long srcIndex=0; srcIndex<<length;
      srcIndex++)
  {
    char ch = *hpSrc++;
    if( ch=='\r')
      skipped++;
    else
      *hpDest++ = ch;
  }
  length -= skipped;
}
////////////////////////////////////////
// HandleComments: Just act as if ignored
// for just now
void HandleComments( int hOF)
{
  HandleUnrecognised( hOF);
}
////////////////////////////////////////
// HandleOrder: Check order details, build
// reply output and store order
void StoreOrder(HPSTR, HPSTR, HPSTR,
                HPSTR, HPSTR, HPSTR);
void HandleOrder( int hOF)
{
  char* pCF = "Content-type:
text/html\n\n<HTML><HEAD>";
  int CFlen = strlen( pCF);
  _write( hOF, pCF, CFlen);
  pCF = "<TITLE>WINCGI Order</TI-
TLE></HEAD>\n<BODY><H1>WINCGI Or-
der</H1><P>\n";
  CFlen = strlen( pCF);
  _write( hOF, pCF, CFlen);

  long ProdLen, NameLen, FaxLen, CardLen,
       ContactLen, AddrLen;
  HPSTR ProductCode =
    GetFormValue(argv[1], argv[2],
                 "ProductCode", ProdLen);
  HPSTR Name =
    GetFormValue(argv[1], argv[2],
                 "Name", NameLen);
  HPSTR Fax =
    GetFormValue(argv[1], argv[2],
                 "Fax", FaxLen);
  HPSTR Card =
    GetFormValue(argv[1], argv[2],
                 "Card", CardLen);
  HPSTR Contact =
    GetFormValue(argv[1], argv[2],
                 "Contact", ContactLen);
  HPSTR Address =
    GetFormValue(argv[1], argv[2],
                 "Address", AddrLen);
  if(NameLen==0L || CardLen==0L ||
    AddrLen==0L)
  {
    pCF = "<H2>Sorry, you must enter a
name, a card number and
an address</H2>\n";
    CFlen = strlen( pCF);
    _write( hOF, pCF, CFlen);
  }
  else
  {
    TidyMultiLine( Address, AddrLen);
    Address[AddrLen] = '\0';
    StoreOrder(ProductCode, Name, Fax,
               Card, Contact, Address);
    char* Msg = new char[ProdLen + NameLen
                         + CardLen +
                         ContactLen +
                         AddrLen + 50];
    wsprintf(Msg, "<H2>Thanks for your or-
der <B>%s</B></H2>\n",
             Name);
    CFlen = strlen( Msg);
    _write( hOF, Msg, CFlen);

    wsprintf(Msg, "You have ordered
%s<<P>>\n",
             ProductCode);
    CFlen = strlen( Msg);
    _write( hOF, Msg, CFlen);
    if( ContactLen>>0L)
    {
      wsprintf(Msg, "Your contact
phone/email is <I>%s</I><P>\n",
               Contact);
      CFlen = strlen( Msg);
      _write( hOF, Msg, CFlen);
    }
    wsprintf(Msg, "<HR>\n<H2>Billing De-
tails</H2>\nName:
<B>%s</B><P>\nCard:
<B>%s</B><P>\nAddress:
<B>%s</B><P>\n",
             Name, Card, Address);
    CFlen = strlen( Msg);
    _write( hOF, Msg, CFlen);

    if( FaxLen>0)
    {
      wsprintf(Msg, "<HR><H2>Sending
confirmation fax to
<I>%s</I>.</H2>\n",
               Fax);
      CFlen = strlen( Msg);
      _write( hOF, Msg, CFlen);
    }
    delete Msg;
  }
  pCF = "<HR><A HREF=/phd//>Return to or-
der menu</A>\n</BODY></HTML>\n";
  CFlen = strlen( pCF);
  _write( hOF, pCF, CFlen);

  _close( hOF);
  if( ProductCode) delete ProductCode;
  if( Name) delete Name;
  if( Fax) delete Fax;
  if( Card) delete Card;
  if( Contact) delete Contact;
  if( Address) delete Address;
}
////////////////////////////////////////
// StoreOrder: Stre away the
// received order
void StoreOrder(HPSTR ProductCode,
                HPSTR Name, HPSTR Fax,
                HPSTR Card, HPSTR Contact,
                HPSTR Address)
{
  // Store in a file somewhere
}
////////////////////////////////////////
// HandleUnrecognised: Handle an
// unrecognised form request:
//       Echo the keys as HTML to user
void HandleUnrecognised( int hOF)
{
  char* pCF = "Content-type:
text/html\n\n<HTML><HEAD><TITLE>Unrecog-
nised request</TITLE></HEAD>\n<BODY><H1>
Unrecognised request</H1><P>\n";
  int CFlen = strlen( pCF);
  _write( hOF, pCF, CFlen);

  EnumerateKeys( argv[1], hOF);
  pCF = "<HR><A HREF=/phd/>Return to main
menu</A>\n</BODY></HTML>\n";
  CFlen = strlen( pCF);
  _write( hOF, pCF, CFlen);

  _close( hOF);
}
////////////////////////////////////////
// EnumerateKeys: List the Query String
// and Logical Path , together
//      all the keys from each Form
//      section as HTML
enum LOCATION {LITERAL, EXTERNAL, HUGE, };
void EnumerateFormKeys(char* INIfile,
                       int hOF, LOCATION);
void EnumerateKeys(char* INIfile, int hOF)
{
char* pCF = "Query String=";
  int CFlen = strlen( pCF);
  _write( hOF, pCF, CFlen);

  char Query[80];
  GetPrivateProfileString("CGI",
                          "Query String",
                          "", Query,
                          sizeof( Query),
                          INIfile);
  CFlen = strlen( Query);
  _write( hOF, Query, CFlen);

  pCF = "<<P>>\nLogical path=";
  CFlen = strlen( pCF);
  _write( hOF, pCF, CFlen);

  GetPrivateProfileString
  ("CGI", "Logical path", "", Query,
   sizeof( Query), INIfile);
  CFlen = strlen( Query);
  _write( hOF, Query, CFlen);
  pCF = "<<P>><<P>>\n";
  CFlen = strlen( pCF);
  _write( hOF, pCF, CFlen);


////////////////////////////////////////

  EnumerateFormKeys(INIfile,hOF,LITERAL);
  EnumerateFormKeys(INIfile,hOF,EXTERNAL);
  EnumerateFormKeys(INIfile,hOF,HUGE);
}
////////////////////////////////////////
// EnumerateKeys: Enumerate the keys in a
// form section as HTML
void EnumerateFormKeys(char* INIfile,
                       int hOF,
                       LOCATION location)
{
  // Allocate a buffer for the entries
  HLOCAL hBuf =
          LocalAlloc(LMEM_MOVEABLE,1024);
  char* pszBuf = (char*)LocalLock( hBuf);

  // Retrieve all the entries in the one
  // of the three sections
  char* SectionName;
  char* pHeader;
  switch( location)
  {
  case LITERAL:
    SectionName = "Form Literal";
    pHeader = "<H2>LITERAL</H2>\n";
    GetPrivateProfileString
    (SectionName, NULL, "", pszBuf,
     1024, INIfile);
    break;
  case EXTERNAL:
    SectionName = "Form External";
    pHeader = "<H2>EXTERNAL</H2>\n";
    GetPrivateProfileString
    (SectionName, NULL, "", pszBuf,
     1024, INIfile);
    break;
  case HUGE:
    SectionName = "Form Huge";
    pHeader = "<H2>HUGE</H2>\n";
    GetPrivateProfileString
    (SectionName, NULL, "", pszBuf,
     1024, INIfile);
  }
  _write( hOF, pHeader, strlen( pHeader));

  // Retrieve the string for each entry,
  // until reaching the double null
  // character.
  for (char* pszKey = pszBuf;
       *pszKey != '\0';
       pszKey += strlen(pszKey) + 1)
  {
    // Retrieve the value for each entry
    // in the buffer
    char szVal[80];
    GetPrivateProfileString
    (SectionName, pszKey, "not found",
     szVal, sizeof(szVal), INIfile);
    // Write each key=value string as HTML
    char szMsg[80];
    if(strlen( pszKey)+strlen(szVal) < 70)
    {
      wsprintf(szMsg, "%s = %s<P>\n",
               (LPSTR)pszKey,
               (LPSTR)szVal);
      _write( hOF, szMsg, strlen( szMsg));
    }
    else
    {
      _write(hOF,pszKey,strlen( pszKey));
      _write( hOF, "<P>\n", 4);
    }
    // For external keys, write the
    // external value string as HTML
    if( location==EXTERNAL)
    {
      char *pLen = strchr( szVal, ' ');
      if( pLen)
      {
        *pLen++ = '\0';
        int hExt = _open( szVal, _O_RDONLY
                          | _O_BINARY);
        if( hExt!=-1)
        {
          unsigned int len = atoi( pLen);
          char* pBuf = new char[len+1];
          _read( hExt, pBuf, len);
          _close( hExt);
          _write( hOF, pBuf, len);
          _write( hOF, "<P>\n", 4);
          delete pBuf;
        }
      }
    }
  }
  LocalUnlock( hBuf);
  LocalFree( hBuf);
}
```

Figure 3 - A working Windows CGI Program

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EXE Compiler report Pt IV

Dave Biggins and Rhea Laboratories

have finally got to the end of their mammoth C++ indulgence. The question on everyone's lips is which one is the best...

So I got there in the end. You will be glad to hear that this is the final part of the series. I will end with three compilers from Metaware, Topspeed and the Free Software Foundation. At the end I will give my recommendations and a summary table of features for all the compilers covered in the series. But to begin with, I have three compilers to review...

Metaware High C v3.3

Metaware does three separate versions of High C. The first covers DOS and Windows 3.x, the second covers Windows NT and the third is for OS/2 v 2.x. This review is of a new beta of the DOS and Windows version, which should be released by the time you read this.

Phar from Windows

The DOS and Windows compiler targets 32-bit DOS code, running under the PharLap 386 DOS Extender, which is *not* included in the package. For this reason, it needs the PharLap 386Link linker, which is also not included. You really need the PharLap stuff to do anything useful with the DOS/Windows product.

The High C/C++ DOS & Windows version also supports the development of 32-bit Windows code running under Windows 3.x. Unusually, the 32-bit Windows support is not targeted at the Win32s Windows extensions. Instead, MetaWare includes a 32-bit supervisor, which handles all 32-bit to 16-bit (and back) translation.

Include at will

Metaware High C compiles C code, conforming to ANSI X3J11/90-013. The C++ compilation supports the language defined in the Ellis/Stroustrup *The Annotated C++ Reference Manual* and is closely tracking the emerging ANSI X3J16 C++ standard.

A pre-processor extension, `#c_include` provides a mechanism for specifying that a given file should only be included if it has not been included previously. This obviously is simpler than the conventional method of testing and `#defining` a unique variable in each include file, but the portability issues are sufficient to suggest caution in using it. A pre-processor predefined macro, `__HIGHC__` allows testing for the Metaware compiler.

Metaware includes several language extensions. `_Alias` and `_Noalias` are hints to the optimiser. If a variable is declared with an `_Noalias` modifier, you are telling the optimiser that it will not be accessed other than directly. You are not intending, for example, to access it by means of a pointer. Unfortunately, the compiler will not enforce this. It will merely generate unsafe optimisations if you do. A pity though: it could also have been quite neat as an aid to data encapsulation.

There are the `_Near` and `_Far` specifiers, for handling the Intel segmented architecture, and a few other extensions such as `_CC`, `__declspec`, `_Dpascal`, `_Packed` and `_Unpacked`.

Compiler				Minimum Development System ***			Delivery				Target CPU					Hosts				Targets								Language					
Supplier / Product	Version	Price	Friendliness	Minimum CPU	Minimum RAM (MB)	Typical Disk Space (MB) for DOS & Windows	CD-ROM	Can run from CD	Floppy Disks	Download from Internet	8086	286	386	486	Pentium	DOS	Win 3.x	Win NT	OS/2	DOS 16	DOS 32	DOS .DLLs	Win 3.x	Win32s	Win NT	OS/2	Novell NLM	AutoCad ADS/ADI	ANSI / ARM	Templates	Exception	Separate Assembler	Inline Assembler
Borland C++	4.5		8	386	4	85	Y	Y			•	•	•	•	•		•		S	•	•		•			S			•	•	•	•	•
Clarion /JP| TopSpeed C++	3.1		2	?	0.64	11			7		•	•	•	•	•	•				•	•	•	•			S			•	•			
FSF GNU g++ (DJGPP)	1.12		1	386	2	5	O		O	Y			•			•					•					S			•	•		•	
MetaWare High C/C++	3.3		3	386	4	14			8		•	•	•	•	•	•		S	S		P		• WX32		S	S			•	•	•		
Microsoft Visual C++	1.51		7	386	4-8	55	Y	Y	O		•	•	•				•			•			•						•	•	N	S	•
Microsoft Visual C++	2		8	386/486	16-20	100	Y	Y	O				•					•						•	•				•	•	•	S	•
Symantec C++	6.1		6	386	4	90	Y	Y	18		•	•	•	•	•		•			•	•		•	•		S			•	•	•		•
Symantec C++	7		10	386	8	>100	Y	Y	O		•	•	•	•	•		•	•		•	•		•	•	•	S			•	•	•		•
Watcom C++	10.0a		4	386	8*	170	Y	Y	O-60		•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•		

Figure 1 - Summary of C++ compiler features

High C does include the standard Microsoft extensions of `extern "C"` to specify external linkage to a C function or variable. It also supports a proprietary `_CC` modifier. This is a more detailed way of specifying external linkage specifications. It looks quite neat, but again is not portable.

There is however no equivalent to the Microsoft `__interrupt`, or `__export` modifiers, which means that interrupt service routines will be a little tricky. Windows development will require the programmer to export all callback functions manually in the .DEF file.

If only ANSI would...

There are however some language extensions which are, shall we say, more... drastic. Probably the greatest of these is support for nested function definitions, where one function can include the definition of another, which is then only in scope to be called inside the function in which it was defined. I must admit I can see the attraction of this one, particularly for any Pascal programmers converting code to C++. Such nested functions cannot be used in a pointer to a function however, which limits their use a little. The total lack of portability to any of the other major C/C++ compilers available may of course be an even greater limit to their use.

Another extension is the freedom to include the underscore character in the middle of any numeric constant. High C will ignore it. The idea is to use it to group the digits as you normally would with a comma when writing the number in English text. One that I suspect many C and C++ programmers would occasionally kill for is the ability to specify ranges of values in `switch / case` statements:

```
switch (n)
{
  case 'A'..'Z':
    printf("Upper case");
    break;

  case 'a'..'z':
    printf("Lower case");
    break;
...
}
```

Now if Metaware can only sell that one to the ANSI committee. An unusual extension provided by MetaWare is Ada-like support for parameters to be passed by formal parameter name, rather than by position in the call:

```
int mread
(
int hFile,
char Far * lpBuffer,
int iLen
);
 char Buff[256];
  mread
(
  hFile => inFile,
  iLen=>sizeof(Buff),
  lpBuffer => Buff
);
```

Such a method of passing parameters allows the values to be passed in any order, provided that each one is given together with the correct formal parameter name. Such a syntax allows functions to be much more self-documenting, and as such is no bad idea. And with some of those huge Windows functions with a dozen or so parameters, it could make them *much* more readable.

I'd die for an IDE

There is no DOS or Windows integrated development environment. The product came bundled with the C Source Inc EC Editor. This is a command-driven DOS-hosted text-mode editor, with its own keyboard commands etc. There are no graphical tools for the development of Windows resources.

The High C compiler comes with a relatively complete Windows SDK (MetaWare calls it the ADK, Application Development Kit). This includes the conventional Microsoft SDK examples and the complete set of examples from Petzold's *Windows Programming*. There is however no equivalent of the MFC or OWL class libraries.

MetaWare also bundle in the popular Rogue Wave Tools.h++ class libraries. These cover a wide area, such as wide character handling, date & time, internationalisation, collection classes, B-Tree file management, etc.

Debugging

MetaWare High C does come with a Windows-hosted debugger. Like early versions of CodeView for Windows, it shows distinct signs of a DOS ancestry and of having been tacked into Windows. It runs as a text-mode Window, while debugging native Windows applications.

It preempted the system to an unusual extent. While it was waiting for input, it proved impossible to switch to another task by the keyboard or mouse. The DOS debugger supports remote debugging over an RS232C serial link

Docs

The documentation is comprehensive and detailed. Fourteen manuals or documents, in a book-shelf slip cover, including a New Testament. MetaWare makes no secret of its commitment to operating as a primarily Christian Organisation.

Installation

The beta supplied was on eight 1.44 MB 3" floppy disks, although one of these was an

Compiler		Libraries							Editing / Development Environment												Debugger					Tools		Docs		Support		Source		
Supplier / Product	Version	DOS Graphics	Windows API	MFC 2	MFC 3	OWL	Other Class Libraries	Royalty-Free Extender	DOS Hosted	Windows Hosted	NT Hosted	OS/2 Hosted	Editor	IDE	Function/Variable browser	Class Browser	Multi-file find	Graphical tools	Wizard/Expert code integration	Multiple projects	Hooks to Revision Control	DOS Debugger	Windows Debugger	Remote RS232	Remote Network	Roll-Back / Replay	Crash Log	Profiler	Paper Manuals	On-line Manuals	UK telephone	EEC Telephone	Library Source Included	Library Source available	Compiler Source Available
Borland C++	4.5	•				•		•		•		S		•	•			•	•	•		•	•	•	•		•	•	•	•				
Clarion /JPI TopSpeed C++	3.1		W					•	•								•					•							•		•				
FSF GNU g++ (DJGPP)	1.12	•					• S	•	•				• S				• S					• A								• 1			•		•
MetaWare High C/C++	3.3	•	•				•		•																										
Microsoft Visual C++	1.51	•	•	•				L		•				•	•	•		•	•			•	•				•	•	O	•	•			•	
Microsoft Visual C++	2		•		•						•			•	•	•	•	•	•	•				•	•		•		O	•				•	
Symantec C++	6.1		•	•				•		•				•	•	•		•	•	•	•	•	•	•	•		•		•	•	H	•	•		
Symantec C++	7		•	•	•			•		•	•			•	•	•	•	•	•	•	•	•	•	•	•		•		O	•	H	•	•		
Watcom C++	10.0a	•	•	•			•	•	•	•	•	•		•	•	•		•		•		•	•			•									

Figure 1 - Summary of C++ compiler features (Continued)

update disk. A normal delivery of the 'live' product would probably be just seven disks. Installation is from the DOS command prompt. A complete installation took a spot under 14 MB, for DOS and Windows.

Conclusion

The language extensions are rich and powerful. If some of them found their way either into the ANSI standard, or into a couple of other major manufacturers' compilers, I'd be quite keen. Otherwise, I suspect I'd be rather nervous to make extensive use of them.

Clarion JPI Topspeed C/C++

Topspeed 3.1 is a DOS-hosted development system, capable of producing code for real or protected-mode DOS, Windows and OS/2. The C compiler claims to be the only validated ANSI implementation of the C language on the PC, but the leaflet saying so is undated. The compiler was validated by the BSI using the Plum Hall validation suite. The C++ compiler is AT&T v2.1 compliant, conforming to the Ellis & Stroustrup *The C++ Annotated Reference Manual.*

The language is kept quite 'pure', with few proprietary extensions, although some of the common Microsoft-based extensions, such as `extern "C"` are provided. Equivalent functionality is also provided by `pragmas`, but of course that does reduce source portability to the MS/Borland/Symantec/etc products.

The usual `near`, `far`, `huge`, `pascal`, `cdecl` and `interrupt` declaration modifiers are supported, each performing the same function as the Microsoft equivalent, although Microsoft now normally prefixes each of these keywords with two underscores, to identify them as non-Ansi extension eg `__near`. As far as I can determine however, there is no equivalent for the Microsoft `__export` modifier, which means that all callbacks etc must be explicitly exported in the linker module definition file. A separate utility, TSMKEXP, will scan an object or library file and generate EXPORT entries into a .DEF file for all public symbols.

There are a number of pre-defined identifiers, which allow conditional compilation based upon the current development environment: whether the target is for DOS, Windows, or OS/2 etc. Unfortunately there doesn't seem to be one which can be used to identify explicitly the fact that the TopSpeed compiler is in use, let alone its version. This means that writing compiler-portable code between TopSpeed and other compilers will be made rather harder than it needs to be.

Nightmarish IDE

Development is performed under DOS. The Topspeed development environment looks as if it ought to be a standard CUA-compliant user interface, but it isn't. In fact, it's decidedly quirky.

There are no project browse facilities, although there is a multiple file search facility. This can include the `?` and `*` wild card characters, but there is nothing like grep's regular expressions, and no 'whole word' option.

There is no inline assembler, but the TopSpeed assembler is included. As by now you might expect, this is slightly different from the standard '86 assemblers. In particular, it is case sensitive, comments are marked in modula-2 style (* and *) brackets, hexadecimal constants must be in upper case, the semicolon (which most assemblers use to mark a comment) is used to separate multiple statements on one line... There are other changes too. You can't use expressions like `[BX-6]`, you have to use `[BX] [-6]`. Additionally, there is no support for 80286 or higher CPU instructions. Don't expect a hassle-free port of MASM code to the TopSpeed assembler.

Now if Metaware can only sell that one to the ANSI committee

Context-sensitive help is provided for the main library functions, but not for C/C++ language elements. There is a basic project facility, which ties in with the development environment, allowing you to do the usual forced rebuild of everything, rebuild only changed files, and recompile a specified file, but with its own syntax for the project file.

The compiler comes with a WINDOWS.H include file which has been tailored to use the TopSpeed `#pragmas` instead of the Microsoft language extensions. You have to use this header to do windows development with the TopSpeed compiler. Unfortunately, these days, WINDOWS.H is no longer anything like enough for creating Windows applications. It is difficult to take seriously Clarion's claim of being able to target Windows development with the products I received for review.

Lightweight tools

The product comes with a resource compiler that will convert .RC scripts into .RES files, etc. But there are no graphic tools for bitmap production, menu layout or visual design of dialog boxes, let alone the sophisticated code/object integration tools that modern windows developers have come to expect as standard in a development environment.

Who debugs Windows anyway

The TopSpeed compiler includes a number of debugging facilities, but none of these can be used to debug Windows programs. For this TopSpeed includes a program which converts the debugging information to CodeView format - which is fine if you already have CodeView or another Windows debugger which can handle CodeView data format! The DOS debugging facilities include a general-purpose debugger called VID (Visual Interactive Debugger), a post-mortem debugger, which allows examination of the state of a program after a fatal error, and Watch, a TSR which monitors DOS function calls.

Other utilities include a Disassembler, a profiler, a library manager, an EXE header editor and a utility to perform compression on the built EXE files.

Compulsive reading

The TopSpeed documentation is comprehensive, well written and well presented. These were among the best I have seen in this review series. The language tutorials were not just a rehash of Stroustrup or Kernighan & Ritchie, (although some of the examples looked familiar) and while they started with a 'Hello World', they built up fast enough so that a programmer experienced in another language would not feel too insulted. The C++ tutorial is mainly aimed at the differences between C and C++, and as such did not do quite enough to put the programmer into an object-oriented frame of mind. There are sections dealing with the grey areas that the language specifications leave as 'undefined' or 'implementation defined'. These were clear, detailed and unambiguous.

Installing TopSpeed

The development system is supplied on seven 1.44 MB 3" floppy disks. Installation is from the DOS command line and took about twenty minutes. It is quite straightforward with an options selection screen at the start and then just keep feeding the disks. An installation of all DOS and Windows-related options, leaving out the OS/2 elements, took only 11 MB of disk space.

Conclusion

Almost every product has a nugget of gold in it somewhere. In TopSpeed it is a DLL facility for DOS programs. This brings the flexibility of run time linking to DOS software and is in my opinion massively overdue for the general DOS and Extended DOS market. Its appearance is a long way out of date and using it to try to keep up with modern Windows development requirements would be hard. I suspect Clar-

tar backup/compression/nroff text formatting software similar to the Unix command line tools, a complete revision control system... The list is endless. But, from what I've found so far, most of it sadly comes from the days of command-line Unix systems. It's a harsh and unfriendly world if you're not used to it. Certainly there's no concept of an integrated or menu-driven development environment.

Source of trouble

As far as I can make out, there is no source-level debugger. There is however a symbolic machine code debugger, which will use symbol information embedded in the compiled program, and can debug 32-bit protected code. The set of files I downloaded unfortunately didn't include the debug32 debugger so I wasn't able to test the debugging facilities. The formats used by the GO32 extender probably mean that third-party debuggers cannot be used.

Text in Tex

Most of the documentation is supplied as files for the Tex text formatting system. It can be (uncomfortably) read as straight ASCII though. Some of the documents are plain text files. I found more useful information in the FAQ (Frequently Asked Questions) files than in the main manuals, probably because, not having Tex, I hadn't completely read all the manuals before I started.

GNU in action

Well, it's interesting. The first time I ran it, it successfully took down the DOS box on my NT 3.5 system, taking the entire system with it, which was not too promising. This hasn't been repeated though. DeLorie's GO32 DOS extender says it is not compatible with EMM386, Windows 3.x, QEMM, or any other software that puts the CPU into Virtual 86 mode. That means that you can't develop, or run the developed programs in the most common DOS environments - you probably want to set up a boot menu to select between setups with your memory manager and without. Eventually, it ran quite well in the NT DOS box though. It seems that NT's virtual machines are much more transparent than standard Windows.

Conclusion

Hey, it's free. Everyone tends to be suspicious of a free lunch. But the GNU product is just that. It is free and it's readily available. It's not over friendly, but I would still suggest that for anyone wanting to make a start into C++ as a programming language, it makes a good low investment starting point. You can always go out and buy a big all-singing development environment *after* you have got a customer whose C++ project will pay for it. But get a **good** C++ book and do find a source of Tex on the Internet and read the manuals. I'm actually quite impressed. I'm going out to try to find a copy of Tex so that I can take a more comfortable look at the manuals.

And finally

I've had quite a lot of fun examining these compilers and development environments. You could say I've found the good, the bad and the ugly. Without doubt, the technical market leaders are Microsoft, Borland and Symantec. If I had to draw up a league table, based purely on features, facilities and friendliness, Symatec C++ 7.0 would come out first, followed by Borland C++ 4.5 then Microsoft.

Personally I use Microsoft 1.5, although that's now being migrated to 2.0. I also use Symantec 6.1, (primarily for its 32-bit DOS support) and will almost certainly migrate that to 7.0 as soon as it's finally released. ■

This article is based on a special report commissioned by EXE magazine and produced by Rhea Laboratories. The full report is priced at £35 for the technical version and £70 for the management version. Ring Suzanne Chamberlaine on 071 287 5000 for details.

Write once, use many

Software reuse has been an issue in software engineering for nearly 25 years. So why it has suddenly become a buzzword? **Dave Reed** explains

There are many issues involved in writing reusable C++. Most centre on the subject of software reuse rather than on the C++ language. Reuse is a broad topic covering management and infrastructure, tooling and construction. In this article we will focus on the last of these, the construction of reusable C++ classes. Specifically, we will cover C++ language support for reusability, C++ library design and examine the problems we face building reusable C++ classes.

Language support

Software reuse is not a new technology even if the current industry focus on object oriented programming and C++ tends to make us believe so. In languages such as C, building reusable components is possible and many examples exist. This, however, requires programmers to follow conventions in emulating features such as inheritance and generics. Different developers of C-based components are unlikely to use the same conventions. This reduces the reusability of the components, because the user must learn and adapt to the convention. If multiple libraries are being used, multiple conventions must be dealt with.

Full, standardized support for reusability is not yet present in C++ either. The construction and packaging of reusable components requires language support for features that include data abstraction (information hiding), inheritance, polymorphism, generic types (templates) and exceptions. Some, but not all commercially available C++ compilers currently support all of these features. This lack of standard language features can cause headaches for library developers and users.

For example, given that exception handling is currently not present in all commercial C++ compilers, as technically attractive as it may be, it would not be wise for a commercial library developer to use the exception language feature. Until the ANSI/ISO standardization process is complete, the C++ community will be faced with language inconsistencies between C++ compilers. Realistically, there will always be some issues here, as there are today to some extent with ANSI C compilers.

Making trade-offs

Library design is the process of making trade-offs based on the goals of the library. Goals of one C++ class library can differ substantially from those of another. Several techniques for constructing C++ class libraries have been discussed and documented, but no single construction technique satisfies the needs of all libraries. Stroustrup states that the driving requirements for a general C++ class library are correctness, flexibility, efficiency, extensibility, portability, consistency, completeness and ease of use. Looking at such requirements, one would be hard pressed to disagree that all are essential for reusable software. Trade-offs must be made, however, once the importance of each of these requirements is analysed.

For example, one possible trade-off exists between portability and flexibility; another between extensibility and efficiency. Given that trade-offs exist and are input into the library design process, no one library is going to satisfy the needs of all C++ programmers. Understanding the kinds of trade-offs our potential library user makes is essential for making the correct trade-offs in our library design. For example, trading off efficiency for portability would not be the correct trade-off for a class library supporting real time systems development.

Writing a reusable C++ Class

Let's look at some of the issues facing the design and implementation of a reusable C++ class. I will drive our discussion by an example. The example uses the class `ReusableComponent`, which is the basis for a hypothetical software tool that maintains reusable components. The example is radically simplified. Figure 1 is a typical first cut at writing an extensible reusable C++ class. The class designer has correctly added a default constructor, copy constructor and assignment operator. Because the class is intended to be extensible, the destructor has been specified to be virtual.

Besides accessors and boiler-plate member functions, the hardest question of all is what should the interface be? This is the primary challenge in building a reusable C++ class. The only workable method is to have a very good understanding of the domain that the class models and implements. Typically, a class undergoes several iterations before it is considered usable by the domain experts. However, once a class is used, it is very difficult both for the implementors and the users to deal

```
class ReusableComponent {
 char* _name;  char* _description;
               char* _author;

public:

ReusableComponent ( char* n, char* d,
                            char* a);
ReusableComponent
  (const ReusableComponent&);
ReusableComponent ();
ReusableComponent& operator =
  (constReusableComponent&);
virtual ~ReusableComponent ();

virtual char* name ();
virtual char* description ();
virtual char* author ();

virtual void install ();
virtual void retrieve () const;
virtual bool_t query (char *s) const;

}
```

Figure 1 - An extensible reusable class

with a change to the interface. This problem will be discussed later in the article.

If classes require several iterations to get right, how can commercial class libraries exist? To date, most libraries are well understood domains in software engineering, such as low-level components. As the class library commercial market heats up, it will be a great challenge to provide off-the-shelf domain-specific class libraries that are usable in the first version.

`ReusableComponent` has been designed with extensibility in mind, hence the heavy use of virtual functions. The first question to ask is whether there can be objects of this class type, or only objects of classes derived from this class? Only the class designer knows the answer. The class is intended to be an abstract specification for other more specific classes. Therefore it should be explicitly made abstract. This is done by making one or more of the virtual member functions pure, as shown in the line below. Once done, the class cannot be instantiated.

```
// pure virtual function
virtual void install () = 0;
```

Another question we can ask is, what part of the interface should be virtual? This is another very difficult question for class implementors, and is yet another reason why building reusable C++ classes is so difficult. C++ forces a class implementor to decide which member functions should support polymorphism, where in other OO languages, all member functions (or methods as they be referred to) are polymorphic. One rough cut technique is to think about which member functions require different implementations in the derived classes. One may think that, for an abstract class, all member functions need to be implemented in the derived class. For `ReusableComponent` this is clearly not the case. The member functions name, description and author will not likely change in a derived classes and should be made non-virtual. This not only makes the class more understandable from a design standpoint, but also improves the efficiency of the class and its children. Now lets shift the focus to the implementation. The internal implementation is based on three character strings.

```
char* name ();
char* description ();
char* author ();
```

The implementation for each of the member functions will need to access and setup C string representations. Is there a more robust implementation? Yes, use a reusable low-level components library. It is less work and there is much less chance of having bugs in our implementation for the simple reason of having less code. In Figure 2 `ReusableComponent` uses the RogueWave `RWCString` class which is included in tools.h++.

```
class ReusableComponent {

RWCString _name;
RWCString _description;
RWCString _author;

public:

ReusableComponent (
  RWCString n,
  RWCString d,
  RWCString a);
ReusableComponent
  (constReusableComponent&);
ReusableComponent ();
ReusableComponent& operator =
  (constReusableComponent&);
virtual ~ReusableComponent ();

RWCString name ();
RWCString description ();
RWCString author();

virtual void install () = 0;
virtual void retrieve () const = 0;
virtual bool_t query
  (RWCString s)const = 0;
};
```

Figure 2 - The ReusableComponent class

Inline folly

We looked briefly at robustness, what about efficiency? There are clearly some places where inline functions could be used to improve the efficiency of the class. Certainly anything that is a one liner and is not recursive is a candidate. Be aware of the trade-offs with inline functions, however. Using inline functions can, in some situations, radically increase the overall size of the program. Another problem with inline functions is they can result in quite a few time-consuming program rebuilds which can radically decrease the performance of a development team. I have heard of cases where a development organization avoided inline functions due to frequent and long program rebuild times.

We also can pass `RWCString` arguments as `const` references instead of by value. This is a good practice in most but not all situations (see Figure 3). Looking at this example, we can make some member functions `inline`.

What about the usability of the class interface? One thing to notice about `ReusableComponent` is that the user is required to understand the `RWCString` class in order to understand the member functions `name`, `description` and `author`. One important design rule is to minimize coupling between two unrelated classes. As there is an automatic conversion between `char*` and `RWCString` closer inspection of the `RWCString` classes indicates a class cast operator which converts an `RWCString` to a `const char*`. Given this, we can have `name`, `description` and `author` return `const char*` values.

```
ReusableComponent (
  const RWCString& n,
  const RWCString& d,
  const RWCString& a):
                _name (n),
                _description (d),
                _author (a)

ReusableComponent
  (constReusableComponent& r):
  _name(r._name),
  _description(r._description),
  _author(r.author) {}

ReusableComponent () {}
ReusableComponent& operator=
  (const ReusableComponent& r) {
  _name = r._name;
  _description = r._description;
  _author = r.author;}
}

virtual ~ReusableComponent () {}

RWCString name () {return _name;}
RWCString description ()
  {return _description;}
RWCString author () {return _author;}
```

Figure 3 - All these member functions can be made inline

```
const char* name ()
  {return (const char*)_name;}
const char* description ()
  {return (const char*)_description;}
const char* author ()
  {(const char*)_author;}
```

By doing this we have increased the localized meaning (reduced coupling), thereby simplifying the interface to `ReusableComponent`. For the purpose of this article, the final version of the `ReusableComponent` class is the one in Figure 4.

Name pollution

One high-level factor is how our class and corresponding class library will coexist with other class libraries. There are two important considerations to take into account.

A name clash is a situation that takes place when one class library conflicts with a class name defined in another library. Anyone who has used C++ for a while has seen name clashes between two `Object` classes. There are short-term and long-term solutions to this problem. In the short term, we can name our classes such that they won't conflict. In our `ReusableComponent` example, RogueWave uses RW as a prefix for its classes. This is to avoid the name clash problem. The long term solution, we don't have to worry about. This problem is being addressed by a new C++ language feature called namespaces (see the article *Keywords, old and new* in EXE, February 1995). Here is an example of using the namespace language feature to differentiate between two `Object` classes.

```
Library1::Object object1;
Library2::Object object2;
```

Who clears garbage?

Another important issue is resource management, notably memory management. If a class library implements a particular memory management technique, such as garbage collection, it will not integrate well with another which implements manual memory management techniques. Even if the two libraries can technically exist together, users will be hopelessly confused as to what they have to free manually and what they don't.

Exception to exceptions

Finally, there is the subject of using new language features. One that comes to mind immediately is exception handing, a wonderful feature that will provide some standardization across multiple class libraries in terms of error handling. However, this feature is not yet implemented in a coherent way by all compilers. Also many developers are still struggling to come to grip with it. Given this situation, a class that uses exception handling may not be all that useable to someone who doesn't have access to a C++ compiler supporting this feature. Before choosing our language set, we should be aware of which compiler(s) our end user is likely to have access to.

```
class ReusableComponent {
RWCString _name;
RWCString _description;
RWCString _author;
public:
ReusableComponent (
 const RWCString& n,
 const RWCString& d,
 const RWCString& a) :
                  _name (n),
                  _description (d),
                  _author (a) {}
ReusableComponent
 (const ReusableComponent& r):
 _name(r._name),
 _description(r._description),
 _author(r._author) {}
ReusableComponent () {}
ReusableComponent& operator =
 (constReusableComponent& r) {
 _name = r._name;
 _description = r._description;
 _author = r._author;
}
virtual ~ReusableComponent () {}
const char* name ()
 {return (const char*)_name;}
const char* description ()
 {return
                  (const char*)_description;}
const char* author ()
 {return (constchar*)_author;}
virtual void install () = 0;
virtual void retrieve () const = 0;
virtual bool_t query (const RWCString&s) const =0;
```

Figure 4 - The final version of Reusable Component

Testing times

Testing reusable classes can be a more difficult task than testing a software program. Typically a reusable class library has significantly more interfaces than a software program. All of these must be tested by writing specific tests to validate the functionality of the interface. This should be done as part of the design phase, as that is the best time to think about how the class can be tested. When the tests are run, an error checking tool should be utilized. Several exist today on both Unix and other development platforms.

Testing tools are of great value but don't replace the need to place significant emphasis on writing complete tests. One commercial tools supplier suggests that its tool assures a certain level of quality and has a logo that products can add to its packaging and advertisements indicating that the tool has been used. Beware! Quality can only be achieved by writing and executing quality tests. These tools enhance the usefulness of the tests in their ability to locate defects but do not ensure that the tests have been written or that they have been run.

Challenging change

I have identified several challenges in building a reusable C++ class. In some ways an even bigger challenge is maintaining one with a user base. Virtually any change to a C++ class interface can have an affect on a user. There are three types of change, ones that break link compatibility with a user, ones that break users source code (it won't compile) and changes that cause programs to execute differently. An example of the first is changing the input signature of a member function. An example of the second is changing a member function from non-virtual to virtual, or adding a new member function to a class interface. Entire articles have been written on this. Help the user! Be aware of these problems, even if we are our own user.

Not for the faint hearted

Writing reusable C++ classes is not a job for the novice. We must understand very well the domain that the class library is modeling, as well as the issues associated with using C++ as the implementation language. The good news is that there is now some experience to guide us. This article is radically simplified, but does offer advice on how to perform the very difficult task of writing reusable C++ classes. Good luck! ■

Dave Reed is chief technical officer at CenterLine Software. He can be reached at drr@centerline.com.

The second problem is more serious. While programmers were being exhorted more and more to think about the user interface, menus proliferated. Although the learning problem is now diminished, the documents sitting on a desktop are still passive objects which are acted upon by a limited palette of commands. There are certainly more commands, but they're nearly all stuffed into menus. Those which aren't are represented by dialogs.

Looking at my physical desk, I can see a number of devices which look like conventional machines. They have a control surface and a feedback mechanism with input and output. And the machinery is entirely hidden from me. These devices are things like the pop-up address book, the telephone and the calculator. These devices have an almost perfect analog on my computer desktop. But, most of the clutter is stuff which is not of that form. My paper doesn't have a control surface, neither does my pencil. Even the books and magazines I have don't work that way.

JAKE ABRAMS

Some objects on my desk, like the flashlight, the pressure gauge and the stereo viewer, are there because I can't find anywhere better for them to go.

And this is the reason why the desktop metaphor is so poor. On the screen, I can't build a pile of books and still find the one I want. I can't fold up pieces of paper and I can't make marginal notes on everything. I can't find a bit of information by context and I can't scribble notes quickly while I'm on the phone. Instead, on the screen, I'm presented with a series of display surfaces, with practically all the interaction controlled by commands. Before creating a display surface, I've got to specify what I'm going to do in the surface and why I'm doing it. The only thing I'm using the positional interaction for is to select a current display surface and to push buttons. There's got to be more to it than that!

A couple of years ago, there was an experiment to create a real virtual desktop. The desk was completely clear and images were projected onto it. The device tracked the user's hand. Menus were, of course, pretty useless in such an environment, so all the interaction was by direct manipulation. In other words, the paper didn't work like a machine, it worked like paper. And, it worked. Other experiments have shown that direct manipulation works and that users like it. Most virtual reality systems, which of course are all about direct manipulation, have very sparse menus, if any. Few games have menus and their interaction modes are far more complex than the average word processor. In spite of this, all the real development effort is directed towards the old-fashioned, modal interfaces. I think the reason for this is that programmers, faced with a classical problem, think about the user-interaction in the same way they think about their own problems. Solutions are phrased in terms of commands because practically all programming languages are phrased that way too.

The ultimate expression of the command, I suppose, is the program. When you invoke a program, even through an embedding command, you're saying what kind of information you want to work with and how you want to work with it. You're deciding, before you create a single line of data, how the data is going to be used and what it's going to be associated with. The reason that the enormous, do-everything programs are proliferating is that in selecting one of these programs you're prejudicing your choices as little as possible.

But, when I pick up my pencil, I'm not prejudicing those choices at all. Apart from its compact footprint and its cheapness, the pencil has two supreme technical advantages over practically all other tools. It can make a mark which can mean anything at all and it can be erased. The reason the desktop metaphor is incomplete is that nobody left space for a pencil.

Of course, the computer allows you to make a mark on the screen and any decent program will allow you to erase it again, but this isn't quite the same thing. When you make a mark on a computer screen, you have to say at the time what the mark means. For example, in a drawing program, you have to select the draw tool or the cut tool, before you can make the mark. All that is needed is to be able to make the mark first and then specify what it means. For example, when you take notes, you subsequently draw around an area and say 'this is a map' or 'this is the price'. To erase something, instead of locating the trash can, it should be sufficient just to sweep the object off the screen.

Ultimately, that's the thing that's missing in the desktop metaphor: the immediacy. Computers are useful because they force the user to think his problem through. But the user suffers because they force him to think it through before he starts work. ■

If you phone Jules on 01707 644185, he will probably be able to find one of the phones hanging on the wall. If you email him as jules@cix, he will find it on his screen. Either way, he can't ignore you.

The reason the desktop metaphor is incomplete is that nobody left space for a pencil.

Let the games begin

As the 27 competitors line up for the start of the first EXE Software Developers' Challenge, do they really know what lies ahead of them? **Cliff Saran** reports from the trackside.

'I program on my own so I don't have anyone to argue with,' said a mildly confident Bruce Lomasky the day before the EXE Software Developer's Challenge. On Wednesday, 7th February he demonstrated both his personal strength and that of Magic, his chosen development tool by taking first place in the competition. What made his achievement all the more amazing was that he was the only competitor to complete the challenge fully. Perhaps this man from Connecticut with a passing resemblance to Chevy Chase, knew something the others didn't.

At the start line

The competition was an eight hour programming marathon. 14 teams had enrolled for the competition, 13 of which were teams of two. The 14th, of course, was Bruce Lomasky. At 8.00 am the race commenced. In their little cubicles, the teams would have until 4.00 o'clock to complete the spec. Cans of fizzy drink, packets of cookies, chocolate bars, all the *extras* real programmers need were arranged neatly on the desks. Some teams had a mascot. Others brought in mementoes of glories past or pictures of loved ones. Even a pair of hi-fi speakers and a stack of CDs was spotted. In the true spirit of competition this was going to be a fun event, even if, at the end of the day, there would have to be an overall winner.

The challenge...

There was a serious side to the competition too. All the talent gathered in those cubicles would be put to good use. The teams were not only developing an application, they were developing an application for a good cause. The beneficiary of the challenge would be the RNIB. David Biggins of Rhea Laboratories worked closely with Steve Pear, IT manager for the RNIB, to develop the specification for a real-life application that would prove challenging to the competitors yet still remain within the bounds of possibility.

Tough enough for Bruce Lomasky

The final spec formed part of a payroll giving scheme whereby employees can chose to have regular amounts deducted from their pay and passed onto their designated charities. The donation is deducted from the employees gross pay and handed to an agency once a month. The teams had to develop a section of the application which took an electronic statement of donations for a given month from the agency for further processing at the RNIB. The system had to be multi-user and provide a facility for manual input of information if an agency could not provide statements on diskette. A further requirement was for querying the donations database.

Tooling up

The mix of development tools the competitors chose to use ranged from the well established to the new and even the unreleased. At the low cost end of the spectrum Microsoft's team worked in Visual FoxPro. And Dunstan Thomas, sponsored by Borland used Delphi. At the time of the

Position	Team	From	RAD tool
1	Bruce Lomasky	Magic	Magic
2	Alistair Ramsey/Ian Sharp	Dunstan Thomas	Borland Delphi
3	Meni Gani/Alex Skorohod	Pilat	Magic
4	Mike Peat/Tim Pickard	Unicorn Business Solutions	Data Access DataFlex
5	Nigel Edwards Paul Hampson	Developer Services	Magic
6	Roy Corneleous Chris Sennitt	Rhino Publishing	CA Visual Objects
7	Paul Jackson Narayan Laksham	Symantec	Symantec Enterprise Developer
8	Matthew Linden David Taylor	Unique	Unique 4GL
9	Julian Lawson Jason Morris	Quidnunc	MS Visual Basic/Access
10	Andrew Heys/Karen Oultan	IBM	IBM VisualAge
11	John Cuthbert/Steve Wallis	BPS Dataline	Gupta SQL Windows
12	Steve Butler David Cattanach	Microsoft	MS Visual FoxPro
13	Dave Ashenhurst/ Chris Rice	Intersolv	Intersolv APS for Client/Sever
14	Ian Davis/Steve Mills	TI Information Engineering	Composer by IEF

A smiling Meni Gani and Alex Skorohod took third

competition both these tools were unreleased. Quidnunc chose the other MS database development tools, VB and Access. CA and Symantec entered the competition with relatively new tool to the RAD market. Rhino Publishing, sponsored by CA, went for Visual Objects. Symantec's own team used C++ and Enterprise Developer. IBM had arguably the only pure object oriented tool with VisualAge, a version of Smalltalk. Dataflex was present, courtesy of Unicorn which was sponsored by Data Access. Three teams entered with Magic. The team from Unique used... Unique 4GL. Intersolv went in with a combination of APS, PVCS and Q+E. BPS Dataline worked in SQLWindows and Texas Instruments chose Oracle 7 with Composer from IEF.

Steve Pear said the RNIB was impressed at both the level of commitment and the quality of the work by all the teams that took part in the EXE Developer's Challenge. 'The winning piece of software will be introduced within the RNIB as early as possible,' he commented. The RNIB explained that the software will help provide more funds for the charity in order to aid some of the one million blind and partially sighted people lead independent lives.

The winners

Bruce Lomasky using Magic was the clear winner. Second place went to Dunstan Thomas which used Borland Delphi. Third place was taken by another Magic team. This time it was Pilat Ltd. Before the competition Bruce predicted two out of the three places would be taken by teams using Magic. The reason? 'What we do very well is RAD,' he replied.

Bruce felt the challenge had 'enough tough stuff' to show the strengths and weaknesses of the tools. But it was not only the development tool that was being pushed. He estimated the overall result was a combination of the skill of the team and that of the tool: 'part person, part tool. About 50/50.'

He had already explained his unusual decision to work on his own. But there was more to come. 'Two people are not necessarily twice as efficient. It is like synchronised swimming. You have to communicate well together.' Working by himself, explained Bruce, had the advantage that there was no one else to argue with. The only time he felt he was at a disadvantage was when it came to writing up the documentation.

A little advice...

Bruce has won the US competition for Magic twice during the last three years. He had come to the UK to win the competition.

PHOTOGRAPHS BY ROMA ALLIOTT OF RHEA LABORATORIES

Guy Martin of Borland with runners up Alistair Ramsey and Ian Sharp

Judith Hann lends a hand on the EXE stand with the hands

And he did just that. What was his tips for success in these types of competition? 'I didn't come in with a lot prepared,' he replied. 'But the most important thing to remember is read the spec, design to it and set out a time management schedule to the hour. Also, leave time for QA.' During the competition explained Bruce, he had planned to end at 3.00 pm. He felt comfortable with an hour of lee-way.

Unusually, he had some advice for team players: 'Decide ahead of time who will do what.' And of, course it helps to be prepared, especially when there is more than one in the team so he recommends, 'practice beforehand'. And as one programmer to another he advises of course to 'drink plenty of soda, coffee and have lots of sugar.'

During the award ceremony at the end of the day Bruce, showing true sportsmanship offered runners up, Alistair Ramsey and Ian Sharp of Dunstan Thomas, the first prize, a trip to the US to compete in the developer's competition over there. 'If they [Magic] want me back here next year, I'll come,' he added. And we look forward to seeing you, Bruce...

Try for yourself

Now the 14 teams that entered the competition this year had eight hours to complete the application and a further two hours to write the documentation. If you would like to try it for yourself you can obtain the RNIB spec from EXE's office by sending a SAE and diskette to EXE magazine, 50 Poland Street, London W1V 4AX. Please mark envelopes 'RNIB'. ■

OO not always the best

C++ is not only the realm of true OOP, it can be used efficiently as a traditional language with encapsulation as an added benefit. **Francis Glassborow** shows the advantage of such a method.

The very strength of C++ is that it has good support for OOP, as well as just about every other approach in current use. Using C++ will not force you into an object-oriented view of problems, nor should it. To a large extent your problem solving approach is orthogonal to the language. It is true that some classes of problem solving such as those supported by Prolog are not well suited to the tools available in C++ but you still have a very wide range of choice. On the other hand, unless you understand the fundamentals of the method you wish to use, your C++ code will be just as monstrous as the worst examples of spaghetti-code in a classic Basic.

In this column I will take a brief look at simple non-object oriented use of C++. This is sometimes called 'C++ as a better C' though that phrase causes palpitations among some C purists.

Relative to assembler

One thing that some of us learn early is the benefits gained from localising effects and encapsulating functionality. I was writing my assembler code that way almost from day one. Having to do hand assembly provides an excellent motive to this end. Relative branches have to be calculated by hand, so any code change effects all branches that jump over it.

Having a mind set that naturally seeks these objectives is, I think, a prerequisite for writing good code. Having a language that supports such styles is a great asset. There is no doubt that C can be used very effectively to localise effects and encapsulate functionality. Even so, it is hard to make these intentions clear to those that use, develop or maintain your code. This is a problem even if only one person is involved in all these phases.

No OO

Let's look at a very simple problem. I want to write one of those programs so beloved by novices and amateur enthusiasts, a simple database of names and telephone numbers. I have chosen this problem because it is simple, will probably require development and maintenance and not least, because the object oriented fans among you will instinctively jump in with an OO solution. It is my contention that in the context of the problem as specified, OO techniques are overkill.

Like the full OO solution, there is too much pain for too little gain

The solution to this problem is clearly made up of three parts. The first consists of implementing mechanisms to handle single combinations of name and telephone number (a record). The second part is implementing mechanisms to handle a collection of such records. And the final part is writing the actual client code. Of course this last part may result in other work such as developing menus but the real client code is intended to be problem specific and I would not wish to waste time refining it for reuse.

The C way

In C, I would set about developing a file to implement the concept of a record via a `struct` and associated functions. Sensible use of `static` allows me to restrict housekeeping and support functions just to this file. If I want to hide the data I will have to complicate my program by working through pointers with `malloc` and `free` for creation and removal of storage.

At this stage, even those with only a very rudimentary knowledge of C++ will recog-

```
#ifndef RECORD_H
#define RECORD_H
#include <iostream.h>
#include <string.h>
class Record {
  enum {NAME_LEN=25, PHONE_LEN=20};
  char name_s[NAME_LEN+1];
  char phone_number[PHONE_LEN+1];
     // treat telephone numbers
     // as strings
public:
// use default constructor,
// copy constructor,
// assignment and destructor
void name(const char *);
// write a name
const char * name()const
  {return name_s;}     // read a name
void telephone(const char *);
const char * telephone()const
  { return phone_number;}
void update(const char * n,
            const char * t)
{
  name(n); telephone(t);
}
void printon(ostream &) const;
void readfrom(istream &);
};

inline ostream & operator <<
(
  ostream & out, const Record & r
){
  r.printon(out);
  return out;
}

inline istream & operator >>
(
  istream & in, Record & r
) {
  r.readfrom(in);
  return in;
}
#endif
```

Figure 1 - RECORD.H, the header file

```
#include "record.h"

void Record::name(const char * new_name){
    strncpy(name_s, new_name, NAME_LEN);
    name_s[NAME_LEN]=0;
       // ensure ASCII nul termination
    return;
}

void Record::telephone(const char * new_number){
    strncpy(phone_number, new_number, PHONE_LEN);
    phone_number[PHONE_LEN]=0;
    return;
} ;

void Record::printon( ostream & out)const{
    out<<name_s << ", "<<phone_number;
    return ;
}
// The following function assumes that the data for input is in the
// same format as that for output. No validation is done.
void Record::readfrom(istream & in){
    char buffer[250];
    in.getline(buffer,250,',');
    name(buffer);
    in.get();       // discard next character, should be a space
    in.getline(buffer,250,'\n');
    telephone(buffer);
    return;
    }
```

Figure 2 - RECORD.CPP, the implementation file

```
#ifndef DATABASE_H
#define DATABASE_H
#include "record.h"
class Database {
    enum{MAX_ENTRIES=100, NOT_FOUND=-1};
    Record list[MAX_ENTRIES];   // store up to 100 records
    int count;
    void operator = (Database &); // inhibit assignment
    Database (const Database &);  // and copying
public:
    // use default destructor
   Database():count(0) { }
    void sort_by_number();
    void sort_by_name();
    int record( const Record &)const;     // return index
    void record (int index, const Record &);   // change a record
    void record (int index, istream &);    // get a record from a stream
    void record (int index, ostream &)const;    // write out a record
    int find_teleno(const char *)const;    // get index given number
    int find_name(const char *)const;    // ditto for name
    void listall(ostream &) const;
    Record & getrecord(int index){ return list[index]; }
       // note that this function needs work to validate index
};
#endif
```

Figure 3 - DATABASE.H encapsulates functionality

```
#include "record.h"

void Record::name(const char * new_name){
    strncpy(name_s, new_name, NAME_LEN);
    name_s[NAME_LEN]=0;                // ensure ASCII nul termination
    return;
}

void Record::telephone(const char * new_number){
    strncpy(phone_number, new_number, PHONE_LEN);
    phone_number[PHONE_LEN]=0;
    return;
} ;

void Record::printon( ostream & out)const{
    out<<name_s << ", "<<phone_number;
    return ;
}
// The following function assumes that the data for input is in
// the same format as that for output. No validation is done.
void Record::readfrom(istream & in){
    char buffer[250];
    in.getline(buffer,250,',');
    name(buffer);
    in.get();                  // discard next character, should be a space
    in.getline(buffer,250,'\n');
    telephone(buffer);
    return;
    }
```

Figure 4 - DATABASE.CPP localises the code

nise that this file is simply emulating a class. In C, I have to use a file if I want private data and functions. These contortions are necessary since C does not provide direct support for encapsulating data and functionality into larger packages. The only way is via the file mechanism. It's quite an instructive exercise to write this C code because it will give you a better grasp of the C++ concept of class along with its constructors and destructors.

In C++, I would provide a header file (see Figure 1) for inclusion by code that needs to know about records. I would also write an implementation file (see Figure 2) which is where the work can be localised. In other words C++ provides me with the tools to express my intentions and localise implementation code.

Collection cornocopia

The second part of the project can also be done in C by using a file to provide the database structure. However, note that the writer of this file must have a good understanding about how a record works. If I want to hide data by using indirection and access functions, then the database file will have to create some form of container for pointers to record. Each of the containers will have to be initialised by calling a *constructor function* and capturing the pointer it will have to return. The container will also have to be dismembered, at the end, via a call to a *destructor function*. This might be done by a design incorporating a special function registered to `atexit()`.

Of course, to support multiple instances of the container, even more work will need to be done. It doesn't take much experience to realise that this careful implementation for possible extension and reuse will almost certainly be avoided in practice because, like the full OO solution, there is too much pain for too little gain.

Now, note how easy it is to provide a database class in C++. Just like my record class, two simple files (see Figures 3 and 4) localise code and encapsulate functionality. It is so easy that once you know what tools are available you can hardly *avoid* using them. Of course you still have design decisions to make: whether your database is of fixed size, how it should be searched, if and how it should be sorted and so on. Decisions about record design, functionality and implementation are strictly contained in the `RECORD.H` and `RECORD.CPP` files. In the same manner the equivalent parts of the database design and implementation are contained in the `DATABASE.H` and `DATABASE.CPP` files.

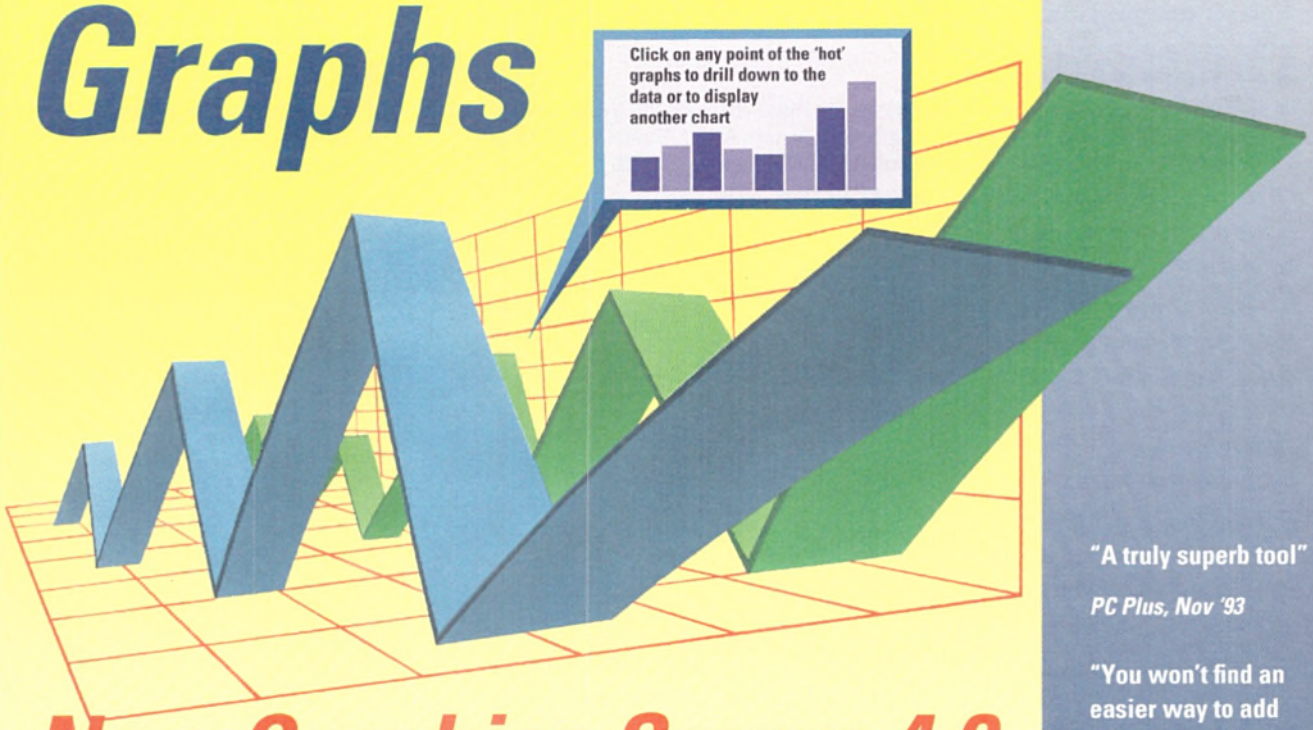
Key to success

Writing the client code to support my simple list of names and telephone numbers

Language

Visual C++
C/C++
SQLWindows
Visual Basic
Turbo Pascal
Powerbuilder
FoxPro
Windows4GL
Access

Programmable Graphs



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Shreaded threads

Dave Jewell, our intrepid explorer, 

having discovered last month 'the truth' about Windows 95 now strides into the murky waters of thread management.

As I mentioned last month, Windows programmers are going to find many new and exciting goodies in Windows 95. One of the most interesting and perhaps most challenging, is the new operating system's ability to run many simultaneous threads within one process. This article introduces threads for the benefit of existing Windows 3.1 developers. The material here should already be pretty familiar to NT programmers, as the API is essentially the same. There is one caveat that needs heavy emphasis before we weave into threadland: the thread APIs are only available to 32-bit clients.

Processes don't run

It's very important here to define our terms properly. The term *process* can be considered a fancy word for a single invocation of a particular program. If we fire up five different copies of the Windows clock, then we have five different processes. Notice that I didn't say 'five different processes running.' A process can't run because it doesn't execute code. Only a thread executes code. A process corresponds to the environment (code, data, resources and address space) in which one or more threads execute. A thread corresponds to a specific path of execution through that process.

When a new process is first created, Windows 95 creates an initial, default thread of execution. This thread can then create further threads as we shall see later. Each of these threads has full access to the process's global variables and address space. Newly created threads can themselves create further threads, and so on *ad infinitum*.

Windows 95 preemptively multi-tasks threads with respect to each other, both threads in the same process and threads in different processes. Windows NT supports SMP (symmetric multiprocessing). It is therefore able to assign different processors to different threads. If we run NT with a dual or quad Pentium configuration, then we can truly execute two or more paths of execution simultaneously. Windows 95 doesn't have this capability, so it time slices each thread through the one processor. Microsoft's documentation claims that the time slice is quite small, of the order of 20 ms. So from a human perspective, it is designed to give the illusion of several threads executing simultaneously.

Classic stitch up

One of the classic examples of thread usage is a large spreadsheet application. Big spreadsheets can take a long time to recalculate when a cell changes. Obviously this will be held up while the user is typing in the value of some cell. By using two threads within the spreadsheet process, we could have a thread that gets input from the user while another thread silently performs recalculations in the background. Of course, this assumes that the cell being edited won't affect the calculation. However, the best way of tackling this sort of job is probably to have at least three threads. One gets user input, one builds trees of dependencies and one performs calculations based on which trees are currently not blocked by the current cell edit.

Microsoft's SDK documentation gives an excellent example of an MDI style application which creates a thread for each new document window that is opened. Even something as mundane as an install program can greatly benefit from a threaded approach. If you've ever installed OS/2, you'll know that the OS/2 installer gulps down the contents of disks at a frightening speed while the installation itself proceeds at a more normal rate. Presumably, one thread is responsible for reading disks into memory while another performs decompression and writing to the hard disk.

Basic anatomy

As mentioned earlier, when a process is first created, it gets an initial thread, usually referred to as the primary thread. This primary thread can then call the `CreateThread` API to create one or more new threads. Here's what the `CreateThread` API looks like.

```
WINBASEAPI HANDLE WINAPI
CreateThread (
    LPSECURITY_ATTRIBUTES
      lpThreadAttributes,
    DWORD dwStackSize,
    LPTHREAD_START_ROUTINE
      lpStartAddress,
    LPVOID lpParameter,
    DWORD dwCreationFlags,
    LPDWORD lpThreadId
    );
```

The first parameter points to a `SECURITY_ATTRIBUTES` structure which is

```
// Routine to insert the element
// 'NewElement' after 'Pos'

void InsertAfter
(
  PNODE Pos,
  PNODE NewElement
)
{
  // enter critical section
  EnterCriticalSection (&ListBlocker);
  NewElement->next = Pos->next;
  NewElement->last = Pos;
  Pos-next->last = NewElement;
  Pos-next = NewElement;
  LeaveCriticalSection (&ListBlocker);
}
```

Figure 1 - Protecting updates to a linked list in the critical section

used in several other places in the Win32 API. If you pass `NULL` for this parameter, then the thread is created with a default security descriptor. The next parameter, `dwStack`, defines the amount of stack space that's initially allocated for the thread. Again, it is possible to adopt a 'don't care' approach and pass 0. In this case, the thread gets the same size stack as the primary thread.

The third parameter points to the application-specified code that gets executed by the thread. Windows will `CALL` this address when the thread starts executing. Consequently, any work that the thread needs to do should be structured as a procedure. This is a thread function that loops around until it receives some indication that it is to die. At this point, the thread function should return in the normal way and Windows will then terminate the thread. Obviously, the function is at liberty to call other routines and API calls, including creating threads of its own. Equally obvious, we will often want to create multiple threads that all have the same `lpStartAddress`. Our hypothetical MDI application is a case in point. Each window's thread will be executing exactly the same thread function. A thread function must have a prototype that looks something like this:

```
DWORD MyThreadFunction
(
  LPVOID lpParam
)
{
  DWORD dwResult;
  // Perform thread-specific
  // initialisation here...
  while (ok-to-keep-going)
  {
   // Do the real work here..
  }
  // Thread-specific cleanup
  return (dwResult);
}
```

The `lpParam` parameter can really be used for anything we like. It corresponds to the `lpParameter` routine in the call to `CreateThread`. It is often used to provide initialisation information to the thread. For example, an MDI program might create a thread for a new document window and pass a pointer to a document file name via this parameter. The thread would then be responsible for loading the document, creating the window and so forth. Alternatively, the window could be created and initialised before calling `CreateThread`, passing the window handle as `lpParameter`.

The next parameter to `CreateThread` is `dwCreationFlags` which can be set to either zero or `CREATE_SUSPENDED`. If the former, then the thread begins executing as soon as it is created. Setting the parameter to `CREATE_SUSPENDED` will create the thread in an initially suspended state. It won't begin executing until a `ResumeThread` API call has been issued. `lpThreadID`, the final parameter, is a pointer to a `DWORD` variable which receives a thread ID on successful completion of the call. Each thread has an associated handle and ID. The handle is returned as `CreateThread`'s function result.

We must take great care when passing a value of 0 for `dwCreationFlags`. Not only can the thread start executing as soon as it is created, but if we port the code to Windows NT, the thread can possibly even be running before the `CreateThread` routine returns to its caller! This can pose potential synchronisation problems if we are not careful.

Death of a thread.....

Having looked at how threads come into being, let's look at how they are destroyed. Essentially, there are three different ways in which a thread can become an ex-thread. We have already looked at the first one. When the thread function returns, the thread is automatically terminated and any stack space allocated to the thread is destroyed. Second, a thread can ritually disembowel itself if the circumstances seem appropriate. This is done simply through a call to `ExitThread`. The function prototype for `ExitThread` is given below:

```
WINBASEAPI VOID
WINAPI ExitThread
(
  DWORD dwExitCode
);
```

```
typedef struct _RTL_CRITICAL_SECTION
{
  PRTL_CRITICAL_SECTION_DEBUG DebugInfo;

  // The following three fields control
  // entering and exiting the critical
  // section for the resource

  LONG LockCount;
  LONG RecursionCount;
  // OwningThread from the thread's
  // ClientId-UniqueThread
  HANDLE OwningThread;
  HANDLE LockSemaphore;
  DWORD Reserved;
} RTL_CRITICAL_SECTION,
  *PRTL_CRITICAL_SECTION;
```

Figure 2 - Critical section data structure

The `dwExitCode` parameter specifies the exit code with which the thread is terminated. A thread will never return from a call to this function. It is expected that a thread will be terminated either by calling `ExitThread` or through returning from the thread function. However, it is also possible for a thread to be terminated from another thread, by calling `TerminateThread`. Here is what this routine looks like:

```
WINBASEAPI BOOL
TerminateThread
(
  HANDLE  hThread,
  DWORD  dwExitCode
);
```

The first parameter is the thread handle which was returned from the initial call to `CreateThread` while the second parameter is again used to set the thread exit code. This particular API call tends to be discouraged. It should really be used only in emergencies when we want to terminate a thread that is no longer responding properly. We can't terminate an arbitrary thread, but only those threads for which we have `THREAD_TERMINATE` access.

Handling identification

Suppose we were writing an MDI program as mentioned earlier, with a separate thread for each document window. There will obviously be times when a thread needs to know which thread it is. The caller of the `CreateThread` API gets back a thread ID, but this information isn't immediately available to the thread itself and nor is the thread handle. The solution is to call either the `GetCurrentThread` or `GetCurrentThreadId` routines. These return a thread handle and thread ID respectively. The thread handle returned by the `GetCurrentThread` call is a pseudohandle. For an explanation see the separate box.

Don't disturb

Threads make life easier (or at least, a little more responsive) for the end user, but there is no guarantee that they'll do the same for the programmer! There are quite a number of little gotchas associated with the development of a sophisticated, multi-threaded application. Last month, I mentioned the problems inherent in managing linked lists in a preemptive environment. Imagine one thread coming along and manipulating a linked list while another (preempted) thread was part way through putting the list back together. Not good...

To solve this problem, the Win32 API introduces the idea of a critical section. This is a block of code which requires exclusive ac-

cess to some important shared data. The implication is that if more than one thread accessed this data at the same time, things would go badly wrong. Here's how we would use a critical section in your application:

```
// critical section for
// double-linked list
CRITICAL_SECTION ListBlocker;
// initialise the critical
// section
InitializeCriticalSection
(
  &ListBlocker
);
```

This declares a critical section global variable and then initialises it. It is important that we don't forget the initialisation call. This code will typically be called by the primary thread before creating any threads that make use of the critical section. Having set up our critical section, Figure 1 shows how a thread would use it.

When a thread calls `EnterCriticalSection`, Windows checks to see if another thread already 'owns' the critical section. If so, the thread that wants ownership is blocked until the owning thread relinquishes control. From the viewpoint of the blocked thread, no delay has taken place since the blocking takes place inside the `EnterCriticalSection` call. This technique is far preferable to the commonly used practice of 'spinning' on a shared data flag until the flag indicates that the way is clear. In terms of efficiency, it is much better to put waiting threads to sleep rather than have them needlessly eating up CPU cycles.

Strictly speaking, the `EnterCriticalSection` API doesn't really need to be called until after the assignment to `NewElement->last`. It's at this point that the integrity of the doubley-linked list is (temporarily) threatened. For obvious reasons, we should minimise the amount of code between entering and leaving a critical section so that other threads are blocked for the minimum possible amount of time.

Note that there is no explicit connection between the `ListBlocker` critical section and the doubley-linked list. It is up to us as application programmers to decide what shared data we want to protect through a particular critical section. Again, it is better to use a separate critical section for each possible shared data conflict (rather than using one to take care of everything) since blocking will thus be minimised.

Finally, bear in mind that the `InitializeCriticalSection` call needs to be balanced by a call to `DeleteCriticalSection` once we have finished with the critical section itself. Typically, this would be done in the primary thread once any subsidiary threads have terminated. The reason we need to call `DeleteCriticalSection` is for the same reason that those `CloseHandle` calls are important. The Win32 API allocates more behind the scenes than some might think. Just to prove the point, Figure 2 lists the definition for the `CRITICAL SECTION` data structure.

```
//-------------------------------------------------------------
//  Name:       MsgCreate
//  Purpose:    Called in response to WM_CREATE for the
//              main application window.
//-------------------------------------------------------------
LRESULT MsgCreate (HWND hwnd, UINT uMessage,
      WPARAM wparam, LPARAM lparam)
{
    int i;
    HDC hdc;
    WNDCLASS wc;
    TEXTMETRIC tm;
    char szChildClass[9];
    void *lpfnThread[4] = { CountThread, GCDThread,
         PrimeThread, RectThread };
    hdc = GetDC (hwnd);
    GetTextMetrics (hdc, &tm);
    cyChar = tm.tmHeight;
    cxChar = tm.tmAveCharWidth;
    ReleaseDC (hwnd, hdc);
    // Register child window class
    LoadString (hInst, IDS_THREADCHILD, szChildClass, 9);
    // Set the class name and the window proc
    wc.lpszClassName = szChildClass;
    wc.style         = CS_HREDRAW | CS_VREDRAW;
    wc.cbClsExtra    = 0;
    wc.cbWndExtra    = 0;
    wc.hInstance     = hInst;
    wc.hIcon         = NULL;
    wc.hCursor       = LoadCursor(NULL, IDC_ARROW);
    wc.hbrBackground = (HBRUSH)(COLOR_WINDOW + 1);
    wc.lpszMenuName  = NULL;
    wc.lpfnWndProc   = DefWindowProc;
    // Register the child windows
    RegisterClass(&wc);
    // Create the child windows
    for (i = 0; i <4; i++)
    {
        // Create the child window and stash handles
        ThreadInfo[i].hwnd = CreateWindow (
    szChildClass, NULL,
    WS_CHILDWINDOW | WS_BORDER | WS_VISIBLE,
                0, 0, 0, 0, hwnd, (HMENU) i, hInst, NULL);
  // Kick off the thread
  ThreadInfo[i].bThreadState = TRUE;
       _beginthread (lpfnThread[i], 0, &ThreadInfo [i]);
    }

    return 0;
}
//-------------------------------------------------------------
//  Name:       RectThread
//  Purpose:    This thread draws random rectangles into
//              its  child window.
//-------------------------------------------------------------
void RectThread (LPTHREADINFO lpInfo)
{
    HDC hdc;
    HWND hwnd;
    RECT rClient;
    HBRUSH hBrush;
    BYTE nRed, nGreen, nBlue;
    int nLeft, nRight, nTop, nBottom;
    while (lpInfo->bThreadState)
    {
        hwnd = lpInfo->hwnd;
  GetClientRect (hwnd, &rClient);
       // Make sure the coordinates of the child
       // window are valid - we could be minimized.
       // and we don't want to do a divide if the
       // coordinates are 0.
       if (rClient.right > 0 && rClient.bottom > 0)
       {
            // Establish size of rectangle
            nLeft   = rand() % rClient.right;
            nRight  = rand() % rClient.right;
            nTop    = rand() % rClient.bottom;
            nBottom = rand() % rClient.bottom;
            // Establish colour of the rectangle
            nRed    = rand() % 255;
            nBlue   = rand() % 255;
            nGreen  = rand() % 255;
            hdc = GetDC (hwnd);
            hBrush = CreateSolidBrush (
     RGB (nRed, nGreen, nBlue));
     // Do the business...
            SelectObject(hdc, hBrush);
            Rectangle (hdc, min(nLeft, nRight),
                        min(nTop, nBottom),
                        max(nLeft, nRight),
                        max(nLeft, nRight));
            ReleaseDC(hwnd, hdc);
            DeleteObject(hBrush);
       }

    }
    _endthread();
}
```

Figure 3 - Example of multi-threading

Uptown OODBMS

Having previously reviewed Poet, a low cost OODBMS, **Mary Hope** now discovers what a market leader has to offer.

Object Oriented Databases (OODBs) are in their infancy. Common approaches have yet to evolve. At the moment there are more differences than similarities between them. There is a lot of flag waving from rival camps yet no one has agreed upon a de facto standard for the underlying architecture. The two companies generally regarded as leading the field of OODBs are Object Store and Objectivity.

Object Store sees the first generation of the OODBMS as characterised by software dereferencing using smart pointers. This is regarded as having a number of drawbacks including speed and limiting compatibility of the language with C++, since it employs overloading of the '.' and '–' operators. It will come as no surprise to learn that Objectivity takes the smart pointers' approach. The second generation, according to Object Store, uses virtual memory. The data has the same layout in memory as on disk, so there is no dereferencing. Thus, it is claimed, the database is smaller, anything can be stored and the database is compatible with most languages.

However from the Objectivity perspective, things look very different. It takes issue with the stated disadvantages, pointing out that Objectivity/DB has a Smalltalk and SQL interface and can 'hold its own' in speed checks. It claims that some of the advantages of the dereferencing model are that you get integrity constraints and run time type checking that are not possible with direct memory addressing. The intermediate process of dereferencing introduces safeguards. While I cannot offer an informed evaluation of them, I can report that each viewpoint is put forward with great conviction!

Scaling up

Objectivity is a client server OOBDMS running on a large number of platforms including OSF/1, VMS, Windows NT etc. Unlike Poet, there is no scaled down development version that runs on a PC. There is a runtime version for systems developed on Windows NT. So getting Objectivity becomes an organisational rather than a personal commitment. It is designed for large databases on mixed platforms linked by LANs and WANs. The top level is a *federated database* which can contain up to 64k *databases*. Databases contain *containers* (up to 32k) and these contain basic *objects*.

Working up from the bottom, a basic object is anything from a basic type such as `int`, `float` or `char` to a pointer to a non persistent class or a reference to a persistent class. A container is a user defined unit that logically hangs together, such as a drawing or design. A database is self explanatory. A federated database is an administrative unit that contains the schemas for the database and configuration information. A federated database might span WANs.

What's in a definition

In essence there are three functions that an OOBDMS should offer. It should enable us to store data persistently, to search for it in various ways and to organise all of this to ensure integrity, security and concurrency. First we will look at how persistence is achieved. In Objectivity the class definitions go in a .DDL (data definition language) file which is similar to a standard header file except that persistence is achieved by deriving classes from the Objectivity class `ooObj` and Objectivity introduces some new types.

The .DDL file for a vehicle program is shown in Figure 1. In the `Vehicle` example there is a `uint32` and a `float32` type. We have to use these Objectivity/DB types if we want to index on the field for searches. There is, off course another argument for using them: it makes the database portable across different architectures. If we had used a string with memory dynamically allocated with `new` this would have to be replaced with a `ooVString` type. The definition includes the relationships that the class has with others. In this instance the class `vehicle` has a one to many relationship with the class `RentalFleet`. The `Car` class inherits this relationship.

The class methods are defined in the usual way in a file with a normal extension (ie .cxx in OSF/1). Additional files can make use of these classes. All of this is done in our normal C++ editor or environment. Having defined the classes and what they do, the Makefile is invoked. This needs to do all sorts of wonderful things. A simple view is that it takes the classes defined in the .DDL file(s) and adds them to a *schema* in the federated database. The schema defines all the persistent classes that can be used in the federated database. When the .DDL file goes through the .DDL processor it produces a header file and a supporting .cxx file. The header must be `#included` wherever we want to use the persistent

```
// vehicle.ddl
class RentalFleet : public ooObj {
private:
  char _location[24];
public:
  RentalFleet(char* location);
  char* GetLocation()
    { return _location; }
  // and define the associations
  ooHandle(Vehicle)
    hasVehicles[]<->inFleet;
};

class Vehicle:public ooObj {
private:
  uint32 _noOfWheels;
public:
  Vehicle(uint32 noOfWheels);
  uint32 GetNoOfWheels()
    {  return _noOfWheels; }
  // and the associations
  ooHandle(RentalFleet)
    inFleet<->hasVehicles[];
};

// and a derived class that
// inherits the association
class Car:public Vehicle {
private:
  uint16 _noOfPassengers;
public:
  Car( uint32 noOfWheels,
       uint16 noOfPassengers,);
  uint16 GetNoOfPassengers()
    {return _noOfPassengers; }
};
```

Figure 1 - .DDL file for a vehicle program

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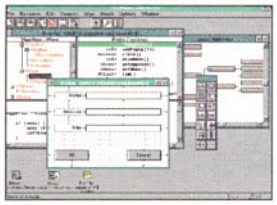

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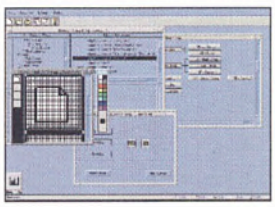

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queries and, in the absence of anything better, act as a poor man's SQL interface. In the query browser for the vehicle class, the query is set up in the bottom area and the results of that query appear in the top box. The syntax of the query can accomodate SQL's AND and OR or the C++ variants of && and ||. There is a great disparity between the ease of use of this and the many stages of setting up a query in C++.

Locking and concurrency

A client server database needs locking mechanisms and Objectivity/DB has a good range. All objects are in either read or update mode. The default tends to be read mode with the consequence that all methods making changes to values in a class have to change the mode of the object to update explicitly before making the change. As expected, changing into update mode puts a lock on the object. What we might not expect is that the granularity for locking is the container. So locking an object effectively locks the container of that object. Some nifty footwork is necessary to leave locking to the last possible moment and to change objects back to read access as soon as possible. The programmer can specify what the system should do if a lock cannot be granted, ie do not wait, wait forever or wait for a number of seconds. If we select the 'wait forever' option then Objectivity/DB checks to see if queuing would cause deadlock.

One way of improving concurrency is the *Multiple Readers One Writer* option.

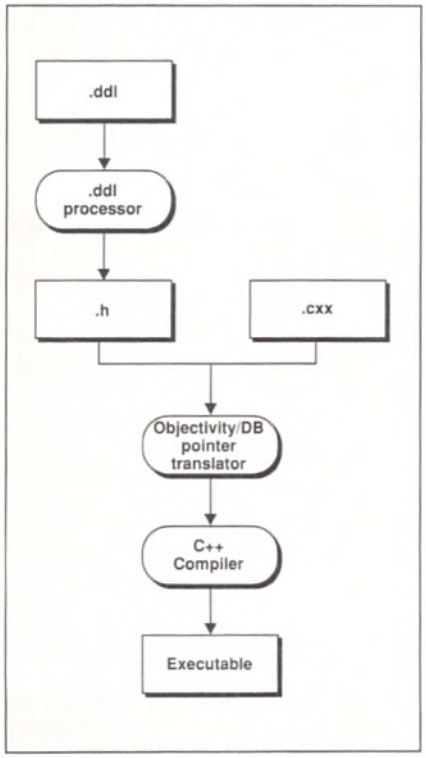

Figure 2 From DDL to final executable

```
'_noOfPassengers' thus
//create a key field for the Vehicle class
ooHandle(ooKeyDesc) mykey;
mykey = new ooKeyDesc (ooTypeN(Vehicle));
//specify the key field,
//ie numpassengers from the Vehicle class
ooHandle(ooKeyField) field1;
field1 = new ooKeyField(ooTypeN(Vehicle),
                                "_noOfPassengers");
//add this field to the key description
mykey-> addfield(field1);
// and then you can create the index
mykey-> createIndex(containerHandle);
//where containerHandle specifies
//the container for the index.
```

Figure 3 - Finding cars with more than three passengers

```
// create a ooLookupkey object and specify
//  that it will have 2 fields,
  ooLookupKey mylookupkey
  (
    OOType(Vehicle), 2
  );
// create the look up key fields and add
// them to the key
  ooGreaterThanLookupField passfield
  (
    ooType(Vehicle),
    "_noOfPassengers", 3
  );
  mylookupkey->addField(passfield);
  ooLessThanLookupField wheelfield
  (
    ooType(Vehicle),
    "_noOfWheels", 4
  );
  mylookupkey->addField(wheelfield);
```

Figure 4 - Combining boolean operators

Readers can look at the old version while another process updates it. Readers can ask whether the object has been updated and, if it has, get a 'refreshed' version.

Query the manual

While I was trying to determine how to perform queries in Objectivity/DB the shortcomings of the documentation became very much apparent. So, was it easy extracting the information regarding queries? In a nutshell, no. It is not just that this is a scaleable database requiring a lot of documentation (one lever arch file covering the customer training course and two hefty lever arch manuals). The difficulty is that it views using a database as an end in itself rather than as a means to an end. In other words it assumes that you want to know how to use features, such as strings, iterators and dictionaries rather than use the database to answer queries. For instance there is a section in one of the manuals called *Getting Started*. This takes you through defining classes, building and running an application and using some of the features. But you look for the term 'query' in vain. How you find the object(s) meeting some simple criteria, such as the name 'John Smith', is buried deep in there somewhere.

More hopefully, I tried turning to the *Master Index* to look up 'query' expecting to find some help. Not really. It points to the Query Browser in which we can construct SQL type queries. But what is needed is a clear indication of the query support offered by the Objectivity/DB classes. I have found some of it, despite the manual. So any evaluation of the query facilities offered by the classes has to have caveat that there may be much more. For instance, on the training course there was a brief discussion about using a *predicate scan* method to set up a numeric comparison (eg `number of wheels 4`) without the complexity of creating an index. However in the manual I searched fruitlessly for a reference to a 'predicate scan'. Chastened by this experience I returned to the manual for the Poet OODBMS and noted a clearly written section titled 'Queries'. Oh, did I realise at the time what a joy the Poet manual was?

Conclusion

In my review of Poet a while ago I wondered what we get with a more expensive database such as Objectivity/DB. My initial impresssions are that, on the positive side we get scalability, but on the negative side it is complex and some of the support for queries is patchy. Mastering this OODBMS will take a very long time. Some of the complexity could be reduced by a manual more orientated to users who want to use a database rather than methodically plod through the various Objectivity/DB features. There is a need to remember that using a OODB is a means to an end, not an end in itself. Using Objectivity/DB has increased my growing suspicion that OODBMs should provide an unseen engine to applications and be placed firmly out of the range of ordinary mortals. Whether this is just a reflection of the raw state of OODBMS or something more fundamental will be revealed in time. ■

Mary Hope teaches software development at Thames Valley University. She can be emailed on hope_m@slough.thames-valley.ac.uk.

(1) Loomis, Mary E S, 'Querying Object Databases', Journal of Object Oriented Programming, June Vol7, No 3.

Thus far and no further

Connecting to the Internet can have the unfortunate side-effect of allowing unwelcome visitors to your LAN. **Paul Richardson** investigates how to confound potential gate-crashers through the use of a firewall.

When connecting your organisation's Local Area Network to the Internet using the standard suite of TCP/IP protocols you are not merely providing your users with access out onto the Internet but are making your LAN and the hosts on it visible to the outside world. This is to be expected as you are simply interconnecting your LAN with thousands of others using standard bi-directional protocols. This level of access could be the end result that you intended. However, most organisations, in particular commercial and government ones, will find this arrangement unsatisfactory from a security angle. They will look to use techniques to combat the access problem. One of the most important tools in the security toolbox is the *firewall*.

Access denied

A firewall, as the name suggests, provides a security screen between the Internet-at-large and the machines on the LAN by blocking or permitting traffic according to rules supplied when configuring it. The majority of an organisation's security effort can be directed towards securing this single point of access, rather than having to concern itself with the nightmare of ensuring that strict security policies are being carried out on all machines on the local network.

A firewall can implement a wide variety of access security measures. At their most basic, firewalls can simply transfer email in either direction. They can also prevent logins from outside hosts other than those that are explicitly allowed. The more complex schemes allow users on the inside access to the Internet via several protocols while prohibiting the same access from the outside.

A firewall host, by its nature of being directly connected to the Internet, is likely to become the organisation's 'public face', providing services to the outside world and acting as a repository of information that the organisation is happy to make public.

It is important to appreciate what a firewall cannot do for you in order not to develop a false sense of security. A firewall will *not* protect you against any form of attack where an executable of some form is sent through the firewall to one of the hosts on the local network and then executed by some means. Many of the protocols that are permitted through the firewall are capable of carrying executables. Indeed one of the most infamous security holes involved sending programs by email, which were then executed on the destination host as a scheduled job. These 'attack' programs could, given the appropriate permissions, open a backdoor account or infect the local network with a virus. So implementing a firewall does not excuse us from continuing to perform some basic security checking.

A multi-level game.

I hinted in the previous section that there is more than one approach to implementing a firewall, for instance. One is to enforce rules that permit certain traffic, while another is to enforce rules that prohibit certain traffic. Of course in the middle ground these two approaches meet but, as will be shown, the two methods are implemented using very different techniques. Firewalls are usually categorised into three groups, based on the network level that the firewall operation takes place at. These three are: packet-level, circuit-level and application-level. Of course, it is quite usual to employ a combination of the three mechanisms to secure the local network from prying eyes. Figure 1 illustrates the principle difference between the distinct firewall types, ie that they operate at different layers in the TCP/IP protocol stack.

I will be describing the operation of all these flavours of firewall, but first I would like to take this opportunity to remind ourselves of some basic TCP/IP terms before going on to discuss the operation of firewalls.

Each computer on a TCP/IP network (and indeed some other components such as routers) has a unique *hostname* such as **dingdong**. There is a one-to-one mapping between a hostname and an *IP Address* such as **132.146.104.11**. TCP/IP traffic is routed between TCP/IP networks wrapped up in *IP Packets*. A *service* is a protocol type such as **FTP**, **SMTP** or **HTTP**. A *port* is something that must be specified in addition to the IP Address when initiating TCP communications with another computer. If you think of a house being the computer, then the *port* would specify which door to enter. There is a mapping between services and ports. Most services having a 'well-known port' defined, behind which a service-specific daemon is running, waiting for incoming connection requests.

A *packet filter* firewall operates at the level of Internet Protocol (IP) packets, blocking packets according to rules that can specify source and destination addresses and port numbers. This functionality can be

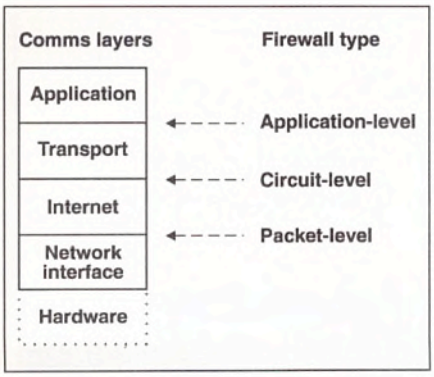

Figure 1 - TCP/IP operating layer for each firewall type

A Unix firewall

I'm going to take a closer look at a freely available firewall toolkit for BSD-derived Unix platforms (see the bibliography) which provides a very comprehensive package of information and tools for rolling your own firewall. This package has been made available by Trusted Information Systems, a States-side network security company. TIS will support users of the toolkit as and when it finds time to do so, ie no guaranteed response time but there is a mailing list through which users can share their experiences.

The software tools come with *guidelines for a firewall design philosophy, host configuration practices* and *security verification strategies*. When retrieving the toolkit beware that the supporting documents are in a separate file. The software is supplied in source form, more precisely K&R C, with makefiles that can accommodate most common compilers. The toolkit has already been used on a variety of Unix systems: SunOS 4.1.x, SunOS 5.x, HP/UX, CMU Mach, Ultrix, BSDI, DEC OSF/1, BSD/386, IBM AIX, SCO XENIX and last but not least, Linux.

The toolkit is very flexible, catering for a variety of environments and degrees of paranoia. At the architectural level, it supports three main approaches (see Figure 2):

- dual-homed gateway - an implementation of an application level firewall consisting of a variety of proxy servers,
- screened host gateway - a packet-level firewall, operating in conjunction with a screening router.
- screened subnet gateway - another packet-level solution, but this time allowing multiple hosts in the 'demilitarised zone' as it is known.

The package consists of a number of proxy servers, namely for, telnet, rlogin, HTTP, gopher, X11 and FTP. There is also a proxy server known as *plug-gw*, which is a generic solution to the problem of providing access through an application-level firewall to a particular service on a host on the trusted network. Plug-gw acts as a plug-board allowing requests for services made to the firewall machine to be passed transparently through to a nominated host and port, rather akin to the action of a circuit-level firewall.

The toolkit also includes *smap* and *netacl*. The former is a wrapper to put around the notoriously buggy and insecure *sendmail* program. It inspects requests for doggy behaviour and logs such events. *Netacl* is an access control wrapper for any selected TCP services. It authorises connections on the basis of the source address and the chosen port. It performs similar functions to the *tcp-wrapper* package mentioned in Peter Collinson's article, but is not as flexible.

Apart from a raft of log analysers and other useful utilities, the other major facility provided is *authd* which is a generic server for a variety of authentication schemes. It provides a common interface across all the methods and comes with an administration tool for managing a database of users.

As mentioned, the toolkit is comprised of many separate software components. This might sound like an administrative nightmare. However, TIS has written all its modules to make use of a common configuration file (by default */usr/local/etc/netperm-table*). This gives a good level of flexibility for each of the various components.

I was impressed with the package as a whole. It is a complete solution and comes with good supporting documentation including examples of system configuration files that need to be changed such as *syslog.conf* and *inetd.conf*. Also, the *netperm* configuration table (see above) contains many examples of *netacl, smap, FTPs* etc rules.

provided by a computer with two interfaces, one outward-looking and the other inward-looking, running appropriate packet-filtering software. Alternatively, many routers provide this functionality these days, and when properly configured are an invaluable aid to a secure system. It must be said that whether or not a router with such facilities constitute a firewall is one of those 'religious' topics. Many people prefer to call such a router a 'secure router'.

As Peter Collinson dealt with much of the material surrounding the subject of packet-level filtering in his excellent article, *Not So Open Systems* in the September '94 issue of *EXE Magazine*, I will concentrate on circuit and application-level protection.

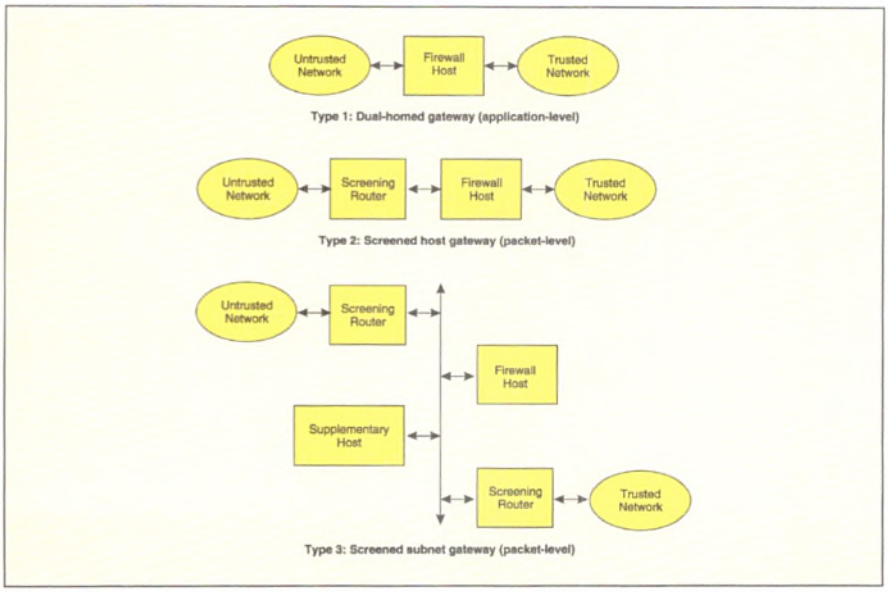

Figure 2 - Three ways to protect

Closed circuit

Circuit-level firewalls arbitrate over the setup phase of TCP connections, but once the connection is set up, the bytes are simply copied through the firewall. A variety of checks can be made at the time that the request to set up the connection is received, such as host access control, ie permitting or prohibiting connections on a host-by-host basis. A more complicated set of checks involves permitting a connection on the basis of the required service and the destination host. A simple initiation protocol propagates this information to the circuit-level firewall. The connection is either permitted or some error message is returned.

A problem with the latter set of checks is that client software must be modified in order to understand the initiation protocol. This is not such a problem though, as a variety of freely-available packages can be employed; the best known being the socks package (see bibliography) which provides replacement system calls for **socket(), connect(), bind()** etc.

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Who's to blame?

Dear EXE

I feel that your article *University Challenge* (January 1995), although well-intended, is guilty of unfair generalisations. The inevitable 'ivory-tower' picture that you painted of academia may have been accurate in the days when I used to be at a 'traditional' university more than 10 years ago. However, it certainly isn't representative of the majority of the 'new' universities today. You bemoaned the fact that vocational training was lost with the passing of the old Polytechnics, but you failed to point out that though the Polytechnics may have adopted the University title, the majority of them have not abandoned their traditional policy of vocational training within their courses.

Blaming problems of graduate employment on the irrelevance of academia has always been an easy option for those in industry. But as an ex-developer-turned-lecturer I am constantly amazed at how unwilling the self same industry is to promote and support the idea of more relevant training for our undergraduates. Finding industrial training places for our undergraduates every year is, without a doubt, one of the most difficult and time-consuming task possible. Industry is just not willing to offer the places, even when the students are willing to travel far and wide and work for next to nothing. As for relevant course content, despite the myths, we are not generally able to chop and change courses at our own whims and fancies, due to considerations for quality and standards. New courses have to be justified on various grounds, one of which is relevance to industry. For that justification, we generally need support from industry itself to say that what we are intending to teach is relevant and what it needs. However, to illustrate the point, about two years ago, I tried to introduce a new course which aimed to teach our students the much-hyped-about art of Windows programming (being an ex-Windows developer myself). I set about contacting numerous software houses and recruitment agencies looking for statements and letters of support for such a course. Though the majority paid lip-service on the phone saying that Windows programming skills would be highly desirable and useful to them, I received not a single letter of support from anyone.

I H Ting
University of Wolverhampton

Broken pipe

Dear EXE

I am not sure where else to turn with regards to the following problem. I have tried phoning Microsoft on several occasions and talked to three different departments: C programmers, Lan Manager and Windows for Workgroups. I have also sent messages over CompuServe in the MSWIN32 and WINNT forum with no response, except someone else saying they had encountered the problem and had found no solution.

The problem is as follows.

I have a server on the NT machine listening on a named pipe for a client connection. Clients connect from Windows for Workgroups using NetBeui. Everything works fine... Almost. On our office system for testing, everything works fine, but at our customers sites a message occurs with no regularity at all. The message is 'Network Error on Drive : ?. Abort, Retry'. I found out why this message appears from the latest MSDN CD. The problem occurs when the client attempts to read from a broken pipe. What I wish to find out about this problem is:

- Is it a problem with the way I create the pipe (I use blocked I/O).
- Is it a problem with the underlying NT networking.
- Is it a problem with the underlying W4W networking.

The main problem with this 'bug' is that it appears with no regularity. Our customers can go a whole day or so without it appearing, then suddenly the message appears numerous times.

If anyone has any ideas as to what the problem is or where I can get help I would be most gratified.

Stephen Croall
(STATUS/IQ Ltd.)

Quick solve

Dear EXE

In response to Andy Flew's letter in December's EXE, I may be able to shed some light on the problem. The version of Quick C he is using is that supplied with MSC 5.1 (ie old) When running a single module program within the IDE, the compiler links calls to standard library functions to functions supplied by the IDE itself. The functions the IDE provides are a subset of all the library functions. In particular, there are no graphics functions or math functions. To get over this, you can do two things:

- Create a quick library with the missing functions and load it with the /l command line option.
- Create a program list with just the single C source file in it. This causes the medium model library to be searched for the missing functions. All this can be found on pages 126 & 127 of the Quick C manual.

Hope this will be of some use.

Simon Munton

Letter of the Month

The writer of the best letter of the month, as judged by the Editor, will receive a £30 book voucher, courtesy of PC Bookshop, 21 Sicilian Avenue, London WC1A 2QH (0171 831 0022). The best letter is the one printed first. Please note that letters submitted to this page may be edited.

Break

Please send your rants, raves and competition entries to:

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

Insel Intide

What a marvellous excuse the Net makes for not doing any work. Any queries from Management can be met with a calm smile and the reasonable excuse that 'it's all research innit?' Ctrl Break's favourite release at time of going to press was the Intel/HAL narrative. This entertaining screenplay-style posting features Dave, the NASA astronaut, and HAL, the disturbed Pentium processor with a TUI (Talkative User Interface). Much as Ctrl Break would love to print the whole thing out verbatim (it would save us having to write anything else for a start), we can't. We shall have to satisfy ourselves instead with a rendering of the ditty that HAL sings after Dave presses Ctrl+Alt+Del (it was a mercy killing darling).

Daisy, Daisy, give me your answer do,
Getting hazy; can't divide three from two,
My answers I can-not see 'em,
They are stuck in my Pente-um,
I could be fleet,
My answers sweet,
With a workable FPU.

And the war rages on...

It must have been obvious to industry watchers from the moment Microsoft bought out the Catholic Church. No self-respecting rival could tolerate such a coup without some form of retaliation. And sure enough, Big Blue has responded with a $1 billion takover of the US Protestant Episcopal Church. The rumour is that IBM plans to consolidate its international religion sector by tendering a bid for the entire Anglican Communion...

Yes indeed folks it's the latest 'press release' in the ongoing Net saga which started with the 'Microsoft to buy out Catholic Church' story. Following on from the Net release of a comment from the real Catholic Church in America (no really, it was) in the ongoing battle to see who's got the best sense of humour.

The IBM 'release' explains the takeover as a natural merging of the White Coated Mystics of the computer world with those of the Episcopal Church. 'We hope to have their White Suited Mystics up to speed in JCL and C++ within a few months,' commented the IBM chairman.

EXE
The Software Developers' Magazine

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Still not received your EXE Subscribers Club pack yet? Don't worry, we're still having problems coping with demand, but we're getting there. Don't forget to turn over to the EXE Book Club page with a fine selection of offers on the latest most reads.

The EXE Software Developers Challenge 1995

There was a keen turn out for the first in (hopefully) a long line of Developers Challenges. Twenty five teams of developers turned up at Sandown Park racing track on the 8th of February to fight it out to the bitter end.

The eventual winner, Bruce Lomasky, took the true spirit of this charity contest to heart and donated his prize to the runners up, Borland and Dunstan Thomas. His reason? Bruce already lives in the US, so the chance to win a trip to the States and compete in the Developers Challenge over there didn't appeal to him quite as much as it would to us Brits. He also wanted to see an English team in the Challenge. Even more heartwarming is the thought that the RNIB now have the application they need.

EXE Compiler Report

Turn to page 37 for the final part of our C++ Compiler report. Two more detailed versions of the complete report are also available. The Technical Version costs £35. The Management Version (including full managerial reports) costs £75. EXE subscribers get a further 10% discount.

The Windows 95 Show

Still not too late to miss the last three days of this, the biggest event of the year. 60,000 attendees were predicted at time of going to press. By now you should know if Windows 95 has been launched. Don't forget to come along and say 'hello' to your friendly EXE team at our stand. There'll be japes, jokes and £5,000 of Microsoft software to be won.

FREE Monty Python!

Following on from the raging success of Monty Python's appearance at the Software Developers Forum (Sandown Racing Park, 8th and 9th of February), we just couldn't resist the chance to let one more lucky person win a copy of the Monty Python Complete Waste of Time CDROM. This features the Flying Pig game, pinball, the Gopher game, a PC desktop Pythoniser, hidden puzzles and many, many, many more things. Far too good to be missed. Don't forget to send in your postcard to stand a chance of winning this.

FREE BOOK!

PGP, Pretty Good Privacy by Simson Garfinkel. Published by O'Reilly Associates, Inc. ISBN 1-56592-098-8.

Phil Zimmerman, the author of the PGP encryption program, claims that even he 'learned a few new things about PGP from Simson's informative book!' What more can we say? Now that encryption of documents is becoming a daily necessity everyone needs to know about this. We have five copies of this book to give away. Send in your postcards now for a chance to win. Please note that entries are not drawn until the start of

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Book and video review

Programming with Class - reviewed by **Colin Smith**

As you may already know, Microsoft considered taking the 16-bit capability out of its latest C++ compiler. It's not that hard to imagine a time when it will take the C capability out of its C++ compiler. So now might be a good time to find out what C++ is all about before you are forced into using it. *Programming with Class* aims to be a practical introduction to OO programming with C++.

As the title suggests, the emphasis is on classes, whether it be designing, building, or reusing them. An OO language is useless unless you know how to design classes. The book is not product specific, which might be a bad thing to some people. But I don't think it is. There are plenty of manuals/books that cover particular language products, but few that explain the underlying concepts and provide practical examples as this book does.

Programming with Class begins with a historical perspective on how OOP evolved. As well as covering C++, the 'premier' object oriented language, several niche languages such as Simula, Eiffel, Object Pascal, Objective C and Smalltalk are also mentioned. These first 70 pages will be wasted if you are not interested in history lessons.

An introduction book to C++ cannot avoid the bread and butter coverage of subjects such as inheritance and polymorphism but Gray manages to serve it with an appetising jam on top. While showing some of the mechanics, he manages to avoid getting bogged down with low level details.

You might balk at the news that the book has a strong 'analysis and design' bias but you'll be reassured to hear that it doesn't wander into the realms of formal methods. Gray talks blobs and boxes.

Nowadays it is difficult to program in C++ without being tempted to use one of the framework libraries that are available to reduce portability hassles. Gray provides a brief overview of some available libraries and illustrates the use of MacApp and ET++ in a simple 'Flash Cards' example. This provides a good insight into the problems/benefits associated with framework libraries.

The fourth section 'Intermediate C++' covers the topics of multiple inheritance, nested classes, exceptions and is up to date with templates.

The book claims to be practical because of its exercises. Some of these are a bit weak, especially the so called 'Find out about...' ones, while others are a bit more demanding such as 'Write a simulation program for an electronic office'. This book is only practical if you do the exercises.

Although the book has evolved from materials in an undergraduate course, it is more than just a cobbling together of lecture notes. A book merely of lecture notes just wouldn't survive.

The book should be considered as a good all round introduction to the features and issues involved in OO development. Hard-nosed C++ programmers will already have crossed the pitfalls and don't need to go back to University.

The example designs are 'Space Invaders', 'Operating System Simulation', 'Editor' and 'Cards'. The code is available on disk for a fee, but more interestingly it can also be sucked from an Internet site. Publishers have really got into the spirit of the Internet.

Verdict: The sort of book you would need to study rather than just read, but it will change your mindset to think in classes.

Title:	*Programming With Class*
Pages:	*623*
Price:	*£24.95*
Author:	*Neil A Gray*
Publisher:	*John Wiley & Sons*
ISBN:	*0-471-94350-9*

Unauthorized Access - reviewed by **David Mery**

This film is a rare piece. It is not yet another Hollywood script about a unique hacker ready to launch a new worldwide conflict. Nor is it a journalistic study of how hackers are such bad guys. For the first time hackers are given a rostrum to put across their case. *Unauthorized Access* is about the people that are hacking, not so much about hacking itself. The film is made up of a succession of short portraits where hackers convey their experience, what happened to them, what they are doing. I was completely hooked.

This 'hacker's movie' has been produced, directed and edited by Annaliza Savage. In a way it is a very personal video. It took her 15 months to make. At the beginning she knew a few hackers mainly around Los Angeles. Annaliza got the idea for the project while attending a '2600' meeting. These meetings are organised all around the world on the first Friday of each month. They were first launched by the quarterly hacker magazine *2600*, hence the name. After travelling all over America and Europe during the filming, she met many more hackers that all became good friends.

It starts in Texas with a police raid on the HoHocon hacker convention in 1993 followed by the last day of freedom of Phiber Optik *aka* Mark Abene before he was going to jail for a year. He had been convicted for... 'unauthorized access'. There is no narrator. All the 'actors' are hackers. It's shot like a documentary or 'cinema-verité' but with a very fast pace, switching rapidly from place to place. In fact during the shooting, Annaliza spent more time travelling from one location to the next than on the shooting itself (most of the travel was by train)! A large part of the film is shot in Germany and Netherlands. The German hackers explain how they installed BBSs in Sarajevo and why communication is the best mean for peace.

As the German scene, amongst others, exemplifies, hackers are depicted not only as being deeply involved in all sort of technology but also as world citizen ready to act in order to create a better communicating world. It's not all about technique. It's more about people, the role of society and the individual, the importance of communication.

Before this film, I found that only Steven Levy's *Hackers* gave a good insight on hackers. But this book was a novel about historic figures. It was published in 1984 but didn't focus on what was happening then, covering instead the legend of the seventies. *Unauthorized Access* is about people hacking today. If you want to know what a hacker really is, this is a must.

Verdict: I was fascinated, email me your impressions...

Title:	*Unauthorized Access*
Length:	*42 min*
Price:	*£15.00*
Director:	*Annaliza Savage (savage@dfw.net)*
Publisher:	*Send a money order to Savage Productions 281 City Road London EC1V 1LA*

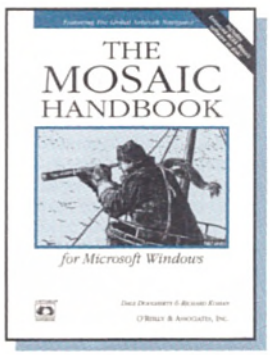
All you need to know about navigating the Internet with Mosaic

Mosaic is an important application that is becoming instrumental in the growth of the Internet. These books, created for Microsoft Windows, X, and the Macintosh, introduce you to Mosaic and its use in navigating and finding information on the World Wide Web (WWW).

It shows you how to use Mosaic to replace some of the traditional Internet functions like FTP, Gopher, Archie, Veronica, and WAIS. For more advanced users, the books describe how to add external viewers to Mosaic (allowing it to display many additional file types) and how to customize the Mosaic interface, such as screen elements, color, and fonts.

The Microsoft and Macintosh versions come with Enhanced NCSA Mosaic on diskettes; the X Window version comes with NCSA Mosaic on CD-ROM. All three books come with a subscription to The Global Network Navigator(GNN®), the interactive guide that makes the Internet more enjoyable and easier to use.

Another new O'Reilly book on a much-requested topic is *Managing Internet Information Services: World Wide Web, Gopher, FTP, and more*. It describes in detail how to set up information services to make them available over the Net. It begins by discussing why a company would want to provide Internet services and how to select which services to provide. Most of the book describes how to set up email services and FTP, Gopher, and World Wide Web servers. This book will be published in December.



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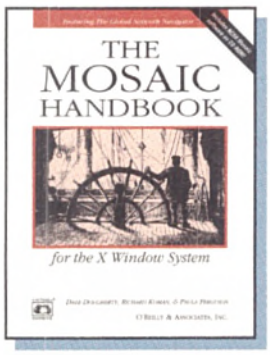

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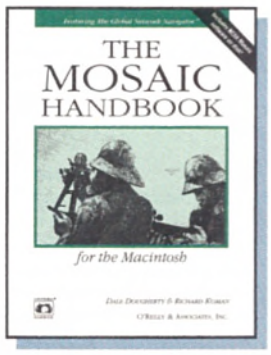

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Space Modesty

Our intrepid investigator checks out Microsoft Space Simulator. It's out of this world.

'Welcome to Ring Station 1. This space station is 1,200 metres wide and weighs 500,000 tonnes.' Well, that's what it says here. No small feat for mankind or software-kind I might add. There's a choice of fabulous hotels located on the upper deck apparently. All with a stunning view of Mother Earth down below. And for light sleepers there's also a choice of those ever-popular, exclusive zero and low gravity apartments. When you go to bed in one of these babies, I am telling you, it's not only your mind that floats.

So here I am on Ring Station 1. Oh look. there goes the Apollo Service module. In the old days, that was the contraption men used to get to the Moon. They're rehearsing for *That was the year that was: 1969*. See the guy in the Lunar Excursion Module. He's acting out the part of Neil Armstrong. The other chap is Edwin Aldrin. Yes, he's the one that no one remembers.

Time to put on my journalistic cap and pull out the good old-fashioned biro and notepad. Why? Because I gave up on technology when the batteries ran out.

So tell me, Edwin, how difficult exactly is it to perform a lunar landing?

It's not difficult at all. Just aim for the yellow cross. No matter how fast you hit the dirt, you will still come out in one piece.

And when you get bored?

Ah well, we have a space shuttle, a Galactic Explorer, a Bussard Ram-Jet, an F-79 Galactic fighter, the Zander Freighter, a thing called Callisto, a couple of space stations. We can travel anywhere in the Solar System and beyond. Distant galaxies, comets... We've seen 'em all.

The problem with space is that it takes so darn long to get anywhere. How does an astronaut like yourself overcome it?

We've got a fix. And we don't need Mr Isaac Newton to upset our enjoyment of the space experience. For every action there is always a... way to cheat. Who needs three years for a one way ticket to Mars. We've got instant. I'll have a mega burger, regular fries, cola and a trip to Mars to take away. Thank you. Say where you want to go and you're there... Even if it's Andromeda which is 20 million light years away, we'll take you there.

I expect you have a Warp drive or something?

Not at all. Bill. doesn't believe it could ever work. I suppose you could say, Warp is a non-word. Defying high school physics we can, in effect, travel faster than the speed of light. But we *don't* use Warp.

Faster than light. Doesn't that produce a blackhole?

Yes.

I suppose we now know where all our money has gone then?

No comment.

Okay, so How do you do it?

It came about when we acquired Time in the year 2000 AD. We can make it run as slow or as fast as we like. Bill's only regret is that he wished he had thought of it in 1995...

This is a review of Microsoft Space Simulator which retails at around £39.

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JOB
C++ MULTIMEDIA DEVELOPERS

LOCATION City/Cambs
SALARY To £30k

Europe's leading CD-ROM publishing company is seeking to recruit Windows development and testing staff at all levels of experience. They are building teams now to work on a number of new titles to be released into Europe later this year. 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 also openings to be trained in Visual C++ and CD-ROM/Multimedia for those with the right interpersonal skills.

REF: EXE/1

JOB
C++/VISUAL BASIC

LOCATION City
SALARY To £30k + BB's

Our client, one of the leading banking and financial institutions in the City, has a number of requirements for highly skilled Software Developers with Visual Basic and/or Visual C++ experience. Any exposure to SQL, NT or real-time systems would be a distinct advantage. Successful candidates will be involved in building banking applications using the latest technologies and can expect excellent salary packages. This company's five year plan is for rapid expansion which will allow successful candidates to grow within an already well-established company.

REF: EXE/2

JOB
REAL-TIME 'C' SOFTWARE ENG

LOCATION Cambs
SALARY £20k - £30k

Our client is searching for highly professional and committed Software Engineers with a minimum of two years experience of developing embedded 'C' software under Unix. Experience of C++ and Object Oriented techniques would be an advantage. The ideal candidate will have some telecommunications experience across a split site. Experience of working in a large, well structured development environment would also be of interest. However, the most important factors are a sense of humour, team spirit and a strong commitment to the production of quality systems.

REF: EXE/3

JOB
VISUAL BASIC DEVELOPER

LOCATION Herts
SALARY £20k - £25k

Our client is a Software Consultancy providing development services to a wide variety of clients. Since 1980 they have achieved steady and continuous growth. Due to their success in the market place, they are now searching for professional PC developers with a minimum of one year's Visual Basic experience to join their fast growing PC division. The successful candidate will be developing systems for a range of clients from blue chip finance houses to hi-tech communications companies. If you want to be part of a professional organisation offering a top quality service, then apply now and give your career a head start!

REF: EXE/4

JOB
VISUAL C++/MULTIMEDIA

LOCATION Surrey
SALARY £20k - £27k

This is an excellent opportunity for talented Visual C++ Programmers to work in the multimedia arena. Candidates should be graduates with one to five years experience in an innovative software development environment. In addition to your Visual C++ experience, exposure to Chicago and Windows NT would be advantageous as would familiarity with DLL's and OLE-2. Working in a small development team, the successful candidates will have used the latest Windows technology in a rewarding and dynamic environment.

REF: EXE/5

JOB
UNIX/C++

LOCATION London/Surrey
SALARY £18k - £28k

This leading supplier of software products to the finance industry is about to embark on major new products and is, consequently, seeking several additional software developers from Programmer to Team Leader level. Suitable candidates will be graduates with at least twelve months experience programming in C++ under UNIX. Working in a stimulating and challenging environment, candidates will be able to use their creativity and work on their own initiative whilst learning new skills.

REF: EXE/6

CONTRACT VACANCIES - UK WIDE

Herts	**VB/Windows Analyst/Programmers**	2 months
London	**Windows/Visual Basic Programmers**	6 months
S.London	**Visual Basic Anal/Progs**	6 months
Berks	**Visual Basic Programmer**	4 months
London	**VC++/SDK Multimedia Developers**	3 months
Cambs	**VB/Finance Developers**	3 months
London	**Windows/Financial Appls. All Levels**	6 months
W.London	**Windows/SDK/'C' Programmers**	5 months
City	**Windows/SDK/'C' Developers**	4 months

REF: EXE/7

City	**Mac/Windows/Text Handling Progs**	6 months
City	**Apple Mac Developers**	6 months
Cambs	**Apple Mac Developers**	6 months
Cambs	**Multimedia/CD-ROM Developer**	4 months
London	**Sybase/SQL Server Software Engineer**	4 months
Oxford	**Oracle/Vista Software Engineer**	4 months
Cambs	**Real Time C Software Engineer**	3 months
Surrey	**Visual C++/MFC/Finance Developer**	6 months
London	**Testing System Tester**	3 months

REF: EXE/8

London	**Visual C++/MFC Developers**	6 months
Surrey	**Visual C++/MFC Programmers**	6 months
Oxford	**'C'/C++ Programmers**	3 months
London	**C++ Design/Development Developers**	3 months
W.London	**'C'/C++ Progs x 2**	6 months
City	**C++/Banking Programmers**	6 months
Manchester	**C++/VB/Finance Anal/Progs**	6 months
London	**Windows/C++ Programmers**	6 months
City	**Windows NT Senior Programmer**	3 months

REF: EXE/9

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CD-ROM review

Experience C++ - reviewed by **Cliff Saran**

There is certainly something particularly attractive about computer based training. It seems more suited to the 'teach yourself' method of learning than its predecessor, the audio and video tape. These are severely limited by the level of interaction they offer to the student. Progress cannot be assessed very easily with these media. But with a virtual classroom on the student's desktop, the computer is able to fire questions and examine replies. Assessment is automatic.

With the growth in multimedia, training courses can now harness the potential of sound and video to produce a richer, more stimulating learning experience. And, unlike traditional training where an individual may be off site for, say, five days, computer based training runs entirely in-house. Furthermore, the course can be run over and over again, without incurring additional cost. So several employees could run the same training course, although not all at the same time!

In my experience, computer based training is boring. Sound and video quickly lose their appeal and often risk detracting from the actual subject being taught. The alternative is worse. Electronic versions of text books suffer from many of the problems of online help. A computer screen is far more difficult to read than a printed manual. Invariably, less information will be present on the page which makes browsing more difficult and it is awkward turning the pages.

Experience C++ is a new CD-ROM from IBM which tries to improve on the former approach. But it is not a true training course as such, more an electronic text book. There appears to be no built-in feature for assessing the progress of the student. However IBM has included a wealth of neat ideas which greatly improves the usability of the book.

The first of these is that it speaks. Rather than having to scroll through page upon page of text, the reader is presented with a selection of voice annotations. By choosing one, the student can listen to the particular topic. If, however, the reader wishes to read the annotation instead, IBM provides a toggle for disabling audio output. In this mode the descriptive text appears in a box below the sentence it describes. As well as allowing the student to choose which annotation to play, *Experience C++* can be set to play an entire page automatically without further intervention. Of course, when it reaches the end, there is still the hassle of turning the page. Next and Previous page buttons are provided for this purpose.

But speech quickly loses its appeal when the voice is that of a monotonous American male. So I would be tempted to disable sound. Nice idea: shame about the voice.

Another trick IBM has used to extend the learning potential of *Experience C++* is annotated programs. Here, the reader is guided through a short listing with a running commentary or a text description alongside. Markers are used to point to the section of code being discussed. A push button is used to step through the code and annotations.

The program can actually be run by clicking another push button. Now that *is* something which cannot be done in a printed text book. And the best thing is there is no need to compile any code! An editor window can also be opened to view the entire program. All source code is actually provided on the CD-ROM. These are 'standard' C++ programs which can be compiled with Borland C++, Visual C++ or IBM C Set++.

I must admit that having enjoyed the annotated programs feature I was somewhat disappointed with IBM's animation efforts. Pushing metaphors to an unbelievable step, *Experience C++* comprises banal animation sequences with childish cartoon characters that confuse rather than explain aspects of C++ programming. I got very bored trying to keep up with the arduous sequence that explained building blocks in terms of building a house. Building a house! What relation does that bear to practical object oriented programming. It is downright condescending to show the concept in such naive terms.

Please IBM, we are not children. Don't treat us as such. And as for IBM's attempt to illustrate polymorphism. A car, a bicycle and a man stand at a traffic light. Had IBM ever stopped to consider what would happen to the pedestrian if he decided to walk when the lights went green? Is IBM really so out of touch with the intended target audience of this product. The animation is dire. It soils an otherwise excellent product.

And as for the rest. Well, *Experience C++* is organised as a traditional printed book divided into chapters. These are further divided into sections. Each section comprises one or more pages of information. It is possible to navigate the 'book' from cover to cover using Next and Previous page buttons. A button is also provided for selecting a chapter to jump to. Once inside a chapter, the sections are listed with brief descriptions of what they contain.

A well thought through feature is that the description indicates whether the section contains information new to C++, or whether it is the same for C. Existing C programmers trying to grasp C++ obviously don't have to visit pages containing material they already know. Such people can easily pick out the specific C++ feature they wish to look at. As expected from an electronic book, hypertext links are available for tracking information.

The information itself seems pretty complete. *Experience C++* covers the language features of C++ including templates and exception handling. Topics are well presented, although in some instance, they are quite shallow. Personally I would like to have seen a better explanation of polymorphism. The example given demonstrates how a storage class could be implemented as a stack or an array. More useful to the average programmer would be a generic stack. Class design is also skimmed over. In fact, IBM admits that it is beyond the scope of the book. Perhaps if it lost those awful animation sequences, there would be more scope to include the important subject of class design.

I would say that *Experience C++* is aimed at the C programmer moving in OOP with C++. It covers the language elements adequately enough to turn a C programmer into a *C programmer who knows C++*. But an elementary understanding of OOP and knowledge of the syntax does not necessarily mean you can program in C++. *Experience C++* is just that: an experience, nothing else.

Verdict: Not detailed enough to recommend.

Title:	*Experience C++*
Price:	*£145*
Publisher:	*IBM*
OS:	*DOS application. Can run under DOS, Windows and OS/2. Sound when sound card is present.*

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Good News for Bookworms

Welcome to The Book Page. It's new. This EXE Subscriber Club initiative will feature in the magazine every month and enable you to get great techie books at up to 25% cheaper than shop prices. We kick off with these seven top sellers and will build up a superb selection in the months ahead. To take advantage of these fab deals, please quote your Reader Number when ordering.

Heavy Metal OLE 2.0 Programming
by Steve Holzner
570 pages

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Price to You: £31.20

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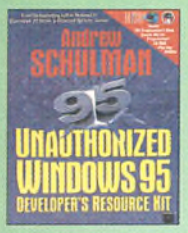

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by Daniel Gilly & O'Reilly staff
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Ctrl

Can seriously damage your health

There's nothing we like better on these rainy Spring days than a quick browse through the old Manual collection. Yes indeed. It can be very instructive. Take, for example, our copy of OS/2 *Warp* plus Bonus*Pak*. Contained within this Bonus*Pak* is a sheet of paper, helpfully intended for anybody who might wish to make use of the Internet facilities provided therein. 'Certain Internet services,' it points out 'may contain language or pictures which some individuals may find offensive, inflammatory, or of an Adult nature.' 'We do not endorse such materials,' it continues, 'and disclaim any and all liability for their contents.'

Ctrl Break whiled away a few happy hours thinking up similar warnings for other manufacturers of household/office products. For example, paper clip manufacturers may wish to point out that they accept no responsibility whatsoever for any crazed-psycho-killers who happen to gouge out the eyes of their victims with the aforementioned pieces of bendy wire. Purveyors of filing cabinets may wish to comment on the inadvisability of dropping one out of a 12th floor window. Knicker stores could further Safe Sex by recommending that their products should at no time be removed in front of strange members of the opposite sex... Gosh, the list is potentially endless. Rumours that the next Big Blue project involves teaching old ladies how to suck eggs are, of course, completely unfounded.

find.love.gsoh.ns...

You may have read of Cyberia's move in January to set up a dating agency service within its Web pages. Ctrl Break was particularly interested to hear that when *PCW* picked up the story there were 10 men looking for women and one woman looking for women. But alas, no women looking for anyone else.

As Ctrl Break was feeling a little dejected *aprés* Valentines Day (absolutely no messages at all, sob). We decided to follow up on this tale of woe and find out just what happened to Love's Young Dream on the Net. After all, Spring has nearly sprung; surely there must be *some* action going on out there?

So you'll be pleased to hear that the situation *has* changed somewhat. There are still 10 men looking for women. But the woman looking for a woman has given up.

All this *in spite* of the fact that one young would-be Romeo described himself as a 'Scientist, Racing Driver and General Good Time Guy.'

It seems that modesty gets you nowhere these days.

Net Trek

Find the singing Space Captain at: **http://www.ama.ca/tech.edu/~edu/mrm/kirk.html**

Alternatively you can have a look at Star Trek Generations page at: **http://generations.viacom.com.** This has a marvellous selection of pictures, sound and QuickTime trailers. And don't forget to look out for the fabulously titled *All I Really Need To Know I Learnt From Watching Star Trek* by Dave Marinaccio ISBN: 1/85286/555/5. Available from The Museum Store, 37 The Market, Covent Garden. This publication originally comes from the American Museum of the Moving Image and costs £5.99.

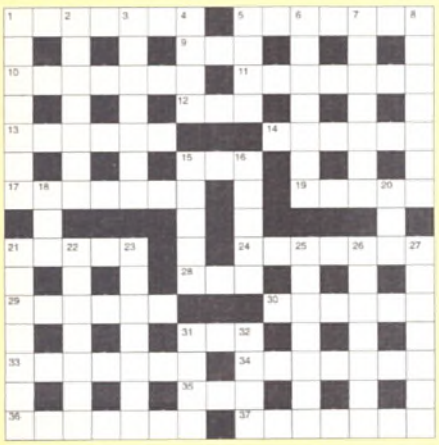
Beam me up Scotty, *please.*

Ctrl Break was skipping gaily through the Internet t'other day, when what should we happen upon? Why The Captain James T Kirk Sing-a-long Page of course. Oh happy chance! A little homage to the actor William Shatner's epic vinyl release *The Transformed Man*. A monolith of the musical age it features such classics as *Elegy For The Brave, Spleen and How Insensitive*. Unfortunately, the author of this precious Internet offering had to content himself with giving us Web surfers *The last half of Mr Tamborine Man, The Finale of Mr Tamborine Man, Lucy in the Sky with Diamonds* and *Hamlet*. 'I have studied this visionary work time and time again,' he comments, 'and never fail to find something new each time I listen.' Well quite.

Virtual sewage

Ctrl Break was delighted to learn that South West Water Services is using Superscape virtual reality software to visualise renovation methods for the Victorian sewerage system in Cathedral Close, Exeter. Colin Howels, Project Engineer within the Sewerage Section remarked that he was extremely pleased with the system. Then moved on to speculate that such a system may well be useful 'for other projects in sensitive areas.' Ctrl Break looks forward eagerly to the first 'visualisation' of a sewage dump. Well, we've always been rather fond of the English seaside.

PRIZE CROSSWORD



ACROSS

1. Micro micro with crown of branches above (7)
2. Setting variables to 4 dn presumably (7)
9. Cheers in Spain for modern coding system (3)
10. Final hard copies, for instance (7)
11. Unfeeling, like Capek's creation with a chip (7)
12. Our number of bits (3)
13. I follow informatics with head cover back in Pacific island (6)
14. Independent state group with reputedly well-paid leaders (6)
15. Aluminium boride may make vestment (3)
17. Cocks lose nothing on tours of duty (7)
19. Who reads badly, but suceeds? (5)
21. Remove error (5)
24. Linear structures that add traversal potential to a list (7)
28. Call for help in all directions (3)
29. Physical set of coding units worth mounting? (6)
30. Execute most successfully but may be bowled with cricket unit... (6)
31. ... or tennis barrier on the WAN (3)
33. Programmer's cups and that? (7)
34. Terminal appraisal (7)
35. Where people take a break in this part of the program (3)
36. Use a password or condom! (7)
37. O Master, somehow you're the most artistic! (7)

DOWN

1. Guy with an output unit (7)
2. Clicks onto electronic modules (7)
3. Executor has corrosion in his golfing starting point (7)
4. Add to the transaction file or bulletin board (4)
5. Common start? Not one bit! (4)
6. State the parameters again and bounce back (7)
7. One Who Speaks Thus While Batting With Laser Supply (7)
8. Little tropical lizards with sticky paws (7)
15. Evaluate endlessly the beasts of burden (5)
16. Gets the system going with Doc Martens! (5)
18. Access file in Shakespeare's way (3)
20. Final reserved word (3)
21. 1 ac's largest sibling? (7)
22. Swagger of Indian not tailed to a party (7)
23. It's too often input and thus output! (7)
25. Reflexive procedure? (7)
26. Up with a pectoral feature (7)
27. Simultaneous beginning (7)
31. Groups of ten raggedly return to indented structure (4)
32. Mate comes round with programming group (4)

Solution to February's crossword.

ACROSS: 1. BARCODE 5. GARBAGE 9. OUTDO 10. DATA BLOCK 11. IRRADIATE 12. TOTEM 13. STIFLES 15. SECTORS 18. SEGMENT 21. ROUTINE 24. ALOOF 26. IMMEDIATE 27. NOT UNITED 28. ARCED 29. RUN TIME 30. NON USER **DOWN:** 1. BIONICS 2. RETURNING 3. OVOIDAL 4. ENDEARS 5. GATHERS 6. ROBOTIC 7. ABORT 8. ESKIMOS 14. EON 16. EGO 17. OLIGARCHS 18. SCANNER 19. EFFENDI 20. THISTLE 21. RAMADAN 22. UNDRAWN 23. EMENDER 25. OFTEN

This crossword prize is Microsoft's CD Cinemania. The winner of January's crossword prize was Chris Hobbs. Please send your entries to the address on the top of the next page.

The prerelease was second in the EXE Developers' Challenge.

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Firewalls and Internet Security
Repelling the Wily Hacker

From the very first few sentences of this book (and even the cover) I felt as if I was chatting with someone very knowledgeable but approachable, rather than being lectured by a dry, cloistered academic. I liked that approach. This is a feat made all the more remarkable by the subject matter: security. A rather negative topic not usually the substance of a 'good read' even for a software engineer.

The authors, Messrs. Cheswick and Bellovin, are Senior Researchers at AT&T and much of the book's appeal lies in the fact that they are sharing experiences of Internet security issues learnt at first hand over a considerable period of time. They also reveal details of attempts made to hack into the AT&T corporate network and in doing so create a profile of a typical hacker.

The second chapter provides an overview of TCP/IP, the Internet's protocol suite. This section provides just enough detail to support the rest of the book, and indeed I would recommend it as a good, concise introduction to TCP/IP in its own right.

The book outlines details of many known security holes caused by poor procedures, negligence and bugs, and fortunately describes how to plug these 'Achilles Tendons'. It deals with the full gamut of Internet-related security issues, starting with the mundane, though most common cause of compromise, the issue of passwords, through to the various types of firewall and on to encryption techniques. Also covered are the related issues of operating a sensible event logging policy and carrying out security audits.

The book manages never to leave the reader in a state of despair because a remedial action is always presented to combat every potential route through a system's defences. Much of the software described in the book is freely available, and a comprehensive listing of all such software including full instructions on obtaining it are given in an appendix.

A significant section of the book deals with some non-technical issues such as; 'Picking a Security Policy', 'The Ethics of Computer Security', 'Computer Crime Statutes', 'Log Files as Evidence', 'Is Monitoring Legal' and 'Tort Liability Considerations'. The latter two subjects are particularly alarming as they contain examples of how the law can stand against system operators rather than the hacker. Apparently, in some US States, the act of monitoring a hacker's activity can be construed as illegal tapping, in much the same way as telephone tapping. The section on Tort Liability is equally worrying as it describes how failure to prevent a hacker gaining access to your system could result in your organisation being prosecuted for negligence, especially in the situation where the hacker gains access to confidential personal information.

For me, and I suspect many others, one of the highlights of this book is a complete chapter devoted to the description of the authors' encounter with a particular hacker that they named 'Berferd'. It chronicles Berferd's initial attempts to gain access and how the authors allowed him in to the computer on their terms. They created an environment that seemed normal to Berferd but which was really tightly controlled, trapping him in a virtual padded cell, where there was nowhere to go but back out. Fascinating stuff!

Verdict: An essential read for every Unix system administrator, whether on the Net or not.

Title: Firewalls and Internet Security: Repelling the Wily Hacker
Authors: Bill Cheswick and Steve Bellovin
Publisher: Addison Wesley *ISBN: 0-201-63357-4*
Pages: 306 *Price: £21.95*

This method of providing security is often known as a proxy system, because a connection is first made to an intermediary who establishes the circuit to the intended destination on behalf of the requester. Such a system of proxying can also be employed for purposes other than security, for instance to make use of a central cache of information, as in the case of a proxy **WWW** server.

Circuit-level firewalls are often used to provide transparent outgoing connections to services that are not allowed for inbound connections. Unlike application-level firewalls, circuit-level firewalls do not impose a great burden on the firewall host or slow down communications speed significantly.

Security service

An *application gateway* operates at the service (or port) level and hence for each service there is specific software that understands it and is capable of operating some very sophisticated security mechanisms. For a specified set of services, such as **SMTP**, Domain Name System (**DNS**), **FTP** and **telnet**, the gateway provides the only means into and out of the local network. Any other services that the gateway does not support are simply not available.

Firewall software at this level is capable of tracking the full context of all transactions going through it and of understanding the semantics of the data. This level of intelligence can be used to provide such services as checking for viruses or preventing the retrieval or sending of files with certain pathnames or permissions.

The complexity of application-level firewalls climbs steeply as software to handle 'through-services' such as **FTP** and **WWW** are made available.

Compulsory reading

To anyone serious about securing their system from unwanted intrusion, they should start by obtaining a copy of *Firewalls and Internet Security* by Cheswick and Bellovin (see the review in the box). However, as software and protocols are evolving continually, it is important to keep on top of the situation by joining an appropriate mailing list and one or more of the various security-related newsgroups (see Figure 3). ■

Newsgroups	alt.security, comp.security.misc, comp.security.unix
General Information (inc. FAQ)	http://www.tis.com
Firewalls mailing list archives	ftp://ftp.greatcircle.com/pub/firewalls/archive
Internet firewall toolkit and papers	ftp://ftp.tis.com/pub/firewalls
Papers on firewalls and break-ins	ftp://research.att.com/dist/internet_security
Texas AMU security tools	ftp://net.tamu.edu/pub/security/TAMU AND http://net.tamu.edu/security.html
SOCKS package	ftp://ftp.nec.com/pub/security/socks.cstc
Mailing List	Send mail to Majordomo@GreatCircle.COM with "subscribe firewalls" in body (NOT in subject).

Figure 3 - More information on Firewalls

Paul Richardson is a director of Motiv Systems Ltd, a consultancy specialising in Open Systems, interoperability and the Internet. He can be contacted on 01223 576318 or by email at paulr@motiv.demon.co.uk.

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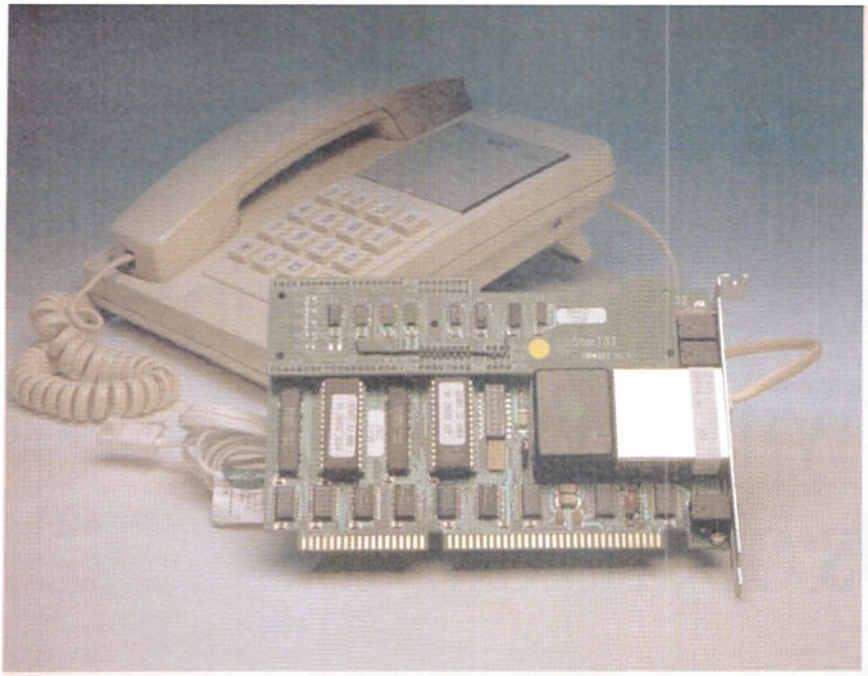

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classes and the C++ module must be linked in. It then goes through the usual process of preprocessing and linking with the addition of the pointer translation required by Objectivity/DB. If all is well you get an executable. Figure 2 shows a simplified view of the process involved.

Relations

Although from a programmer's point of view the persistence mechanisms are interesting, from a business perspective the *raison d'être* of a database is to extract data in various ways. How good is the query support in Objectivity/DB? In a previous article (EXE, November 1994) I used a set of guidelines outlined by Mary Loomis (1) to evaluate the query support offered by Poet. For the sake of comparison I will use these again.

Quantification. is the act of determining if there are any instances which match a given criterion and performing a predefined action for all matches. Generally this sort of query will involve matching class attributes. It does so mainly by creating an index. I will ignore the apparently undocumented 'predicate scan' method. An index exists at the container level and can be used for all objects in that container. Although creating an index introduces an extra step in the process there are a number of advantages. The most obvious is speed. Also, one index can be used in many containers (and as you would expect one container contains many indices). So if we want to search for all cars with more than three passengers we have to create an index on the attribute as shown in Figure 3.

Although this index only has one field you could sequentially add several fields and index on these. Now the index can be used with an iterator to extract instances of the `Vehicle` class using `_noOfPassengers` as a criterion. The operators that can be used are `=`, `>`, `<`, `>=` and `<=`. With Objectivity/DB the objects matching the criteria are retrieved one at a time, compared to Poet in which they are placed in a set.

As is probably apparent there is a great deal more code to be written than the succinct commands available to the SQL users. For instance in relational databases users will use `SELECT`, `FROM` and `WHERE` to draw data from several tables. The result of this could then be used in a further query. In Objectivity/DB (and I believe in other OODBMS) queries are class specific and the unit extracted is an instance rather than an attribute. Because queries are class specific it is not possible to have one query spanning several classes.

Boolean functions allow search criteria to be combined using `AND`, `OR` and `NOT`. The Query Browser (ie the poor man's SQL) supports these in their usual '`AND`, `OR` and `NOT`' form. However the support in the C++ classes is more disguised. For example if we want to search for all instances in which the number of passengers is greater than 3 *and* the number of wheels is greater than 4 (full Robin Reliants?) the sequence would be as follows. First create an index as above but specify that it will have two fields. Next add the `_noOfPassengers` field and then the `_noOfWheels` field and then create the index. The code in Figure 4 lists how we create the look up index. We then initialise an iterator for the index with `lookupkey` as a parameter. However note that all this work is only for an `AND` query. The manual does not appear to consider `OR` and `NOT` queries. We are still working on them.

There appeared to be no support for aggregate functions such as `sum`, `count`, `min`, `average` either in the Query Browser or the C++ classes of Objectivity. Nesting Queries allow the result of one query to be used directly as the scope for another. Although appropriate in relational databases, because OODBM queries are class-based it is not relevant. It is logically the same as combining the queries in the first place. Nesting, in an OODBM context, occurs when we can query a class within a class. Rather to my surprise I discovered that 'the DDL does not currently support classes defined within persistent classes or within classes that are embedded or inherited from persistent classes.' So if we cannot put it there we certainly cannot query it!

Poor man's SQL

The program is written and the makefile edited, using the normal C++ editing environment. The 'look and feel' of Objectivity is revealed through the Tool Manager. This is a graphical tool for application development and includes various browsing and debugging tools. It also allows us to set up ad hoc

Spoilt for choice

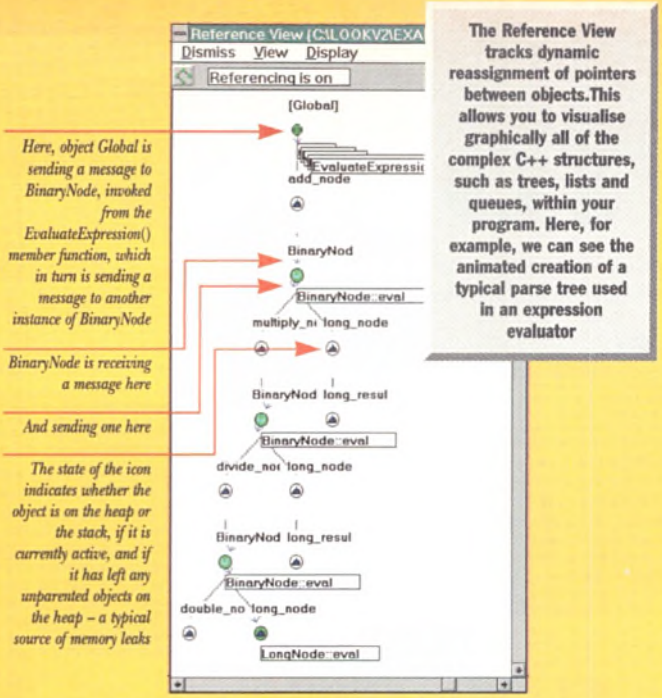
Every University has a need to explore the forefront of computing. A few months ago we decided that a topic worth pursuing was Object Oriented Databases. We have taught Oracle for several years and so had an established foot in the database camp. In more recent times we had jumped onto the Object Oriented bandwagon with fervour. Moving into object oriented databases seemed a natural place to go.

The main object oriented analysis and design method taught is Rumbaugh with a little dabble into Booch, Coad and Yourdon and Wirfs-Brock. For the implementation we use C++ and had hit persistence problems. I had tried to solve this by providing the students with a container class that saved records to a file, but under duress it proved vulnerable! We either needed a class library or an OODB. We opted for an OOBDMS. There were only three problems; we did not have much time to research it, we did not have much money and, in truth, we did not really know that much about object oriented databases. But one should not be deterred by the details.

It is generally acknowledged that there will be a lot of fallout in the OODB market in the next few years. Only a small proportion of the current vendors will survive. The major players are Versant, O2, Object Design and Objectivity. With hindsight the way to identify the major vendors would be to ask who is involved in setting standards for OODBMS?, Who is represented on ODMG-93? The outcome would have been the companies named above plus Poet, ONTOS and Servio.

In an attempt to be rational we then tried to draw up some criteria. A key feature, needed in the short term, was the ability to use the OODB with non programming students on a database module. In the longer term we will develop a module focusing on using the OODB via C++. So a leading question was 'does the OODB have a SQL type interface?' This is probably not the main criterion used by buyers of OODBs. I have listened to several arguments about why it is inappropriate to use a SQL type language to query an OODB. While accepting the limitations of this, the facts are that a SQL query language is part of the ODMG-93 specification and not everyone has mastered C++. My impression is that producing C++ and Smalltalk based versions for a variety of platforms is a higher priority than the SQL type interface. Obviously OODBMS are intended for men (ie C++ users) rather than wimps (ie SQL types).

As a prospective purchaser we not only had an unusual need but we did not know what hardware platform it would run on! This seemed to confuse everyone. The reason was that the university was investing heavily in new equipment and there were many possible permutations of hardware and operating systems. Finally out of the confusion came a decision. We would get Objectivity because the company offered us a good price and I saw and used a SQL interface at an exhibition, which appeared easy to use.



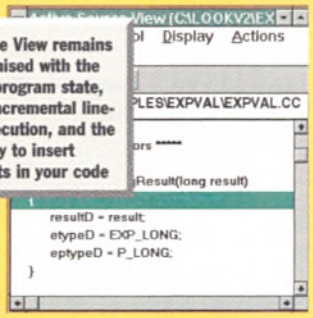
Here, object Global is sending a message to BinaryNode, invoked from the EvaluateExpression() member function, which in turn is sending a message to another instance of BinaryNode

BinaryNode is receiving a message here

And sending one here

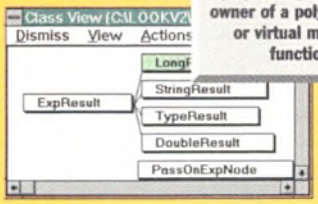
The state of the icon indicates whether the object is on the heap or the stack, if it is currently active, and if it has left any unparented objects on the heap – a typical source of memory leaks

The Reference View tracks dynamic reassignment of pointers between objects. This allows you to visualise graphically all of the complex C++ structures, such as trees, lists and queues, within your program. Here, for example, we can see the animated creation of a typical parse tree used in an expression evaluator



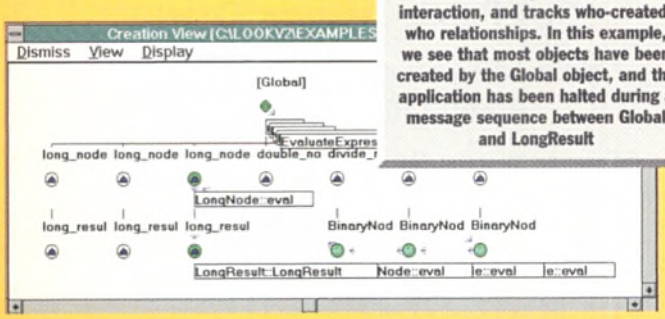
The Source View remains synchronised with the current program state, allowing incremental line-by-line execution, and the ability to insert stop-points in your code

Like all other views, the Class View is synchronised with the current state of the program, and is particularly effective at pinpointing the exact owner of a polymorphic, or virtual member function



This Class View shows that LongResult is the currently active class, this means that a member function defined in LongResult is now executing. For large applications, when you only want to view a small proportion of the total object population, the Class View is one place where you can specify filter criteria that exclude classes and member functions of no interest. LOOK! comes pre-supplied with skeletal filter sets that operate on OWL and MFC libraries

The Creation View depicts an animation of object creation and interaction, and tracks who-created-who relationships. In this example, we see that most objects have been created by the Global object, and the application has been halted during a message sequence between Global and LongResult



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Practically speaking...

At the time of writing, the current Windows 95 beta SDK documentation appears to be in a sort of no-man's land between the Windows 3.1 and Windows NT documentation. It is not 100% clear how much of the foregoing relates to Windows 95 programming. For example, Windows 95 doesn't support security descriptors. As a consequence we might be tempted always to pass a value of `NULL` for the `lpThreadAttributes` parameter in the call to `CreateThread`. Doing so would be a mistake. Wherever possible it is far better to write our program as if we were coding for Windows NT. Aside from the fact that (if Microsoft has its way) the whole world will be running NT in 10 years time, Windows 95 is designed to 'stub out' the NT-specific calls where it makes sense to do so.

Further threading

This brief intro has only touched on the basics of thread management. A complete working example program is available with this article. Figure 3 lists the thread routines. See below for obtaining complete code. Other issues include the allocation of so-called 'thread local storage' (storage on a per-thread basis), setting thread priorities and thread synchronisation, about which a whole book could - and probably will - be written. I would recommend the interested reader to Richter's book for a more in-depth coverage. ■

Handles as resources

Under Windows NT, as well as bitmaps and icons, certain types of handles are themselves considered 'resources' which must be deallocated in the appropriate way. A thread handle, for example, must be closed through a call to `CloseHandle`. If this isn't done, then Windows NT can't properly clean up when a thread terminates.

For example, suppose that Thread A creates Thread B. This means that Thread A will receive a thread handle for Thread B via the `CreateThread` call. If Thread A disposes of this handle by calling `CloseHandle`, it is effectively telling NT that it is not interested in referencing Thread B directly from Thread A. NT will then be able to perform a complete cleanup when Thread B terminates.

Conversely, if the `CloseHandle` call isn't made, then NT will have to retain certain data structures in memory even after Thread B is long dead on the off-chance that Thread A might make some sort of enquiry using the handle for Thread B. Conceptually, a thread handle is a handle to some 'thread object' which has an associated usage count. Calling `CloseHandle` decrements the usage count. When the thread terminates, the thread object is deallocated provided that its usage count is zero. According to Jeffrey Richter, author of *Advanced Windows NT*, failure to call `CloseHandle` is one of the most prevalent bugs in NT software.

A pseudohandle (in the current discussion) is a handle to a thread which doesn't need to be closed. Retrieving a pseudohandle doesn't increment the thread object's usage count. Calling `CloseHandle` with the pseudohandle does nothing. A pseudohandle is a sort of no fuss handle, but it is only valid in the context of the thread.

Dave Jewel can be reached on email as djewell@cix.compulink.co.uk. For example program, send disk and SAE to EXE Magazine, St Giles House, 50 Poland St, London W1V 4AX. Label envelopes 'Threads'.

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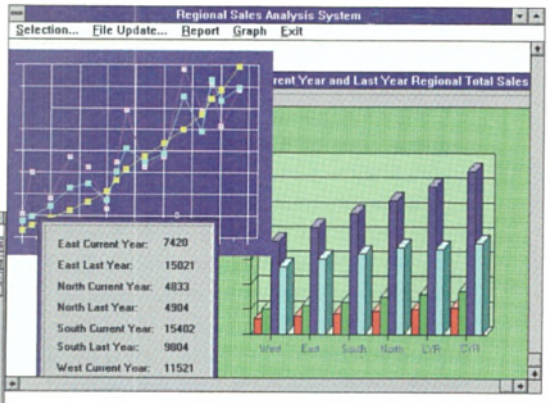

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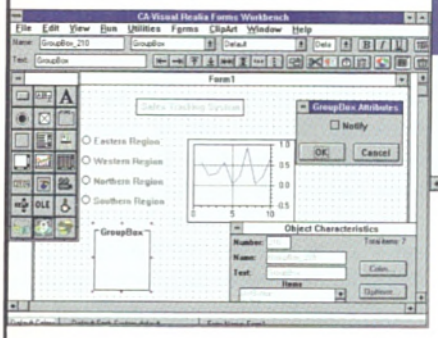

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then becomes quite simple (see Figure 5). I will be able to develop persistence for the database and steadily develop my other skills: implementing linked lists, file handling, alternative sort algorithms, variable field sizes and so on. I can do these things because I have found the secret of programming, localise implementation details and encapsulate functionality.

Many programming problems benefit from this simple use of C++ without needing anything more. Note that I have said nothing about overloading (function and operator - they are different with different rules), templates, namespaces, exceptions, derivation and dynamic binding. All those things and quite a bit more are valid and useful tools in C++ but the programmer must learn to use the tools appropriate to the job at hand. In this way programming is no different from any other craft. Too many moving to C++ are dazzled by the wealth of tools available and deluded by the much hyped concept of object orientation. They finish up with poorly designed code relying on unnecessary complexity.

```
#include "database.h"
#include <iostream.h>
int main(){
       Database bb;
       Record r;
       r.name("francis"), r.telephone("01865 246490");
       cout << "Enter three items in the form 'name, phone'"
            << "  press enter at the end of each complete item"
            << endl
       for (int i=0; i<3; i++)
                bb.record(i,cin);
       bb.listall(cout);
       bb.record(1, r);
       bb.listall(cout);
       cout << bb.getrecord(0) << endl;
       return 0;
       }
```

Figure 5 - TESTMAIN, the client code

The 'right thing'

Do not misunderstand me, object orientation has much potential but the C++ programmer has to learn when to use it and when something simpler will do just as well if not better. The programmer's job is to write code which meets the problem specification as quickly as possible having due regard to future maintenance costs. Both over-designed and under-designed solutions will take longer to implement and will be more expensive to maintain. Like Goldilocks we have the problem of finding the version that is just right. If you understand your craft you will find C++ often has just the tools you need but it is not a miracle language. So it will support both appropriate and inappropriate code solutions. It is for you, the programmer, to be responsible; take the blame and take the credit. Next time I will look at some aspects of using C++ as an OOPL. ■

Subscriptions: individual £14, student £7, corporate £75, Overload & C++ SIG £15 (+ACCU membership). For further information about ACCU write to Francis Glassborow, 64 Southfield Road, Oxford, OX4 1PA, ring 01865 246490 or email francis@robinton.demon.co.uk.


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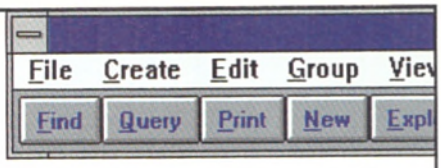

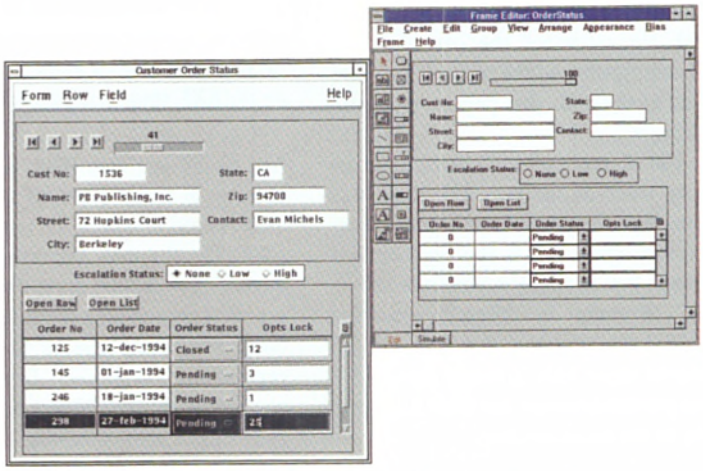

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Mayhem!

When is a GUI like a desktop? Never, says **Jules**. That's just the problem...

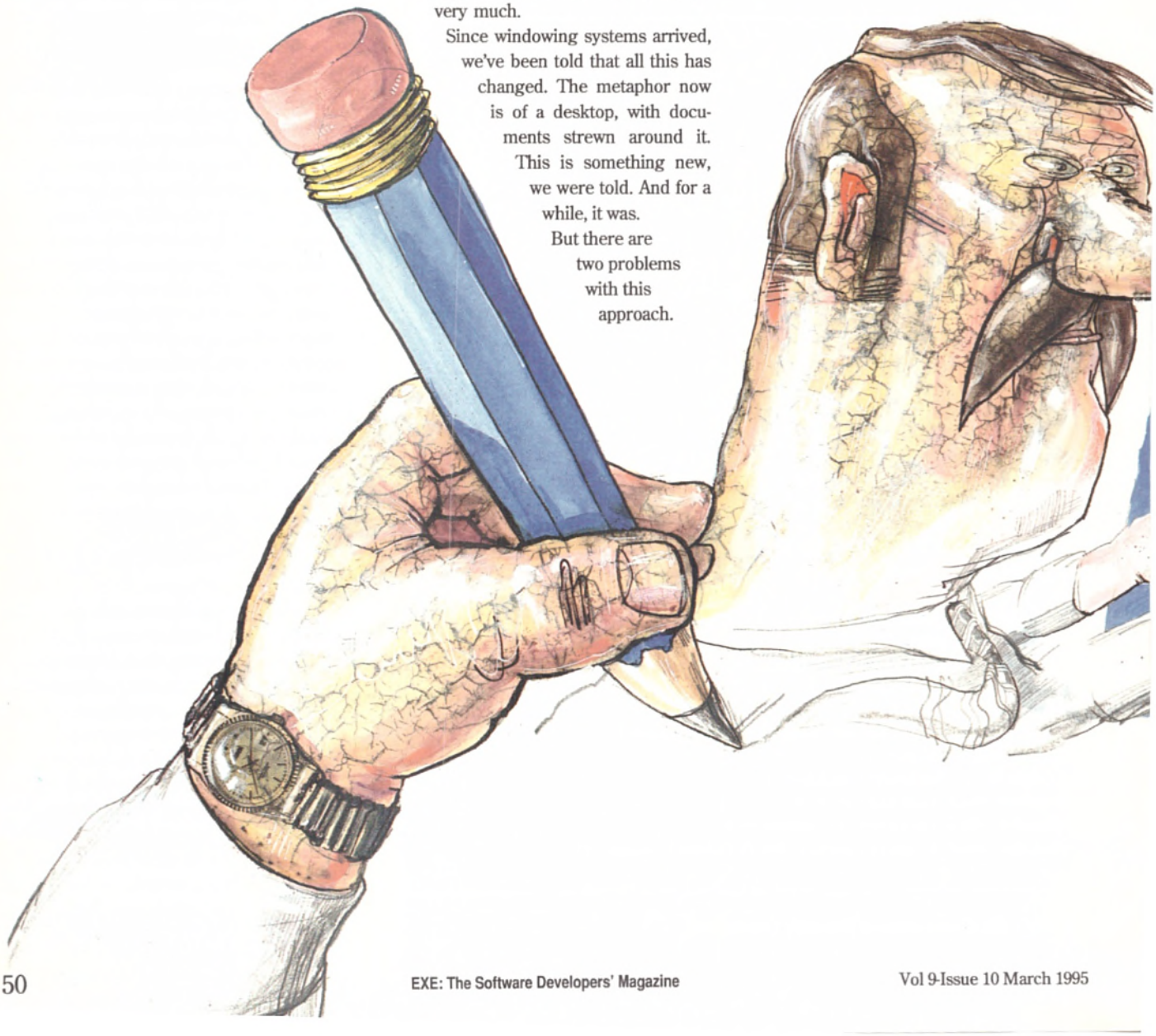
All computers, all the time, are pretending to be something they're not. A program creates and represents things with which the user is familiar; things like words, files, documents and so on. This is the only way that a user can gain access to the immense power that the computer can wield.

Originally, of course, the user had to contend with learning a set of commands, which acted upon passive data which was loaded from files. In this sense, the user interface was very much like the metaphors that the programmers used. Both required considerable training and both provided considerable intellectual freedom. The move to put these commands onto menus eased the learning problem, but didn't really change very much.

Since windowing systems arrived, we've been told that all this has changed. The metaphor now is of a desktop, with documents strewn around it. This is something new, we were told. And for a while, it was.

But there are two problems with this approach.

Firstly, these computers were placed onto people's desks. Presumably the desks were needed because the computer didn't entirely mimic what a desktop could do. The paperless office is still a distant possibility. What was more serious, though, is that a desktop is fundamentally a stationary device. You can't take your desk with you on a train. You can't take it home and it's hard to justify having two of them in a single office. As long as the computers were sitting on desks this wasn't too much of a problem. But the next great market battle will be in portable machines. Trying to make an incomplete version of the desktop metaphor work on a train strikes me as entirely futile.



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ion/JPI will have to move a *long* way towards Microsoft compatibility, rather than ANSI conformance, if it wants to make serious progress with Windows developers. However, serious DOS developers may want to take a closer look, if only for the DOS-level DLL facility.

GNU g++ compiler

g++ is the Free Software Foundation (FSF) C++ compiler. It has been ported to a variety of platforms including Unix, Solaris, Amiga, VMS, OS/2 and DOS. Several ports for other platforms are under development in various locations around the world, as the source of g++ is also freely available.

As the ultimate in budget C++ compilers, g++ would seem at first sight to be ideal for beginners and for experienced programmers in other languages wanting to get some experience in C++. The DOS g++ is a 32-bit compiler which comes with its own DOS extender. The version being tested is DJGPP v1.12 maint 1. This is D J DeLorie's port of the FSF gnu g++ version 2.6.0. There is another port, called EMX (ported by Eberhard Mattes), which is available to run under OS/2 or DOS.

Eventually, I would expect the GNU g++ compilers to be available on most common platforms with the possible exception of Apple products. There appears to be some fairly serious disagreement between Apple and the FSF. This has resulted in statements on the Internet that: 'Because the legal policies of Apple threaten the long-term goals of FSF, as well as the concept of free software, no support will be lent to efforts to port GNU software to the Macintosh or other Apple hardware.'

It is difficult to take seriously Clarion's claim of being able to target Windows development

Zip anarchy

The FSF software is available in many places. Much of it is carried in the `free_software/dos_ports` conference and topic on cix. It is also available on CompuServe, and on any number of Internet ftp sites, including `src.doc.ic.ac.uk`, `ftp.mcc.ac.uk` and `unix.hensa.ac.uk`. Downloading the ZIP files from the `free_software` conference in cix took a while. It was hard to be sure which ones I wanted, so I ended up downloading more than I needed. It came to just a touch under 10 MB in just under 30 ZIPs. Several false starts were caused by the fact that some of these seem to be from different versions of the compiler! Eventually, I found I only needed a few of them to get started. However life was not made any easier by the fact that the ZIPs did not all use the same version numbering system. When expanded they consume around 4.5 MB of disk.

ANSI but watch out

The gnu compiler is supposed to be ANSI standard, with support for templates, although there is some comment in `comp.lang.c++` which suggests that there may be a couple of bugs in the template system. Certainly these seem no more serious than the level and type of bug commonly found in commercial products. The version of compiler tested does not seem to support exception handling - `try` is reported as an undefined variable, not as a reserved word.

Remember the day...

It's impossible to talk about a features list purely in terms of the g++ compiler. FSF GNU products generally include a wide range of tools. There is the g++ compiler itself, an emacs-style editor, a vi-like editor,

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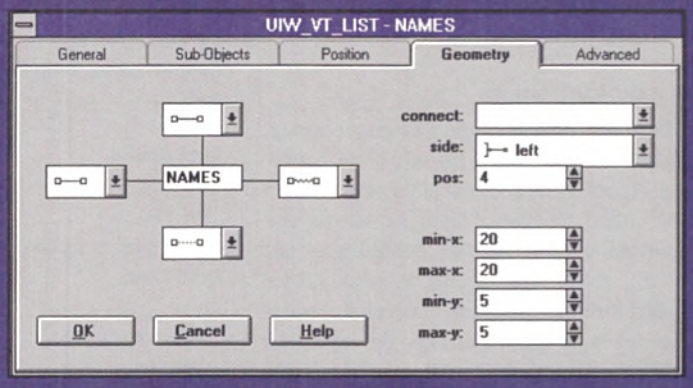

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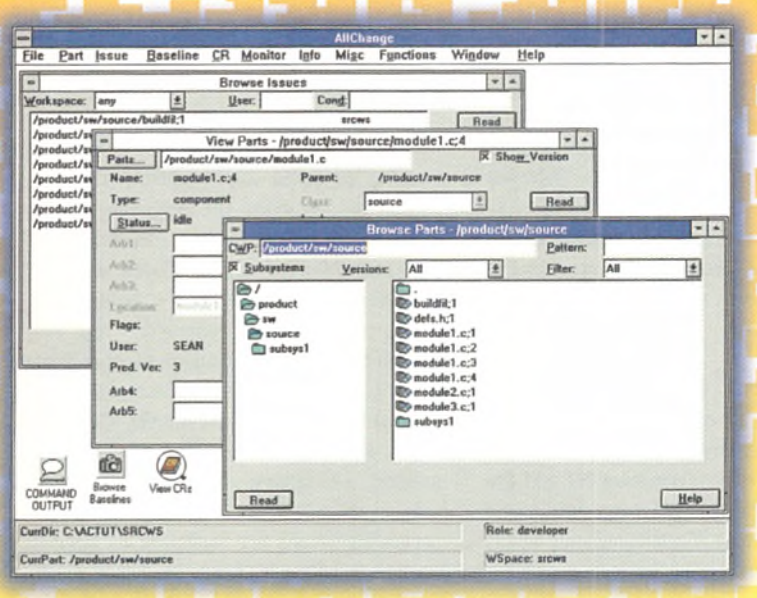

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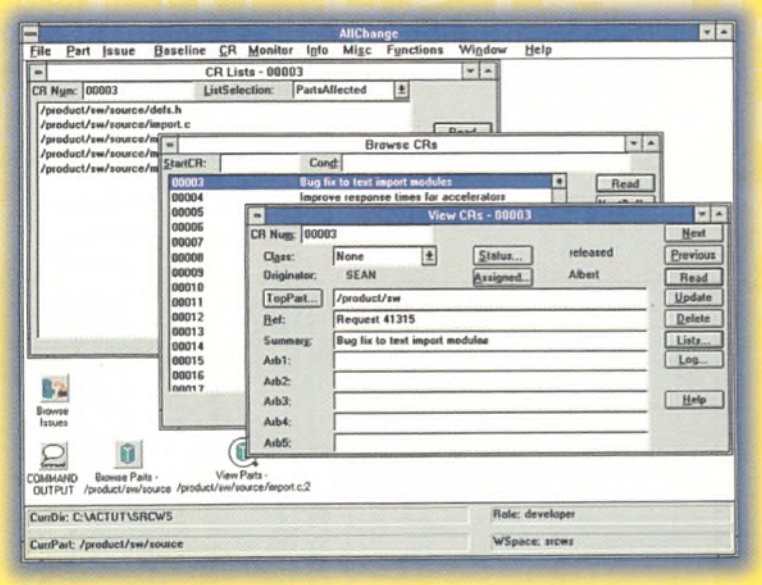

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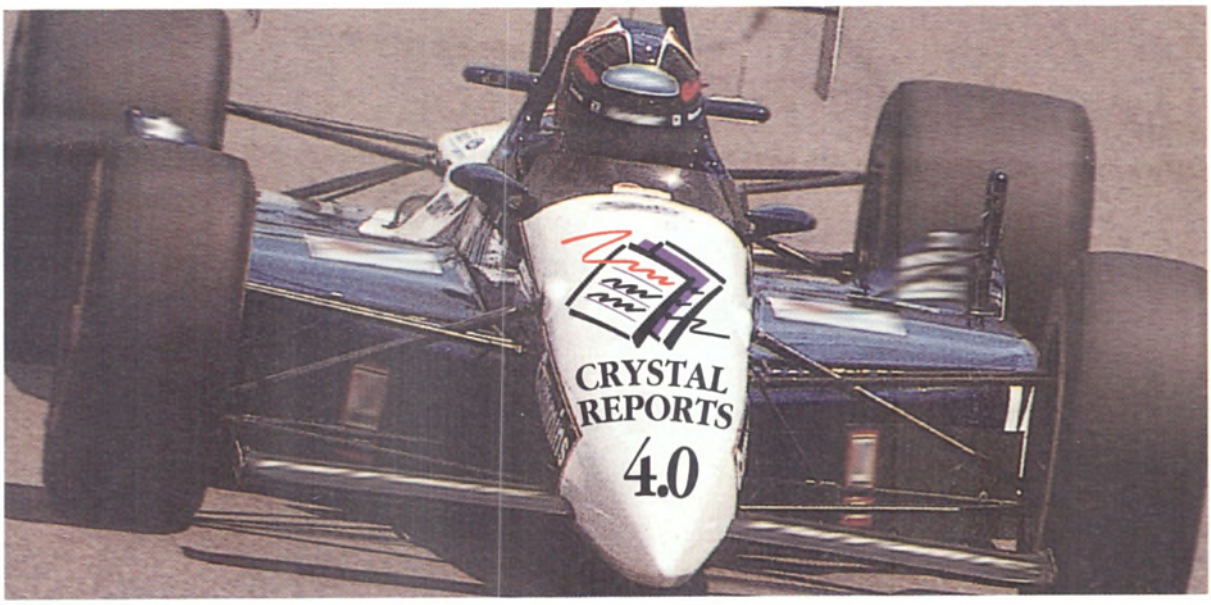

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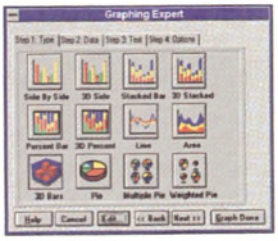

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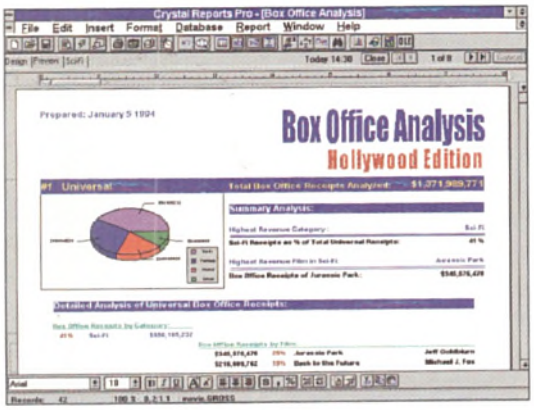

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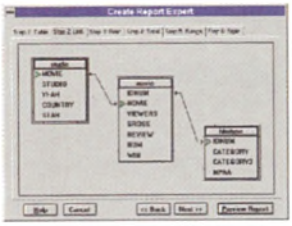

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ISINDEX

Instead of using the <FORM> tags, we can use the even simpler <ISINDEX> HTML tag, somewhere in our HTML document. This presents an edit box with a prompt asking the user for their query. The text is encoded and passed back as a query, ie appended to the current URL after a question mark.

Now if the original URL (containing the <ISINDEX> tag) is just a HTML document, then it will not know what to do with such a query. Although the documentation does not say so, the only practical way of using <ISINDEX> queries is as follows: the original URL must be a program. If the program has no query then it outputs the required HTML containing the <ISINDEX> statement. If the program has a query then it knows that it must be the result of its earlier emanation, and so can process the result accordingly. All this may it not seem worth while. Perhaps it might be useful if we know that a certain browser does not have forms capability.

Getting around empty fields

As mentioned earlier, it is a complete bore if the user does not fill a form in fully. After an error message has been returned, all the user's efforts so far are erased. This is a sure recipe for disenchantment. The way round this is to make the original form the output of a program. The form results get sent back to the same program. If all is well then a nice confirmation notice is returned. Otherwise the program can output the original form with all the user's valid entries as defaults. This technique might be foiled if the browser caches the original form.

Applications

PC executables can be used in two ways: either to provide plain hyper text URLs or to receive the results of a form. In the first category, we might want to return real time information. For example, when called our executable might take a snapshot of the office coffee machine and return it as a GIF image. Alternatively, a program could log who has used it and when, or retrieve data from another source.

Executables that process the results of forms will usually want to store the information returned; as well as send a confirmation message back. Perhaps we could send a fax to prove that it has got through. Alternatively forms could provide a querying interface, so that our program goes away and does a search on the given details and returns the results as an HTML message. Note carefully that our program runs on the server PC, not on the user's computer. If we receive text back which is a command of some sort we should consider the security implications carefully.

HTML basics

An HTML document is plain ASCII text marked up with various tags. Some of the tags come in pairs, eg <B> and </B> for bold text, while other occur singly, eg <P> for paragraph breaks. Browsers ignore white spaces, including line ends, so we have to put <P> for paragraph breaks. However, headings <H1></H1> (the biggest) to <H6></H6> are placed on lines by themselves. If we have text that is in a set format, eg program code, then placing it within <PRE> </PRE> preformatted tags preserves the white space and line breaks.

The document should be enclosed within <HTML> </HTML> tags with a header and body in between. But these tags can be missed out. Note that the various lists can be nested. The <A> = tag provides a hypertext link to another document. It can also be of another type, eg an audio WAV or a video clip. It is best to stick to common formats to ensure that users will have the appropriate viewers. Inline images in GIF format are almost always supported. To jump within a document we set up an anchor (eg `<A NAME=chap01></A>`) and do a link to that name preceded by a # character (eg `<A HREF=#chap01> Chapter 1 </A>`).

We show a left angle bracket character with the four characters '`&lt;`' Similarly '>' is '`&gt;`', '&' is '`&amp;`'. We can also do umlauts and other characters with special sequences.

Format/Style	HTML
Comment	! ...
HTML document	<HTML> ... </HTML>
Header	<HEAD> ... </HEAD>
Body	Y ... /BODY
Title	<TITLE> ... </TITLE>
Headings 1-6	<Hn> ... </Hn>
Paragraph break	<P>
Horizontal rule	<HR>
Hypertext link	<A HREF=url> Link name </A>
Anchor	<A NAME=anchor> anchor text </A>
Inline image	<IMG [ALIGN=TOP] SRC=file.GIF >
Unnumbered list	<UL> {<LI> ...} </UL>
Numbered list	<OL> {<LI> ...} </OL>
Descriptive list	{ ... ...} /DL
Preformatted text	<PRE></PRE>
Italics, Bold, Underline	<I></I> <B></B> <U></U>
Fixed width	<CODE></CODE>
Others fonts	<ADDRESS></ADDRESS> <BLOCKQUOTE></BLOCKQUOTE> <EM></EM> <CITE></CITE> <VAR></VAR> <TT></TT> <SAMP></SAMP> <KBD></KBD>

[] optional {} optionally repeated

Other environments

As an aside, we can also write executable programs in other computer environments: the Bourne shell, C shell, PERL, the TCL argument processor as well as C and C++. I think that the API is still called the Common Gateway Interface.

The future

HTML forms are a good way of getting responses from users anywhere in the world, whatever their computer. Writing PC programs that respond to forms, or provide real time HTML, is pretty straight forward. Get connected! Several companies are working on commercial browsers which should get round some of the problems with Mosaic. Also, there is a working group on the next generation of HTML, ie version 3.0, and an associated browser. This may include OLE/OpenDoc style embedding within HTML documents. Could this be more efficient than CGI? Form fields should be improved and client-side scripts should be able to be associated with forms ■

Chris Cant does Windows programming and any other odd jobs for PHD Computer Consultants Ltd, Manchester, on 0161 445 1650 or cant_c@nsa.bt.co.uk. You will be glad to hear that the complete code given in this article is available in electronic format. Send an SAE and diskette to: EXE Magazine, St Giles House, 50 Poland Street, London W1V 4AX. The files are also available from exe/files conference on CIX.

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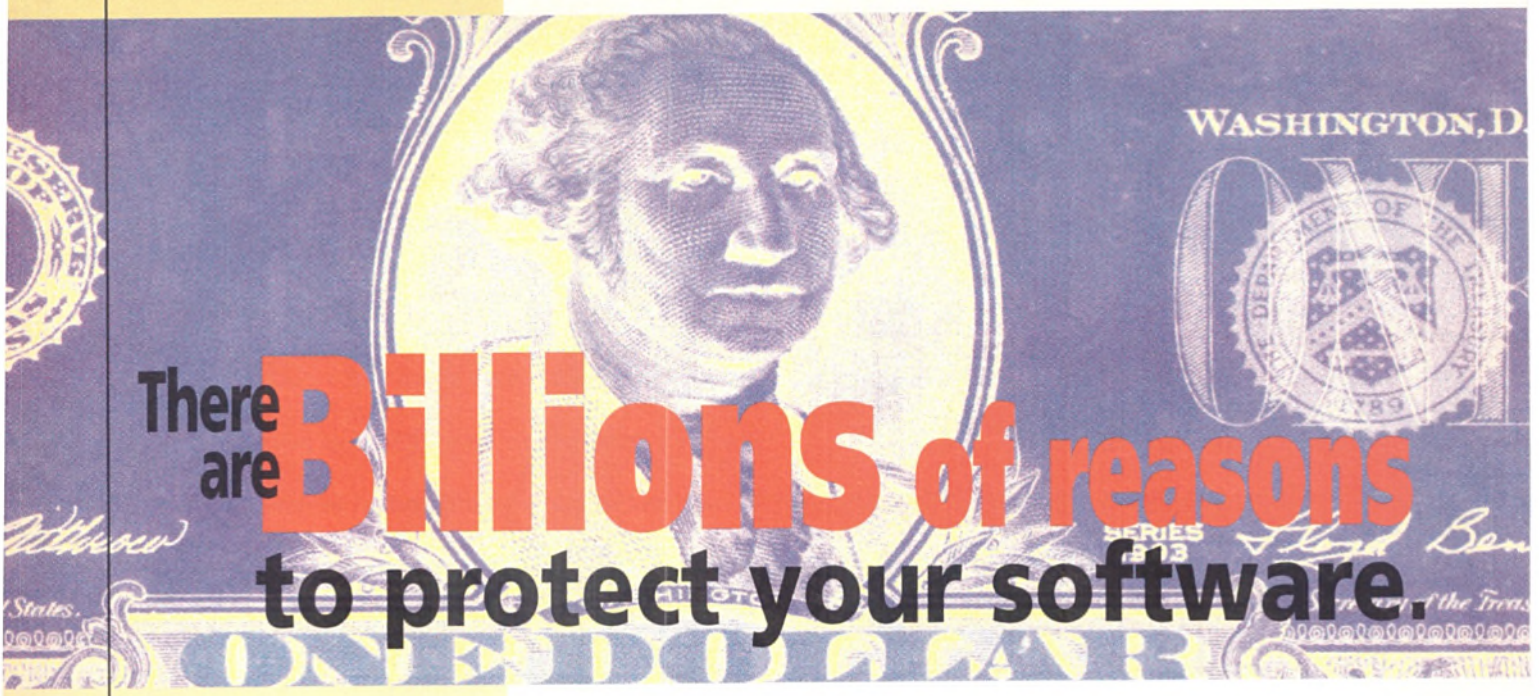

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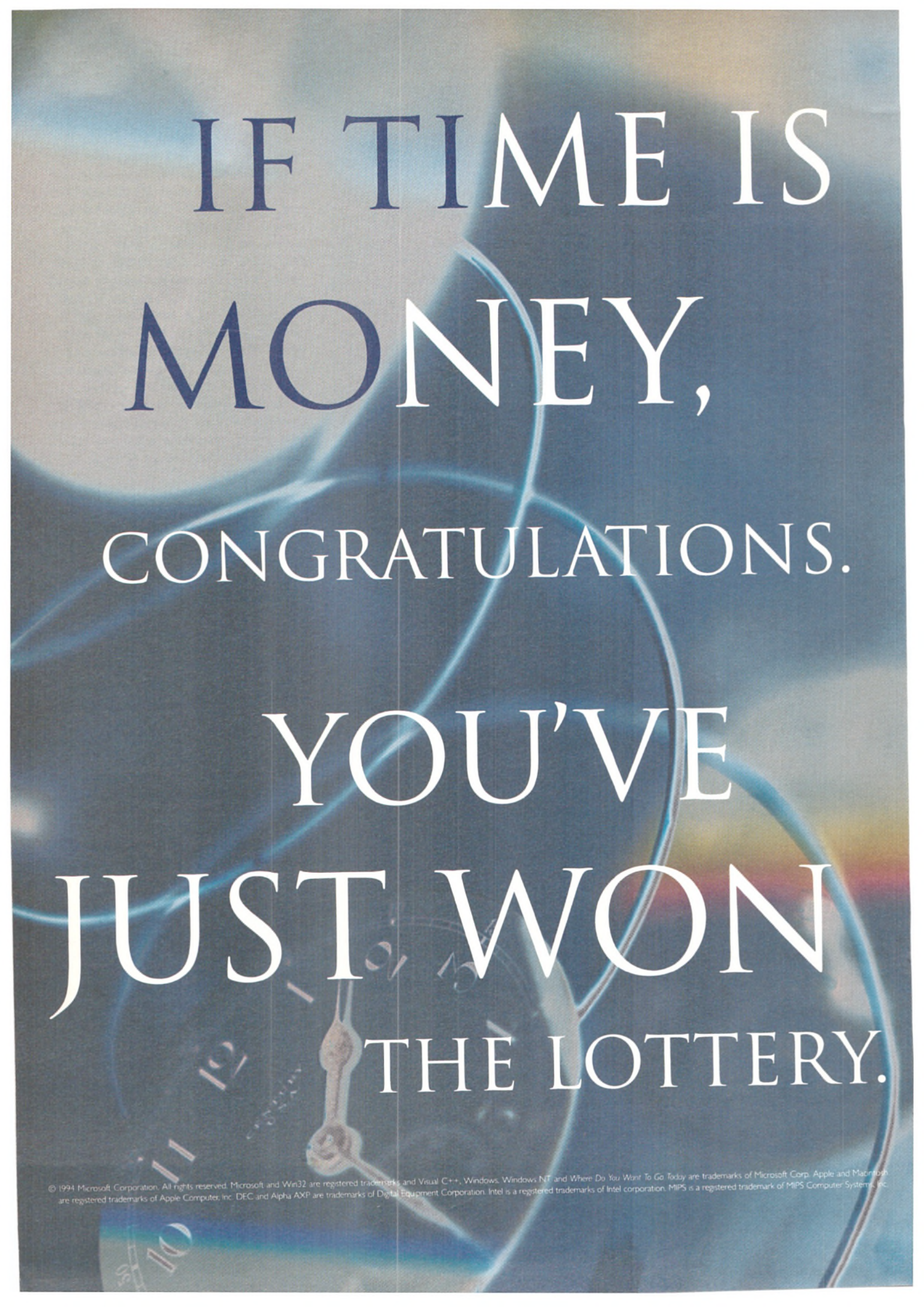

Beyond a browse pt II

Having discussed the intricacies of interactive Web forms in DOS, **Chris Cant** now presents a Windows version

Last month I ended the first half of my article with a DOS demo program callable from a URL. The more useful type of executable that we can write is an ordinary Windows application which has a number of distinct advantages over one written in DOS. For a start, there is no need to run a DOS box. Also, form results can often be decoded automatically. Even the user interface need not be written since the browser will take care of that anyway. Documentation on creating these applications which can be called from a URL usually give examples written in Visual Basic. In this article, however, I will discuss C++ executables, as they avoid having to load VBRUN300.DLL.

Show stopper

`httpd` runs our program with three or four parameters, namely the CGI data file path, the content-file path, the output file path and optionally a string with any query given with the URL (ie after a question mark). The CGI data file and the output file are usually the main items of interest. If the returned data is huge, then we may need to refer to the actual content file. This is in the usual encoded form (eg `'Name=Chris&Pound=Sign+%A3'`). The query string is also copied into the CGI data file, so we may as well pick it up there.

As before, our task is simply to inspect the input data and write the results to the output file. However if we roar through the job then `httpd` loses sync, so we have got to add in a message loop with a timer delay. The other obvious point to make at this stage is that programs should be designed to run to completion. If we detect an error, then we shouldn't simply popup a MessageBox as this will stop everything dead. I write any errors to the end of a log file. If we don't return any valid output then `httpd` or our browser will usually comes up with a suitable message.

DOS Environment Variable	Windows [CGI] key	Description	Example
SERVER_SOFTWARE	Server Software	Server software name and version	NCSA/V1.3Pre (MSWindows)
SERVER_NAME	Server Name	Server host name or alias	localhost
SERVER_ADMIN	Server Admin	Server administrator e-mail address	cant_c@nsa.bt.co.uk
GATEWAY_INTERFACE	CGI Version	CGI Version	CGI/1.1 DOS (experimental) or CGI/1.1 WIN (experimental)
SERVER_PORT	Server Port	Port number	80
SERVER_PROTOCOL	Request Protocol	Protocol and revision	HTTP/1.0
REQUEST_METHOD	Request Method	Request method	GET or POST
HTTP_ACCEPT	The MIME types are listed in the [Accept] section	Path to the list of MIME types that the client will accept	E:\TEMP\HS00A217.ACC
SCRIPT_NAME	Executable Path	Executable path name	/phd-dcgi/form.exe
OUTPUT_FILE	[System] Output File	Output file name	E:\TEMP\HS00A217.OUT
PATH_INFO	Logical Path	Extra path added to URL	/chap01
PATH_TRANSLATED	Physical Path	Extra path info, added to server root path...not much use	C:\HTTPD\chap01
Passed as a command line argument	Query String	Query string appended to the URL	?100,34
REMOTE_ADDR	Remote Address	Client IP address	193.100.100.100
REMOTE_HOST	Remote Host	Client host name	localhost
REMOTE_USER	Authenticated Username	httpd user name	
REMOTE_IDENT		httpd RFC931 identification	
AUTH_TYPE	Authentication Method	httpd authentication method	
CONTENT_TYPE	Content Type	Content encoding: only one type possible:	application/x-www-form-urlencoded
CONTENT_LENGTH	Content Length	Total length of the raw content	60
CONTENT_FILE	[System] Content File	Content file path	E:\TEMP\HS00A217.INP

Figure 1 - Parameters passed by **httpd**.

today come with not only MS-DOS and Windows but also Microsoft Office preinstalled on the hard disk. Office was the top-selling software package in 1993, with revenues just under $500 million, according to Dataquest; it outsold its closest competitor, Lotus SmartSuite, by 4 to 1 in 1993. In turn, Microsoft estimates that 50 percent of its revenue comes from Office (*InformationWeek*, June 27, 1994). Microsoft Office seems more and more like part of Windows. Or is it the other way around? The Windows 95 user interface appears to borrow heavily from that of Microsoft Office.

Microsoft has even added features to DOS and Windows to make them into better platforms for the Microsoft Office applications suite. For example, during the Stac v. Microsoft trial, it came out that one of the main reasons Bill Gates urged the MS-DOS group to include disk compression was that, without it, Microsoft would have a harder time selling the disk-hungry Office suite.

On a broader scale, OLE appears to have been designed largely for the convenience of Microsoft Office. With the Office Developers Kit (ODK) and Visual Basic for Applications (VBA), Microsoft is encouraging developers to write Windows applications targeted specifically at Office. Of course, Lotus and Novell have similar programs to encourage applications targeted specifically at their suites. But given Office's market share, particularly the fact that it comes bundled together with Windows on most new PCs, Microsoft, unlike Lotus and Novell, has a good chance of convincing developers to view its suite as a major development platform.

Lessons from the past

First, accept the fact that Microsoft runs the show. I've seen developers make business decisions, such as using Borland's OWL rather than Microsoft's MFC, simply because they dislike Microsoft. It's okay to resent Microsoft, I suppose, but don't cut off your nose to spite your face.

Second, realise that systems such as Windows 95 will be important and that systems such as Windows NT won't be. Evolutionary changes are much easier for the market to accept. Specifically, products such as NT and Daytona (NT 3.5), and perhaps even Cairo, speak to too small a niche to be interesting. And even the NT sales that do occur don't lead anywhere. Right now I'm running on a network with an NT server, but no software is likely to ever be bought for that server. It sits in a closet that no one touches for weeks at a time. This is not the sort of platform on which to base your fortunes.

Third, remember that what ultimately matters is not technical excellence but market penetration. The two rarely go hand-in-hand. Standards have tangible benefits that are more important than the coolest technical feature. Yes, Windows 95 still uses MS-DOS; no, it's not a pure Win32 system; no, it's not particularly integrated; no, it hasn't been rewritten from the ground up; and yes, it is lacking some nice features found in Windows NT or OS/2. But none of these compromises will hurt Windows 95's chances for success and some will actually help make it a success. Windows 95 will be the standard desktop computing platform for the next five years. That by itself is worth far more than the coolest technology. ■

Adapted by Dave Jewell from Unauthorized Windows 95 by Andrew Schulman, published by IDG Books Worldwide, Inc.

Betrayed

'My job is to get a fair share of the software applications market, and to me that's 100 percent' - Mike Maples, senior vice president for applications, Microsoft ('Microsoft applications unit seeks market dominance', PC Week, November 18, '91). Could Windows 95 be the vehicle which will drive this initiative?

Disk compression belongs in the OS - Stac had a nice ride for a while

Windows 95 will have a tremendous impact on the PC software industry, and almost certainly will be more of a phenomenon than any previous piece of systems software. Yet the product's significance and its likely impact on the industry, are somewhat different from what Microsoft portrays. Microsoft says that its Windows 95 product is a brand-new operating system that completely replaces MS-DOS and has been rewritten 'from the ground up'. But the fact is Windows applications running under Windows 95 will still end up using MS-DOS. Windows 95 is based on the same architecture as Windows 3.x Enhanced mode, which has been available since 1990 (we might as well call it Windows 90). From a technical perspective, Windows 95 is not a revolutionary product. It's just Windows 90+5. Windows 90 Enhanced mode architecture was a far more radical departure from the old real-mode DOS operating system than most of us realised at the time. It is okay for Windows 95 to keep it.

Microsoft also says that Windows 95 is 'integrated'. This isn't accurate either. Windows 95 isn't integrated; instead, it 'just grew'. Windows 95 does have many more features and capabilities than its predecessors, performing many tasks that until now required applications and utilities produced by vendors other than Microsoft. But there isn't much genuine integration at a technical level. It could very well turn out that the only integration we'll see with Windows 95 will be Microsoft's vertical integration, that is, the company's further expansion throughout the software industry. In fact, this is occurring right now. The inclusion of more applications/utilities in Windows 95, the increasing ties between Microsoft Windows and Microsoft Office, the merger and acquisition fever that has taken hold of the PC software business and the limited US Department of Justice (DOJ) antitrust settlement with Microsoft are all signs of a maturing industry. It is the normal activity of the restructuring of an industry from one that once had hundreds, if not thousands, of firms of all sizes, to one with a small number of large firms.

What it means to you...

If you are a software developer or entrepreneur, the brief answer is that Windows 95 should make you nervous. Windows users should welcome Windows 95 as a big improvement over previous versions. But this is short-term. Users too ought to worry about the long-term effect of Microsoft's growing dominance over the software industry. Windows 95 is a big step towards Microsoft's stated goal of supplying 100 percent of your software needs. So the Department of Justice (DOJ) apparently found Microsoft is not in serious violation of the antitrust laws of the US, and the company's goal of owning 100 percent of the industry is merely what every other company in a similar position would want. Nonetheless software developers and entrepreneurs ought to realise fully the special role that Microsoft plays in the software industry: Microsoft is not only the supplier of your operating system. It is also your competition.

Dead end...

Since the incorporation of several major third-party utilities into MS-DOS 5.0 in June 1991, Microsoft has been putting features into its operating systems that once were the turf of other vendors. Windows 95 is the clearest expression of this trend. In other words, Microsoft competes with its own customers. The Independent Software Vendors (ISVs) that make Windows applications and utilities are essentially customers of Microsoft in that they depend on Microsoft for the tools and information necessary to write Windows software. Microsoft intends to expand Windows greatly at the expense of the ISVs it is supposed to be assisting. Here are just a few of the features Microsoft is including in Windows 95:

- Networking
- InfoCenter universal in-box (electronic mail, fax)
- Explorer (a vastly improved shell)
- WordPad (a full-featured word processor)
- Microsoft Paint (a full-featured paint program)
- Hyperterminal (a full-featured telecommunications package)

An impartial observer might interpret Microsoft's approach not so much as 'look at all the work we are doing for you', but instead as 'look at all the avenues we are closing for you.'

In an *InfoWorld* article titled, 'ISVs: Wake up', (June 27, 1994), Windows 95 enthusiast Steve Gibson paints a similar picture of the

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WARPed

Warp is the first multiplatform version of OS/2. As **David Mery** recounts, the differences between OS/2 and Windows are a matter of religion.

Microsoft and IBM announced that OS/2 will be rewritten in 32-bit code, that it will be ported to the RISC architecture and that IBM will modify the Extended Edition so that the Database Manager and the Communication Manager will work on all compatible computers. The first RISC architecture targeted will be the Intel i860. Microsoft and IBM also have advised developers that unless they have already started development in Windows, they should first write their applications for OS/2. Windows is officially targeted only for client workstations *not powerful* enough to run OS/2.

This is the substance of the joint announcement made by IBM and Microsoft in the beginning of November 1989. I guess it was an obvious evolution for Microsoft. In 1988, Gordon Letwin, Chief Architect, System Software at Microsoft published a book titled *Inside OS/2* at Microsoft Press. A full chapter discussed 'The OS/2 Religion'. Strategies and products have evolved since then. The first 32-bit version of OS/2, version 2.0, appeared in 1992 and worked only on Intel i386 compatible microprocessors. The first RISC version is in beta now and works on the PowerPC chip. It is a port of OS/2 Warp version 3 commonly called 'Warp'.

As you know Microsoft has followed another road, even though it seems that it is now 'warping' Windows. Windows 95 does have some 32-bit code and an interface very similar to the Workplace model tried and tested in OS/2 2.x and Warp.

Product	Announce	General Availability	Content
Standard Edition 1.0	04/87	01/88	Operating System, text-based
Extended Edition 1.0	11/87	08/88	Communications, Database
Standard Edition 1.1	04/87	11/88	Presentation Manager GUI
Extended Edition 1.1	04/87	05/89	LAN Support
Standard Edition 1.2	05/89	10/89	HPFS, PM Upgraded
Extended Edition 1.2	05/89	01/90	Remote Database Access
Standard Edition 1.3	10/90	01/91	Performance, System Resources
Extended Edition 1.3	10/90	02/91	Memory req., enhanced comms
OS/2 Version 2.0	10/91	03/92	32-bit Exploitation, WPS
OS/2 Version 2.1	05/93	06/93	Win 3.1 support
OS/2 Warp Version 3	10/94	11/94	4 MB, BonusPak

Figure 1 - OS/2 chronology *(Source: IBM UK)*

Back to basics

OS/2 2.1 was mostly 32-bit code and it also used the Workplace shell as a GUI. So what's different in Warp? First its speed, footprint and overall reliability have been improved. This is the result of a multitude of changes spread all over the base OS. Let's review some of them.

Right at the start, the initial boot process is slightly faster thanks to the use of multiple threads. But if you have many open windows and applications the Workplace shell will still take some time to load up. This is not the only modification of the boot process. When Warp boots a recovery menu can be activated which offer the possibility to boot one of the last three saved archives of system configuration files (including the Workplace appearance), to go to a command line, to start the system in VGA mode or to 'Restart the system from the Maintenance Desktop'. Options in the *Desktop Setting* notebook set the automatic creation of an archive during the boot process or the voluntary saving of system files.

As is true of most operating systems coming from a 16-bit history, OS/2 has some 16-bit code and some 32 bit code. Of course the 32-bit code is faster and sometimes smaller (no need for all the segmentation code). Most of the code that was still 16-bit in OS/2 2.1 has been rewritten as 32-bit code in Warp. This includes Presentation Manager and the majority of printer drivers. All in all the kernel has reduced in size by about 200 KB, even though it has some additional features. On the way, the Workplace shell has been upgraded from being SOM compliant (since OS/2 2.0) to support most of SOM 2.1 functionality. SOM 2.1 was previously called DSOM. It provides an extension to the SOM model which allows methods to be called across different address spaces. Use of SOM across networks is not supported in Warp.

As the little light flicks on and off, disk swapping has the most apparent effect on system performance. That is, unless you have more RAM than hard disk space! So IBM has worked on optimising this operation. All zeroes present in a page are compressed. If a page contains only zeroes then an empty entry is created in the page table but no page is actually swapped. Also

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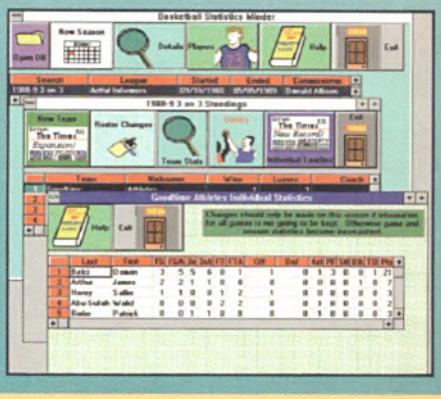

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Breaking the barrier under OS2

Stac claims to have broken the 2:1 compression barrier with the latest release of Stacker. In v4.0 for DOS and OS/2, Stacker takes advantage of the patented Stac LZS compression algorithm and Stac's SmartPack technology. According to Stac, the new release is as much as four times faster than its predecessors. Under OS/2 the Stacker Toolbox is provided which produces reports and alerts users of the state of the hard disk, such as whether it needs to be defragmented or backed up. DoubleSpace, DriveSpace and SuperStor/DS formats can be converted automatically to Stacker. Other features include password protection of hard disk, online help and AutoSave which enables the user to recover data even after a quick format of the hard disk. Stacker 4.0 costs £99. Upgrades start at £49. Stac is on 01344 302900.

Small apps for Smalltalk

Enfin 4.1 is the latest release of Easel's Smalltalk language system. Enhancements include a new event editor for specifying how an application should handle a particular event, and a new text editor with colour syntax highlighting of Smalltalk code. There is a Small Program Generator which allows the developer to reduce the run time size of Enfin applications by specifying classes which can be deleted. Otherwise, all classes are handled into the application. On the comms side, there is a new TCP/IP class and classes for named pipes in OS/2. A class encapsulating ODBC v1.0 is provided. Easel has also included interface components which allow developers to reuse screen components in the same or other applications. Enfin 4.1 costs £3,500 from Easel (01344 304611).

Downright AS/400

Screenview is a new tool from JBA for revamping AS/400 applications. It takes an existing application running on an AS/400 and maps the screens so that, in a remote session from a PC running Windows or OS/2, the user is presented with a GUI. JBA claims that all SAA applications will convert automatically. Non-SAA compliant apps will run only in character mode. Screenview costs £99 from JBA (01789 400212).

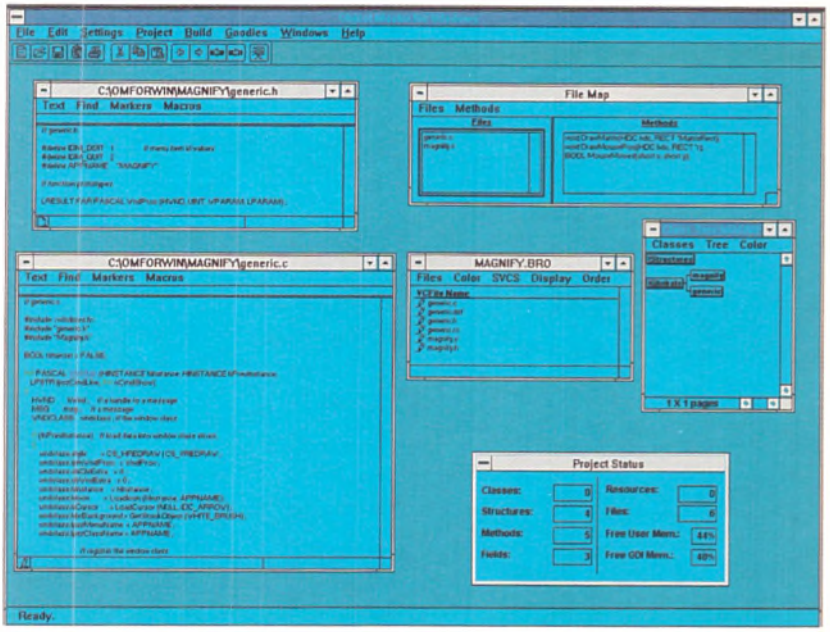
WinZip goes 32 bit

The graphical Windows front-end to PKZip has been rewritten as a Win32s application. This new version, dubbed WinZip for NT, works on Windows NT, Windows 95 and Windows 3.1 with Win32s installed. WinZip for NT is bundled with the original Windows version for £29 and is available from Atlantic Coast (01297 552222).

Windows finds its Object Master

Developed four years ago for the Macintosh environment, Object Master has just been ported to Windows. Object Master is a C/C++ development environment that ties in with most major compilers such as Borland C/C++, MS VC++, Symantec C++ Professional and Watcom C/++. The manufacturer claims it has especially powerful navigational tools. From the class hierarchy displayed in the *Class Tree* window, any number of *Browser* windows can be opened to zoom on methods, procedures, functions, classes or fields. Every time a file is added to a project, Object Master parses the file in order to add all components' details to a data dictionary and to check the source for syntax error. The syntax check is also performed when files are saved. Editing can be done directly in a *Browser* window; once finished, Object Master update headers when needed. Also when adding a new class or a method, a template is automatically created. To enhance readability, the display of procedures, keywords, compiler directives, syntax errors, disabled directives and comments can be colour customised.

Projects are compatible between the Mac version and the Windows one. According to Mark Minshull, ACI MD, Object Master has a user base on Macintosh of over 5,000 programmers. Some, like Chris Knepper, Software Engineer at Taligent, are 'over the moon' about this tool: 'I use the browsing and navigational capabilities of Object Master and I couldn't live without them. We can use Object Master as our complete environment' Object Master costs £159 and is available from ACI UK (01625 536178)



Browsing a project in Object Master

Notes for VB developers

Lotus Notes HiTest Tools for VB is the latest development product announced by Lotus. Jeff Papows, VP of Lotus' Communication Business Group, positions Notes HiTest Tools for VB as a 'significant extension to Lotus' *open* programmability strategy. [It] offers developers an additional choice among tools that include Notes ViP, NotesSQL, the Notes HiTest C API and the core Notes API.'

In this new tool, Notes object are represented by a set of 12 VB custom controls which give access from within VB to Notes' object store. These Visual Controls include several combo boxes representing selectors (for server, database, view style document) which match Notes function, a button for sending mail and some check boxes, edit boxes, etc. To manage these controls, they all have properties and events that can be set by the developer.

When used from an OLE2 compliant application, for instance from Excel using VBA, Notes HiTest can create an OLE automation link between the application and Notes itself. Along with the Visual Controls there is also the Notes HiTest BASIC API described by Lotus as 'an object-oriented API [..] which organises the functionality into high-level objects accessible from VB or VBA'.

Lotus Notes HiTest Tools for VB should be available this quarter at £495. There's no run-time license fee needed to distribute applications. Full installation takes 10 MB. Don't forget that VB or a VBA application is required. Lotus is on 01784 455445.

More power

IBM and Motorola have added a further two processors to the PowerPC family. The 603e is a 100 MHz version of the 603 with 16 KB data and instruction caches. It is aimed at the portable computer market. The SPECint92 rating is estimated at 120. For floating point SPECfp92 is estimated by IBM to be 105. The 602 is the newest member of the family. It is targeting the consumer electronics market. SPECint92 is estimated at 40 and there is a dual 4 KB data and instruction cache.

By George

Documenting its software was becoming a problem at K2 Software Development. It needed a tool which could produce the documentation automatically. So it wrote one. The end result is called George. He's the 'man' who documents code generation and regeneration. The documents created have hypertext links, allowing access to the code base. George is able to compare new and old versions of a document which means that developers don't need to delve into actual code to see what changes have been made. A single user licence of the product costs £3,750. Additional licenses are priced at £1,250. K2 can be contacted on 0161 7778118.

eXceeding NT

Windows NT users can turn their machines into PC X servers with eXceed 4 for Windows NT Release 4.1 from Hummingbird Communications. The company claims its PC X server is the first to comply with X11R6 and supports XTEST, SYNC and font transformation. It includes a scripting language called eXceed Basic and a dial-up facility for remote access to Unix and X applications over a telephone line. There is a remote configuration tool, a local, Motif-like window manager, FTP, Telnet and drag and drop file transfer. eXceed 4 is priced at £425. Hummingbird Communications is on 0113 2467253.

Changes to AllChange

Intasoft has a new version of AllChange, its change, control, configuration management and version control software tool. The biggest change has been the inclusion of a GUI interface both for Windows and for Motif. Under Windows, AllChange presents an MDI application with a separate window for each part of its database. A full audit trail is available with life-cycle status logging, site specifiable Change Request numbering schemes and support for Quality Metrics. Prices start at £1,990 for the DOS/Windows version. Intasoft can be reached on 01392 217670.

But can Oracle pull off its own Visual Basic?

With the slogan 'proof that you can' Oracle has launched a new product family. While it has been christened Oracle Workgroup/2000, it appears that workgroup computing is but one component in the product range. Arguably, for Oracle the most radical product in the range is Power Objects, the final rendition of Oracle's big secret: Project X.

In effect, Power Objects is an Oracle version of Visual Basic. But to call it Visual Basic would be unjust. Rather, it is a client/server development environment, similar to Visual Basic, which has been enhanced to provide true OOP. The similarity to Visual Basic is such that the scripting language it uses, OracleBasic, is syntax compatible. It also supports OCX custom controls. Code in OracleBasic can call external Windows DLLs.

Even the IDE bears a remarkable likeness to Visual Basic. It provides a toolbar of custom controls. A Property window is used to set the style and other properties as in Visual Basic. Power Objects also provides a report painter and a 'local datastore' which is upwardly compatible with Oracle 7. Other database support will include Sybase, Microsoft SQLServer and DB2.

One of the highlights of Power Objects is that, unlike Visual Basic, it is cross platform. Applications developed in Power Objects are portable to all supported platforms without modification. The Mac and Windows version will ship simultaneously. OS/2 will follow later in 1995. Power Objects is expected to be released in the summer.

Another member of the Workgroup/2000 family is Oracle Objects for OLE. This provides developers with a means to access Oracle 7 without the need to call the native API or use a database driver. Instead, it provides full access to Oracle 7 via OLE 2.0 automation. This includes Views, PL/SQL and stored procedures, schema references and In/Out variables. A VBX control is included for accessing the database in Visual Basic, Visual C++, Borland C++ or any language tool that can understand the VBX format.

Class libraries are also provided for run time binding of OWL or MFC widgets to SQL queries. With Oracle Objects, application software like Excel can talk to Oracle 7 using Visual Basic for Applications and OLE Automation. Oracle Objects for OLE is available now for £165.

What is interesting about the whole Workgroup/2000 strategy is that Oracle will be posting on the Internet fully working evaluation version of the products. The trial software is valid for 90 days. Oracle is on 01344 860066.

OO and Visual for new fox on the block

It has happened at last. Microsoft has announced Visual FoxPro. The product is in fact v3.0 release of FoxPro for Windows. It claims that Visual FoxPro is 'the only xBASE product easy enough to be visual but powerful enough to be Fox.' The good news for those developers still struggling with programming Windows apps in 2.6, is that Microsoft has finally got around to putting in a *proper* event-driven programming paradigm into Fox. Applications written in Fox 2.6 will still run under VisualFox. For the purpose of backwards compatibility, Microsoft has also Value/When events map onto Windows events.

Hand in hand with the new event-driven architecture, Microsoft has strapped extensions to the xBASE language to provide OOP. In Visual Fox objects can inherit characteristics from their parents or override particular features. Reusable classes are also available in the form of subclassing which allows the developer to create libraries of classes. Encapsulation and polymorphism are also available. While classes can be coded by hand, Microsoft has included the Visual Class Designer for creating classes interactively.

Other graphical tools include the Database Designer and the Form Designer. With the Database Designer, developers can create database schemes interactively by dragging and dropping related fields. Interestingly, Microsoft has tweaked the DBF file format slightly, to give Fox the concept of a database. In effect, it has added an extra entry in the DBF header to contain the name of a directory in which the table is stored. It will come as no surprise to learn that this is similar to the way the Access MDB format works. At the time of writing prices were unavailable. Microsoft can be contacted on 01734 270000.

Browsed and confused

So Microsoft will be standardising on Mosaic. Guess what Novell has been up to? It has signed an agreement with Netscape Communications to licence Netscape Navigator for browsing the World Wide Web. This will be incorporated into products from the Unix Sytems Group, Applications Group and Information Access and Management Group at Novell. However, the company is also working on its own browser technology codenamed 'Ferret'. Graeme Allen, brand marketing director at Novell sees both products working together in the future. 'As the Internet access market matures, both offerings will address varied customer needs.'

MUST Alsys joins Thomson Software?

Alsys and MUST Software International are both joining the Thomson-CSF group by creating a new company called Thomson Software Products. Alsys has a portfolio of Ada development environments and a family of GUI tools. Its founder is one of the creator of the Ada language. MUST's flagship product, NOMAD, is a cross platform Client/Server 4GL. In addition to the current products the new company will provide training, system development and system integration. Thomson Software Products is on 01491 579090.

Novell on the Web

If you want to know more on NetWare 4.1 then browse the URL `http://www.netware.com`. But if you're just looking for a way to generate HTML from WordPerfect 6.1, then `http://www.novell.com` is the right address. WordPerfect Internet Publisher, for that's its name, will be available to download in the second quarter, free, from the URL above mentioned. It includes NetScape Navigator and Envoy viewers. Novell should also be releasing soon WordPerfect 6.1 SGML with which HTML documents can be edited directly without any conversion required. A CD-ROM version, WordPerfect Internet Publisher Pro, will be available for about £40 from Novell (01344 724000).

Explore the Galaxy

Visix is organising a number of free half day seminars about the Galaxy Application Environment. Galaxy is a cross-platform (Windows, NT, Unix, Macintosh, OS/2 and OpenVMS) development environment for distributed applications. The next session will be on the 23rd of March. To register call Visix Software on 0171 8725825.

Do you partition?

ButlerBloor has recently published a report titled *Leading Edge Development Tools: An Evaluation and Comparison*. For this report ButlerBloor evaluated 21 products which it considers involved 'a significant amount of *new generation* technology'. It *even* described these software tools as belonging to a 'Fifth Generation'. One feature it felt made all the difference: 'one feature which separates *the men from the boys* in new software development is support for application partitioning.'

The report is divided into several sections. In the Large Scale Client/Server category Forté from Forté Software came just ahead of SNAP from Template Software. Both support a publisher-subscriber type architecture. For the 4GL Based Tools, Obsydian from Synon and Uniface from Uniface/Compuware were considered best. The main criterion was the modelling based approach of the tools. In the IBM Mainframe Based Tools category, NS-DK/2 from NAT Systems was found to be the most advanced thanks to its partitioning capability and its 'flexible broker based middleware'. Distributed Smalltalk from HP and ObjectIQ from Hitachi took the first place of the OO-Development Environments category. They both offer good support for distributed object management.

We've just mentioned the products that came at the top of the lists but ButlerBloor has analysed these products and many others in more detail in the 500 pages of the report. You can buy it for £580 from ButlerBloor (01908 373311).

Rational acquires Palladio Software

In 1992, Rational licensed and integrated into Rational Rose the Windows OO analysis and design product originally developed by Palladio Software. Recently Rational acquired Palladio Software. As a consequence of the acquisition, Palladio's employees will join Rational. Also Palladio's Object System/CRC will be integrated with Rational Rose. Object System/CRC is a domain analysis and design tool which supports responsibility-driven design.

Rational Rose is only one of the product of Rational's portfolio. It's a graphical OO software engineering tool automating the method developed by Rational's Chief Scientist Grady Booch. Specialised versions exist for both Ada and C++. The tools allow reverse engineering of the code to present it in a graphical form. Other products include Rational Apex which controls the complete life-cycle of large scale software project; SoDA to automatically generate documentation; TestMate, a testing suite integrated with Rational Apex; VADS, a complete development system and DADS, a distributed development system for Ada.

Jon Hopkins, president and founder of Palladio, will join Rational's professional-services organisation. He will work closely with Grady Booch and Jim Rumbaugh. Rational is on 01273 624814.

StreetTalk directory services for free

Banyan Systems wants to make its StreetTalk directory services an industry standard. Best way to achieve such a goal is to release for free the API and the toolkit code. That's what Banyan just announced. The Directory API (DAPI) toolkit will be available 'at no cost to software developers by mid-1995.' This toolkit is network operating system (NOS) independent and already available for NT, NetWare, Unix and of course Banyan's own Vines. The first release will not be fully interoperable with X.500, but a second release should be.

Richard Dearmun, Principal Consulting Engineering at Banyan, considers that X.500 is not easily scaleable and not at all user friendly. When the directory gets big, X.500 is not quick. He adds 'Programmers will be able to take StreetTalk code and use it to build a unified set of directory services directly into their application.' Application using DAPI will allow users to login once to gain access to all the resources on their networks. Furthermore DAPI compliant software provides a location independence logon procedure so that users can connect from any workstation.

Banyan will benefit from a wide adoption of StreetTalk by being able to sell a full range of back-end products which are DAPI compliant. These products include security, printing and directory synchronisation applications. Banyan is on 01293 612284.

Ada in 95

ISO has accepted the 1995 revision of the Ada programming language. The new revision will be called Ada 95. It retains the features of the original Ada (Ada 83) but is enhanced with support for OOP and better facilities for real time programming. Ada 95 is still fully portable. New features include international character sets and improved generics which are similar to C++ templates. This new version of the language is aimed for business users in addition to the traditional military user base. The entire revision process took over four years to complete and involved the effort of 28 *Distinguished Reviewers* from six different countries. In total, over 750 recommendations were received. The process to attain ANSI approval has now reached the last stage of completion.

Microsoft certifiable...

At this year's VBits conference at the Wembley Conference Centre, Microsoft has extended the Microsoft Certification programme with the announcement of a new Solution Developer certification (MCSD). The new certificate means that the individual concerned has been endorsed by Microsoft as a developer of custom business solutions using MS development tools and the Microsoft solution platforms. These are Microsoft Office, BackOffice and Windows 95. Four examinations must be passed in order to attain the certificate, two core and two optional. The core subjects are MS Windows Operating Systems and Services Architecture I and II. The optional subjects are application development in Visual Basic 3.0, Access or Excel 5.0, and database implementation in MS SQL Server. Microsoft is on 01734 270000.

Is there a Motif?

Motif 2.0 was announced only last July but according to IXI its future is in question. The OSF has effectively stopped any further work on Motif. This move has prompted active consultations between Motif providers such as IXI, iXOS, ICS, IST, UIT, Centerline, etc. They have decided to cooperate to make Motif evolve according to software developers needs. A course of action has already been pushed forward. Among the main features planned is a cross-platform ABI, the addition of CDE widgets as they stabilise and Motif 2.0 elements where there are consistencies with the X/Open CDE. Other features include Windows support (such as MFC) and integrating Motif applications with the Internet. If you want to participate in the evolution of Motif you can contact IXI on 01223 518000 or email support@ixi.com.

Web standardisation with Mosaic

Microsoft seems to have a very strong interest in Mosaic. It has recently signed an agreement with Spyglass to license technology from Spyglass and the National Centre for Supercomputing Applications (NCSA). This encompasses the widely used NCSA Mosaic Web browser. Microsoft intends to incorporate the browser into its various products. The company has also said it will be using the Mosaic browser for its own online service. It aims to provide 'seamless' access to both the World Wide Web and the Microsoft Network. In fact, users of the Microsoft network will be given access to the Internet through a strategic relationship with UUNET which will result in the construction of a new global TCP/IP network.

Douglas P Colbeth, president and CEO of Spyglass was very happy with the agreement. 'It's a win-win-win situation for the Internet community... We are happy Microsoft has selected the open standard of Mosaic technology for users of the Internet,' he explained.

The NCSA believes with Microsoft's support there will be a boom in new Internet users. 'We believe that Microsoft's support will dramatically expand the number of people that can enjoy the Internet's rich multimedia residing on the World Wide Web,' commented Larry Smarr, director of NCSA. He predicted that the Microsoft decision will accelerate greatly the move towards an open global standard for browsing the Internet.

In a separate announcement, it appears the industry is backing the Microsoft Network. According to Microsoft, more than 50 companies, both hardware and software, have signed up. These include Borland, Computer Associates, Dell, Gateway, Hewlett-Packard, Apricot and Lotus. But both Apple and IBM are going their own way. The Microsoft Network will be launched in August 1995. Access to it will be built into Windows 95, whenever that finally ships.

Simplifying Borland

Borland, it seems, has finally given up with its efforts to regain a foothold in the applications software market. It has already lost out in the Office suite wars. The sale of Quattro Pro put an end to that. Now, the company's much thwarted attempt at establishing itself as a provider of productivity software, has taken a mortal blow. It has sold its Simplify division which looked after Sidekick for Windows and Dashboard for Windows to Starfish Software. Starfish, interestingly enough, is a new startup company headed by Philippe Kahn.

Last month we reported that Philippe has stepped down as president of Borland but he remains chairman and would 'continue to serve in an advisory role in long-term strategic planning and technology vision.' If only we could get into the Borland boardroom. Imagine, Philippe suggests that the company should get rid of Borland Simplify. And he just happens to know a man who would buy them!

But seriously, the sale of Borland Simplify means that the company is finally focusing all its efforts back onto the area it knows best, that being software development tools. As Gary Wetsel, the new president of Borland maintains: 'Borland's strategic focus is on the software developer market... Borland Simplify division was clearly not consistent with our long-term plan.'

Techno-Woodstock

Computer Associates has reserved five acres in New Orleans for its CA-World '95 conference and exhibition. It will happen July 16-21. CA-Word director, Edward J. Markovitz describes the future event as 'we're joining together the bedrock business world epitomised by President Bush and the dreadlocked, cyberspace vision of Jaron Lanier. Both are necessary and both - as we'll demonstrate - can work together.' The goal is to bring together 13,000 people (13,000 hotel beds are supposedly already booked) from 50 countries in what Jaron Lanier calls 'Techno-Woodstock'.

The conference will cover several CA product families including CA-MANMAN, CA-InfoPoint, CA-Ingres. But there will also be free courses on subjects ranging from Unix to re-engineering and the Internet. Numbers are impressive. CA announced there will be up to 48 hours of hands-on technology test drives, 200 exhibitors and 3,000 interactive displays, lectures and demonstrations. It is not completely clear from the announcement how much of the events will be completely CA focused. But Markovitz tries his best to convince that CA-World '95 is more than just a CA show: 'We expect this to be the kind of information technology event that a decade from now people will claim to have attended, even if they didn't'. CA is on 01753 577733.

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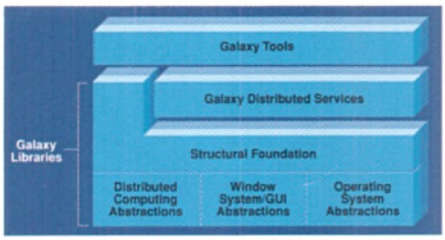

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