February 1996

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EXE

The Software Developers' Magazine

Life after Death

Adding persistence to C++

Smalltalk

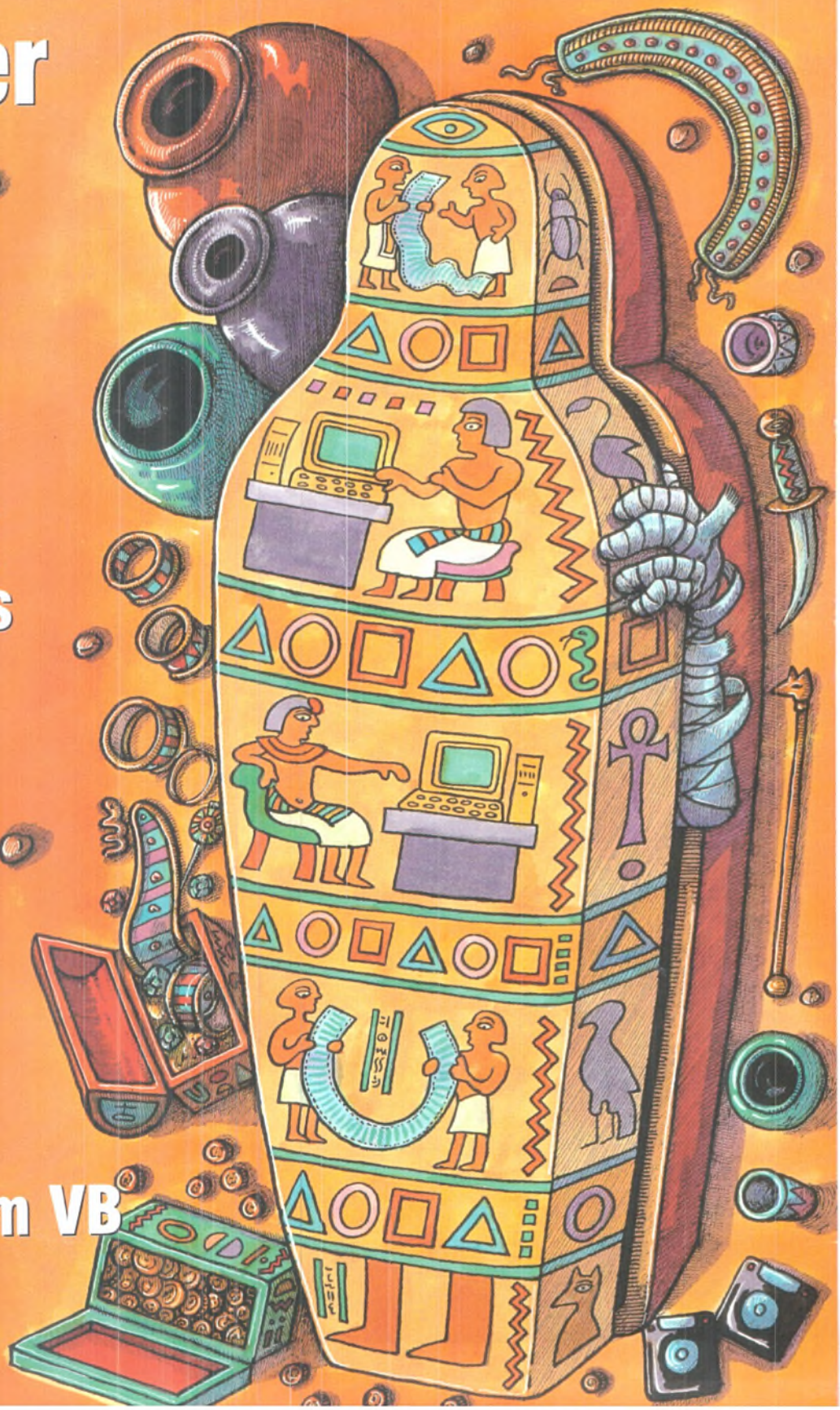
From the 70's to the 90's

OOP

The basics

Windows 95 Game SDK

Audio CD from VB



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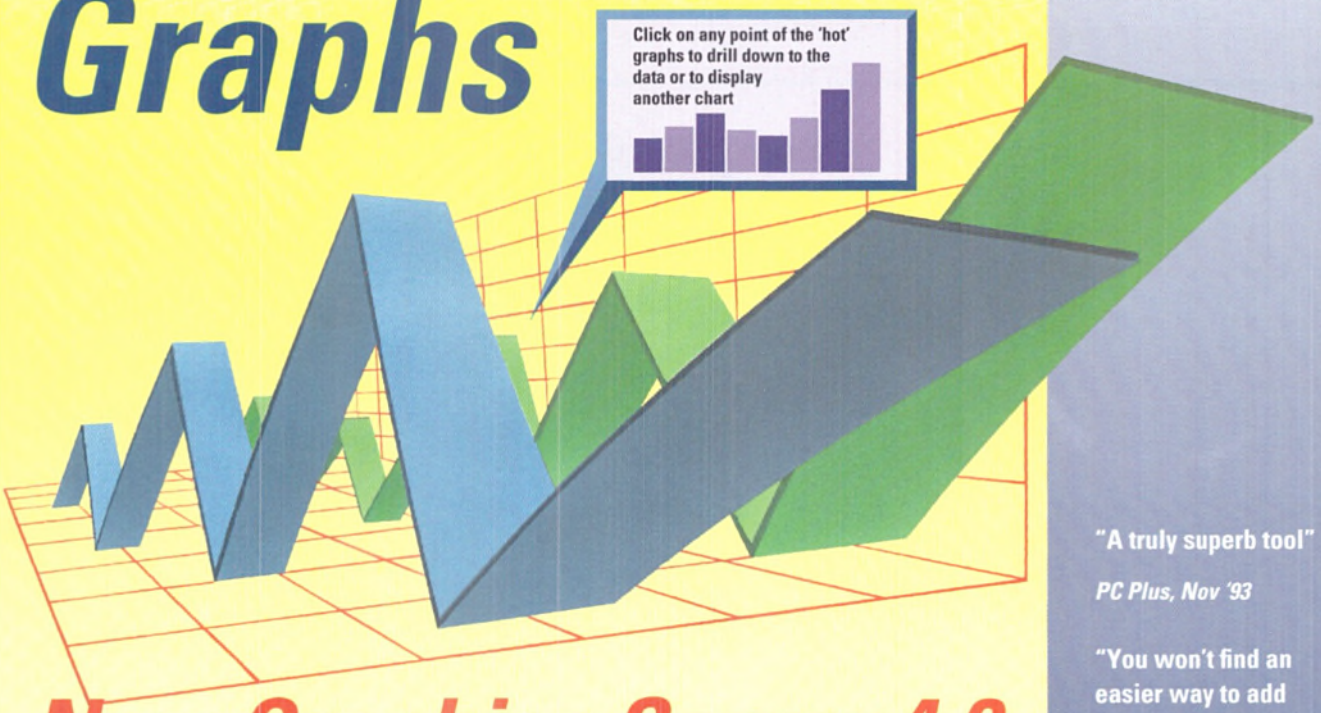

New Graphics Server 4.0

Thousands of developers use the original GRAPH.VBX, licensed from us by Microsoft back in 1992.

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Now Graphics Server 4.0 is here.

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STAY OUT IN FRONT !

Call us now, and find out how Graphics Server 4.0 can keep you and your users out in front.
(And remember, you can distribute the run-times royalty-free).

"A truly superb tool"

PC Plus, Nov '93

"You won't find an easier way to add charting to your Windows applications"

PC Magazine, Sept '93

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CIRCLE NO. 481

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The Software Developers' Magazine

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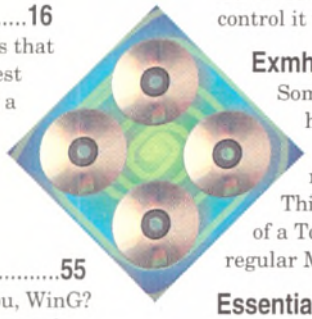
Although David Bailey agrees with Jules that complexity has increased with the latest versions of Windows, he's proposing a different way to tackle the problem.



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Philip Harris does not avoid reading the 82 *Pitfalls of Object-Oriented Development* and Rob Kings reviews the quality of *Software Quality Management and ISO 9001*, mentioning on the way quite a few other ISO standards.

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News & Views

INTERNET TOOLPAK

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- Web control - create WWW browsers
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- **Client/Server** control - for TCP/IP messaging & file transfer

The Internet offers a variety of ways in which you can improve the level of service you give your customers. Tech support, program updates, documentation updates, real-time data feeds - the possibilities are endless. The Internet is here to stay - why not take full advantage of it.

The Internet ToolPak also includes numerous demos and example programs. Call us for full details - only £145

CODEBASE 6.0

Are Sequiter Barking Mad?
Royalty-free database server!

CodeBase has already established itself as the premier xBase library. Now Sequiter have decided to bundle their server in the base product and let *you distribute it with your apps royalty-free!*

This new version also features data aware controls, report wizard and an ad hoc reporter for your end-users. The following variants are available:

- CodeBase for VB/Delphi at £159 includes a 5-client server
- CodeBase (5-Client) at £270 adds source code and C/C++ support
- CodeBase (Unlimited) at £900 adds an unlimited client server.

CODESQL 6.0

Yes they have definitely flipped!
Royalty-free SQL server!!

Sequiter have also developed an ODBC compliant SQL engine which *you can distribute royalty-free!* It includes CodeBase, can be used in single-user, multi-user or server mode, and is available as follows:

- CodeSQL (5-Client) at £360 includes a 5-client server
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CIRCLE NO. 482

SoapFlakes

Object mass production

The industrial revolution has taught us some remarkable lessons. All areas of manufacturing, from cars to appliances, mature in the same way: they evolve from crafted goods to mass production and then from single-plant mass production to multiple-plant part production and integration.

The software industry, vanguard of the new industrial revolution, is in the throes of the same changes. Companies like Microsoft have already reaped the benefits of mass production and mass distribution of prepackaged software.

We are now in the midst of the second wave of changes in the software industry. A specialised parts industry is emerging which will let new players provide software components, and let others integrate them into custom-built or standard applications.

Just as the wide-spread availability of microprocessors opened a window of opportunity for a multitude of new entrants in the PC manufacturing business, the availability of software components will create tremendous opportunities for a new wave of application developers.

In this new software model, who will be the Compaq and DELL, the Gateway 2000 and Packard-Bell? Today the software business is dominated by a few giants such as Microsoft, Oracle, and SAP; who will be around tomorrow?

In the same way, we inevitably wonder who will be the Intel of tomorrow, whether a single component provider will achieve dominance in this fast-growing business.

Ilog is a strong contender in this race for market share and size. Its customer list demonstrates that the component market is real and exploding. Its global reach demonstrates that from Singapore to Sweden, from Argentina to Australia, the same standard software components can satisfy ISVs, IS departments in Global 2000 companies, and large system integrators.

As more and more applications and prepackaged software using these components are deployed worldwide, millions of users benefit from smoother air traffic control, just-in-time washing machine production, and more comfortable mini-vans.

The software industry is uniquely poised for amazing growth in the coming years: it is flexible enough to incorporate successful models from other industries and remake itself radically to create new opportunities and new successes.

Pierre Haren is CEO of Ilog and can be reached by phone on +33 1 49 08 35 01, or by fax on +33 1 49 08 35 35. Ilog's home page is at http://www.ilog.fr.

Client/server in a GUI mess?

Challenges faced by programmers generating a mission-critical application are very different from those encountered when writing small self-contained PC applications. As disciplines, they are as far apart as constructing a house is from building a sand castle. However, in the rush to client/server, many development teams are ignoring these differences and are only now finding, to their cost, that this was not the right approach. These organisations have found themselves with GUI clients (often developed using rapid application development tools) which are unstable, difficult or impossible to modify and which lack the performance required for business-critical applications.

The developers had lost sight of what they were trying to achieve. Building a sand castle is a relatively straightforward task. The specifications for the castle, such as they are, are stored mentally and are liable to change arbitrarily at short notice. The construction is usually a solo affair and often for the use of just the builder or one or two others. The castle cannot withstand heavy use and is not expected to last a long time.

The construction of a house is very different. A team of builders with specific skills

work to formal design specifications and complete each section to certain standards. Some problems, such as the design of the rafters, have been solved before and so the same solution can be reused. When the house is finished, the plans are filed so that modifications and maintenance can be carried out easily in the future.

This metaphor holds up well when it is applied to program design. PC client applications are very different from the small, self-contained PC applications of before. They are now fully integrated modules within a business-critical application and must be treated as such, and not as if they were just another sand castle.

This superficial approach to client development has led teams to use GUI tools that were never designed to be (and to be fair to vendors, never marketed as) part of an integrated IT development strategy. Many of the GUI tools on the market were originally intended to be rapid application development tools and as such are able to generate working prototypes very quickly. However, like all prototypes, these applications are in general too fragile, and do not have the performance required of heavy-duty business applications.

Just as with a house, the development of a client application depends on a team, relies on work that has gone before, and needs to be ready for work to be carried out in the future. However, many companies now find that the code they have laboured over is impossible to maintain or modify, and performs below expectations. To get out of this situation requires that the development teams realise that they are in the house-building, rather than sand castle, business.

In practice this means using an object-oriented language and the same integrated CASE environment and design methodologies that the other development teams are probably already using for the server and mainframe code.

Many people still program procedurally, largely ignoring the benefits of OO programming, and start each project afresh without a backward glance. However, with proper documentation and control, some dramatic savings can be made through reuse of existing code. One organisation found that it could replace its existing 2.6-million-line financial application with a more functional 0.4-million-line object-oriented implementation. And as the library of objects grows, the savings will accumulate in later development projects.

In addition, an OO development environment based on a solid repository brings extra benefits. These include: economies through the central storage of object definitions; easier teamworking – as well as the locking out of objects under modification; version control; and documentation. If the application has been designed with structured methods, the documentation will drop out at the end almost automatically.

To build houses, not sand castles, developers should have an easy-to-use integrated CASE environment, an OO language and an OO repository. Only by applying these things together will they be able to drag themselves out of the GUI mess in which they are currently wallowing.

Pat Flisher is Commercial Manager of the CASE division of CGI, an IBM software and services company. Pat Flisher can be contacted on 0181 643 4443.

Building for the future

Today's corporations face constant pressure to improve the quality of products and services, increase operating efficiencies and reduce costs.

To meet these business objectives, corporate computer system architectures have undergone radical changes over recent years, with an increasing number of organisations embracing client/server as the computing paradigm of the 90s.

However, software programming techniques have evolved much more slowly, often slowing down the rate of change or, at worst, stopping it in its tracks.

For the past three decades, corporate application developers have been using third- and fourth-generation programming languages to write business applications. These require software analysts to define business problems in terms of sequential procedures, which can lead to maze-like structures embedded in the application's code. The resulting software systems are often complex and expensive to maintain.

These early client/server development tools might have helped developers write tactical applications for departmental solutions, but have done little to satisfy today's need for truly enterprise-wide, mission-critical applications. Computing environments are becoming both heterogeneous and highly complex. Organisations face the challenge of writing, or rewriting, software applications for distributed systems. Applications have to be designed to run on a variety of platforms, including Windows, Windows NT, OS/2, Macintosh and UNIX-based systems.

OO technology and client/server have much in common: both rely on independent, interoperable modules and support the concept of distribution across heterogeneous networks. Developers can create systems by assembling and refining reusable, function-specific software components, or objects. Using objects as 'building blocks', software applications can be designed to accurately model the business. Objects can be as simple or as complex as a business requires: at a high level, they can represent, say, how a factory is structured, and include components which contribute to the operation of the factory and communicate with one another to accomplish certain tasks.

Objects are independent and can be modified without affecting other parts of the system. They are also extensible: an object can be re-used in new applications and refined to form new objects. And because objects are described using everyday vocabulary, systems built using them better represent the enterprise.

In addition to modelling the 'real' business world, object technology can enhance programmer productivity, improve software quality and reliability, and lower software development and maintenance costs.

As a result, interest in, and deployment of, object technology in large corporations is surging. In addition to rapid and cost-effective application development to support business processes, organisations can fully interface with relational, OO and the latest object/relational databases, as well as design and analysis, software testing and team development tools.

Client/server development tools, based on object-oriented technology, can no longer be described as 'vapourware'; they are underpinning mission-critical applications today and represent the future of enterprise computing.

Large organisations are building for the future with OO-based client/server development technologies. Is yours one of them?

Andy Smith is managing director of AI International Ltd, a Hertfordshire-based company marketing and supporting object-oriented application development and database management solutions for the client/server environment. Tel: (01442) 876722.

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MKS Toolkit ver 4.4

MKS Toolkit gives Windows NT3.5+ and Windows 95 developers a full suite of powerful UNIX tools including KornShell, awk, awkc, vi and visual diff for Windows, make, a windows scheduler, grep, sed, tar, cpio, and pax - more than 190 utilities and cammands for performing a variety of computing tasks, with support for NT & 95 long filename. NT, Intel, Alpha and MIPs and Windows 95 versions on a single CD.

CodeBase 6.0

CodeBase 6 offers Client/Server development for the popular xBASE DBMSs. CodeServer is a client server database engine for C, C++, Visual Basic, and Delphi with all the functionality and performance of the CodeBase library. New features include support for 16/32 bit programming and transaction processing, with portability to all Windows platforms plus OS/2 and UNIX. CodeControls and CodeReporter are included free. Call for upgrades.

InstallSHIELD

InstallSHIELD Windows 32-bit for Windows 95 and Win NT, includes all of the facilities for effortless and easy installation, including registry operations, group creation, icon installation, file compression and splitting for multiple volume disk sets, scripting language, call any DLL, graphics display, and checking the target system for adequate resources. InstallSHIELD Editions are also available for Windows 3.1 and OS/2.

CodeWright Professional 4.0

The programmer's favourite programmer's editor, now has a user interface polished for Windows 95. Favourite features, such as multi-file, multi-window editing, including search & replace, chroma-coding and more.. are enhanced with the new API Assistant and Button Links to tag notes etc. Available for Windows 3.1 and Windows 95 & NT in a single pack. ***Special offer £159 until 28 Feb 1996***

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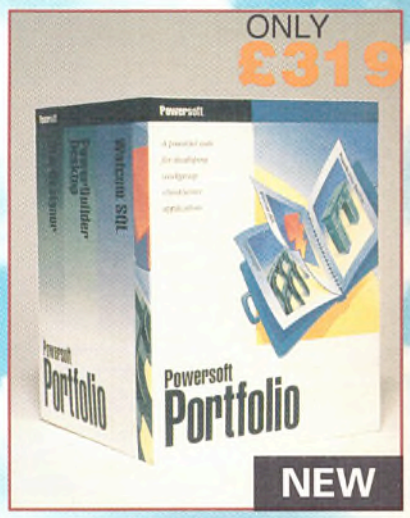

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CIRCLE NO. 483

Mayhem!

Impressed by the evolution of computer science, **Jules May** gets emotive about people, animals... and machines

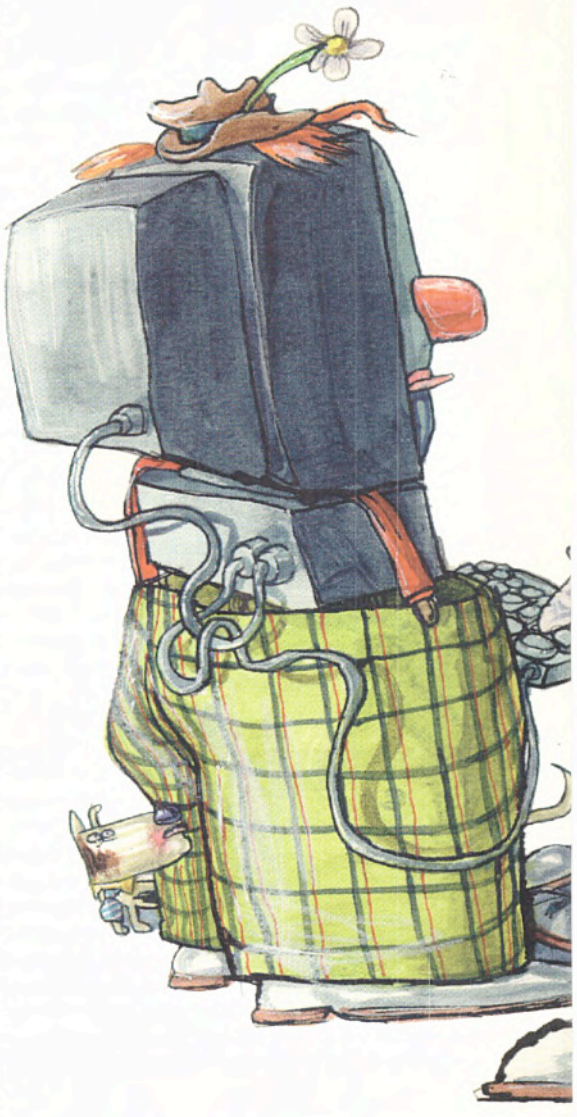
I suppose the veal calves were a very emotive issue, and I suppose I can forgive the extremists of both sides because of that. But philosophy has been increasingly concerned with what it means to be cruel to an animal, and that concern has unearthed a right bag of worms.

The tiny single-celled animals, though they're capable of reacting to their environment, can't feel pain. The higher the animal, the more complex its reactions to its environment. Humans, who (provided the pain is not too great) can think their way out of the painful situation, pay a price because the pain overtakes their consciousness. This happens to few animals; most animals in painful situations will react immediately to the pain, for example an injured animal will run away on whatever remaining means of locomotion it possesses.

Functionally, the reason for the pain overtaking human consciousness makes sense. The rare people who are born without a sense of pain die young, crippled by innumerable injuries. Pain means little more than 'do something about this, now'. To a human, who can easily get sidetracked into mental abstractions, a mechanism to keep the attention from wandering off the immediate threat is clearly desirable. There's a case to be made that you've got to be smart enough to hurt.

So, what's it like to be a veal calf or a laboratory rat? We can talk about being hungry, or being too hot, or too crowded, but I don't think it makes any sense to try to equate our experiences of those environments with the animals'. All we can do is look at the behaviour of the animals, and try to draw our conclusions from that.

That level of detachment is hard. To make the case particularly strongly, it's the wrong question to ask whether an animal feels pain. We first have to ask if a human feels pain. Well, I know about me (I've torn a muscle in my neck, and I can feel it as I write), but I'm not sure about anyone else, and I've probably never met you. I have not one shred of evidence that you feel things the way I do, but in order to make life easy, I assume that since we both have the traditional number of arms, legs, and heads, arranged in the traditional disposition, we're going to experience the world in a traditionally equitable manner.



This is called anthropomorphism, and we do it with animals the whole time. I kick a dog, the dog whimpers, and we call it pain. The dog stops whimpering, even though it may be injured, and we call it tough and uncomplaining. The dog comes back after the kick, and we call it loyalty. Whatever the dog's internal experiences, I'd bet anything that the dog wouldn't characterise its own actions this way.

All our interactions with animals are guided by this anthropomorphism – so much so, in fact, that we blur the boundaries between people and animals and describe human motivations in animalistic terms. We speak, for example, about doggedness and cow eyes; we describe someone as being foxy or a snake.

Anthropomorphism extends to other things too. Way back when, when I was writing strategy games, I noticed a very odd behaviour in my testers. When they were beating the game, and the game was playing transparently, they would talk about 'it' and 'its program'. When they were losing, suddenly the machine came alive, and utterances like 'what's he planning?' became common. This switch between perceptions could happen many times in a single game. I've seen similar behaviour around other expert systems too.

Computers, as always, provide the specific examples to confound the philosophers, and we're reaching an interesting point now. You see, if I built a machine with an accelerometer, such that it said 'Ow!' if it were dropped, in no way could it be said to feel pain. But if the accelerometer was embedded in a system where the observer had already anthropomorphised it, such as a game, what then? Maze-running robots can be built easily now; what if we made a game in which two robots in a maze had to find each other, then fight to the death? A successful machine would use features of the maze to help it in its fight, and tactical retreats would be a valuable strategic device. A machine would have to know when it had defeated its enemy, in order to prevent further damage to itself. Question: would this be as cruel as cock-fighting is regarded as being?

All right, let's try something easier. Let's suppose we built sensors such that a drop in hydraulic pressure would be treated by the machine as a sign that (a) damage had been taken, (b) further damage to the same area was even more likely, and (c) further fighting with that area was probably useless, unless the intention was to sacrifice it deliberately. Would we describe that as pain? What if we associated the drop in hydraulic pressure with the utterance 'Ow!', and then programmed the machine to tell us that it was in pain? Would that utterance give any validity to the experience of pain? Would making the robot by genetic engineering rather than robot engineering make it more likely to feel pain?

We can extend this game to include multiple robots (which could form temporary alliances), to several rounds (where cumulative damage became significant), and so on. At each stage, the robots become more like chess machines, and more easy to regard as a 'him', and more likely – I suggest – to experience pain.

I'm concentrating on pain, here, because it's so emotive and so human an experience. But the principle this illustrates is a general one, applying to people, animals, and machines. When the item under observation behaves mechanically - under orders - we regard it as a rightless 'it', but when it appears to be acting under its own motivation, we regard it as being person-like (or more accurately, me-like) and deserving of rights. Have you noticed, for example, how people fall in love with only the most ratty and cantankerous cars, never brand-new ones? Or have you noticed how the most reliable secretary is the worst treated?

Will computers ever acquire human-type rights? I think they will, shortly after they acquire human-type motivations. With the current research on agents (and their deliberately anthropomorphic icons) starting to yield results, I suspect we might not have long to wait. ■

Jules is an independently-motivated non-deterministic device living in Hertfordshire. He can be contacted on 01707 662698, or on Cix as jules@cix.compulink.co.uk.

Pearls of Borland wisdom

A two-day Developers Conference hosted by Borland at the Royal Lancaster Hotel, London, will bring together the expertise of 30-odd experts on Delphi, Paradox and C++. The conference, which will feature only a small vendors' exhibition, is split into five 'tracks' each comprising five one-hour sessions on programming techniques. Pre-conference tutorials will be held on 28th April, providing fast-paced introductions to Paradox 7 and database programming with Delphi32. Two post-conference tutorial days will cover advanced Paradox and Delphi techniques.

The topics of the conference sessions range from multithreading with Delphi32 and component-building to using OCXs with Paradox 7 and programming with OWL 5.0. By picking a suitable 'track' developers can ensure they only attend sessions that interest them. Keynote speakers include consultants, developers and Borland people from around the world.

Date: 28 April - 2 May. Contact Desktop Associates Ltd on 0171 381 9995/9996.

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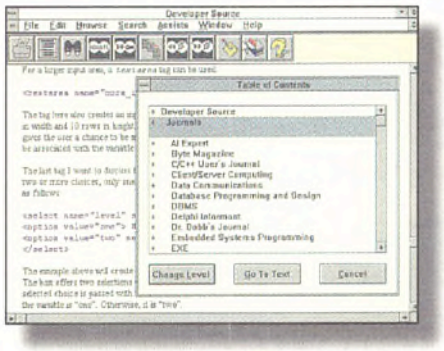

A new CD-ROM product from I-MODE Publications provides a valuable information resource for software developers. Developer Source contains articles, editorial, algorithms and tips from recognised authorities in the industry, drawn from five books (four on C++) and 29 computer publications – including *EXE* – over the last three years. Also provided are over 1,000,000 lines of published code for copying and pasting into your own projects.

A variety of retrieval features, including keyword search, table-of-contents browsing and bookmarks, make finding topics easier. The product is available on an annual subscription basis that includes four quarterly updates on CD-ROM.

$545 for single-user subsription $2,495 for a five-user network version. I-MODE: 001 914 968 7008.

There's HOPE yet

A new product from Aladdin Knowledge Systems Ltd promises to revolutionise object-oriented team development in C++. HOPE (Human-Oriented Programming Environment) views code as a collection of 'particles' - a particle being a unique function, class or variable – which it stores in a central repository. By avoiding the crude file-based approach of existing IDEs and configuration management systems, HOPE allows different team members to work on the same code, with subsequent code synchronisation carried out at the particle level. Conflicts are automatically detected and resolved.

HOPE's other collaborative features include information sharing between team members, particle locking, process-oriented configuration management, and real-time change management. The process management component is coupled with an Automatic Version Control System. In addition, HOPE's object-oriented editor allows browsing and editing via a class-based view of your project.

Aladdin will be launching the product for Windows 3.x, NT & 95 at CeBIT '96, to be held in Hanover, Germany, from 14-20 March. Aladdin has also announced a smartcard developer's toolkit, available immediately.

Introductory price: £225 for 3 users. Smartcard toolkit: $395. Tel: 01753 622266.

IBM swallow Taligent

Taligent, the company formed in 1992 by Apple and IBM to develop a comprehensive, cross-platform application 'framework' using object-oriented technology, is to become a wholly-owned subsidiary of IBM. Apple and Hewlett-Packard, which along with IBM were the principle investors in Taligent, will retain licensing rights to Taligent technologies. 'We plan to continue working with IBM to improve the accessibility of object technology for our customers,' said HP vice president Bernard Guidon.

Taligent will become an object technology development centre, accelerating the integration of such technology into IBM's products. he new centre will be located at Taligent's headquarters in Cupertino, California, and will work to ensure that products comply with industry standards.

IBM: http://www.software.ibm.com.

Portfolio 95

Powersoft has announced a fully Windows 95-compliant version of its Portfolio suite of development tools. Portfolio, which was reviewed in December's *EXE*, currently comprises PowerBuilder Desktop 4.0 for 16-bit Windows, the StarDesignor database modelling tool for Windows NT, and the Watcom SQL relational database (multi-platform). The new bundle will consist of three native Windows 95 products: PowerBuilder Desktop 5.0, StarDesignor, and Sybase SQL Anywhere 5.0, the successor to Watcom SQL. Portfolio should be available from the end of this quarter.

Powersoft UK: 01494 555555.

- Market research carried out by **CenterLine Software** reveals that 76% of developers believe users are 'programmed' to accept software flaws, knowing that they will be addressed in future releases. CenterLine makes automated software testing tools.
- Hobbyists new to programming for the Macintosh will be pleased to hear that **Metrowerks** is offering a **CD-ROM starter kit** for the Mac platform. The kit features CodeWarrior C, C++ and Object Pascal compilers for 68K targets plus three on-line books, for a mere £59.95. Distributed by Full Moon, **01628 660242**.
- Database gurus galore, including Bill Inmon, father of the data warehousing concept, will be present at **DB World '96 Conference**, to be held at Olympia, 19-21 March. **0181 541 5040**
- **Objectivity** has announced its **Objectivity/DB** OODBMS server for the Macintosh. Also available is a beta of Objectivity/DB for Alpha NT. **0161 428 8506**
- Software distributor **QBS** has placed its entire catalogue on-line at **http://www.qbss.com**, providing detailed product information on over 400 tools.
- **Salford Software** has announced low-lost Student Editions of its **Fortran 77** (£49), Fortran 90 (£99) and C/C++ (£29) compilers for the PC. All three are 32-bit protected-mode compilers for DOS and Windows platforms. **0161 834 2454**

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Fast learning curve for increased productivity	✔	—	✔
More than 100 reusable components	✔	—	—
Visual Form Inheritance	✔	—	—
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Data Dictionary	✔	✔	—

and enhanced data-aware components like the *New Multi-Object Grid* and *enhanced DBGrid* to build scalable database applications. Store extended field attributes and reuse them across forms and applications with the *New Data Dictionary*.
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>
> *Windows Tech Journal*
> December 1, 1995

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AS/9605/DE

Capitalist kibbutz attracts interest

Looking for an interesting job as a C++ programmer? Fancy a few months away in a country house? But, willing to work for peanuts? A new team management strategy, the brainchild of businessman Jonathan Friedman, has shown that there is a surprisingly large number of people who would answer 'yes' to all of the above.

Friedman, who currently runs a data conversion business with his brother, decided to use on-line conferences on the Internet to recruit staff for his latest venture. Instead of the £1000+ a week that IT contractors command, Friedman is offering prospective employees a mere £75-£150 a week plus health insurance. Even more unusual is the fact that the entire team will live – as well as work – in a country house, complete with cook and cleaners. Friedman will pay for food and rent, and team members will automatically become shareholders in the company. The commune-like feel of the project extends to the length of the working day: Friedman acknowledges that 'some people can produce huge amounts of code in two hours and then sleep for 18 hours; others work steadily for hours on end.'

As well as looking for C++ programmers (with Windows 95 and NT experience, plus OLE skills), Friedman is trying to recruit a business expert, a project manager and a computer scientist. A number of professionals have already expressed an interest, including many from abroad. Recruits will take part in a brainstorming session in March or April and will be expected to sign non-disclosure agreements. Friedman describes his product as 'a new genre of software which will change the way people think about their business'. His approach is certainly a new genre of software *development*.

◗ *Tel.: 01582 696911.* ◗ *Email: comgen@cix.compulink.co.uk.*

Sybase to acquire Visual Components

Client/server vendor Sybase has entered the components market with a proposed acquisition of Visual Components, purveyor of VBX and OCX custom controls. Under the terms of the agreement, Visual Components will become a wholly-owned subsidiary of Sybase operating within the newly-created Powersoft components division. The new division will market reusable software components such as spreadsheets, charting tools and spell-checkers to application developers.

Visual Components current products include the Formula One spreadsheet component and VisualWriter, a text processing component that provides mail-merge and database support. Powersoft, which merged with Sybase last year, has incorporated Visual Components technology for some time now into its PowerBuilder product.

◗ *Visual Components: http://www.visualcomp.com.*

◗ *Sybase: http://www.sybase.com.*

EXE Awards imminent

The EXE Software Developer of the Year competition is now well under way, with teams competing furiously to develop an application for the Big Issue Foundation. The winning team or individual will be announced at the Windows Show, Olympia, Kensington, on 27th February. Also announced will be the winners of our two other awards: *EXE Development Tool of the Year*, and a special award for the best program as judged by attendees of the show on the day.

The task is to write a database application for managing donors and their donations. For a detailed spec, call the number below. Judging will be undertaken by the Ovum consultancy, EXE's editorial team, and other IT experts. The competition is open until 14th February 1996. Entry costs £850 per team.

◗ *Developer of the Year enquiries: Robert Bateman, 0171 434 3711.*

Store objects in your RDBMS

A new tool from Logic Works enables users to benefit from object technology without changing to an object database. OOwin/CRC is an object modelling tool with a bi-directional link to ERwin, Logic Works' database design tool. It maps object models to relational tables, automating the task of translating OO designs into RDBMS schemata. (See *The rewards of persistence*, p. 18.)

Being fully object-oriented, OOwin permits both process and data abstraction, and is not subject to the limitations of the traditional structured analysis approach. It is based on the CRC Card (Class, Responsibility, Collaboration Card) method.

◗ *Tel: 0171 323 4770.* ◗ *http://www.logicworks.com*

◗ Scare-monger **Gartner Group** has suggested that 90% of business applications will have failed due to invalid date computations by 1999. Given that it also predicted a failure rate of 20% by 1995, things might not be as bleak as the Group suggests.

◗ **Sun Microsystems** has spawned **JavaSoft**, a new business unit whose mission is to develop, market and support products based on Java technology. **01494 472900**

◗ Interest in the language is mounting, with London consultancy **Objective Computer Systems** announcing the **Java Foundation Classes**, a series of training courses. Next start date: 19 February. **0171 315 6510** bmcgill@objective.co.uk

◗ **CentreLine** has introduced a bug-monitoring tool conceptually akin to an aeroplane's flight recorder. **QC/Recall** captures information about how a user was interacting with an application when it failed. **001 617 498 3000**

◗ Borland's **Paradox 7** for Windows 95 & NT is now available, priced £99.

◗ Research company **Forrester** believes that NT will displace little of NetWare's network operating system (NOS) market. As they put it, NOSs and server OSs like NT are 'very different animals'. **http://www.forrester.com/**

http://www.qbss.com/

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†VB Language Manager Pro	£195.00
VBtrv Btrieve for VB	£185.00
Vision StoryBoard	£175.00

FEBRUARY NEWS

Erratum: Having exhorted you all to use our new address, phone/fax etc, we note with horror that we published the wrong fax number in last month's EXE. Big apologies - the person responsible has been shot at dawn. Our fax number is 0181 956 8010.

QBS on the Web. http://www.qbss.com/. For the latest, comprehensive info on developers' products. Hot links direct to EXplodE, Borland and other publisher sites. Please pay us a visit and feel free to make suggestions and criticisms.

Maestro Developers Toolkit 2.0. Developing for Lotus Notes? The latest major revision (and renaming) of Globebyte's excellent Maestro Pro is now available. Along with a number of truly excellent new features (bi-directional rich text access, for example), Maestro now contains interfaces to VBX, OCX, native Delphi and C++, both 16 and 32 bit throughout - all in one box.

Borland Delphi 2.0 Before the month is out, so will this major upgrade of Borland's flagship RAD tool. Fully 32 bit with big improvements on Version One's already staggering performance. Available in three versions: Desktop, Developer and Client/Server. Call us or check our website for the latest info on features. We hope to have price information too by the time you read this.

OCX Bargain Bundle - Save Over £500! Visual Components, the people who brought you the Visual Developers' Suite Deal have just released an OCX bundle comprising: Formula One, First Impression, Visual Speller and Visual Writer Pro. *All for just £225.00*

The new **Graphics Server Component Kit** from Bits Per Second now includes a Delphi VCL component to go with the 16 and 32 bit VBX/OCX combination. All features from Graph VBX and OCX are included in the VCL.

32 bit developers and fans of VideoSoft's elastic forms control **VS-VBX** will be interested to know that **VS-OCX** is now shipping.

Delphi
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†Apollo 2 Standard	£129.00
†Apollo 2 Pro	£199.00
†Async Professional	£135.00
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Delphi RAD Pack	£129.00
Distinct TCP/IP SDK Std	£375.00
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†Infinity Report VCL	£69.00
†Infinity Security Component	£69.00
†Infinity MAPI Component	£69.00
†InfoPower VCL + Source	£298.00
†InfoPower VCL	£199.00
Light Lib Images Std VCL	£225.00
Orpheus	£135.00
†Mobius Drawkit	£95.00
Mobius Widgets	£95.00
Titan runtime	£225.00
†Titan runtime inc. source	£375.00
TOLEAutomation Client	£39.00

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CommTools	£225.00
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Foxfire Developer's Edition	£299.00
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†SilverFox Comms (Win/DOS)	£249.00
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SymScript	£145.00
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Borland C++ v 4.5	£275.00
Borland PowerPack	£69.95
†CodeBase or CodeBase++	£235.00
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Distinct TCP/IP SDK Std	£375.00
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dBest Barcodes for Windows	£345.00
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Adv. Xbase Server 10 user	£1195.00
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†Class(y)	£109.00
†Clip-4-Win	£195.00
†Comix RDD	£99.00
†dGE Graphics	£189.00
†FAXualLib	£79.00
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†FUNCky	£169.00
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†NovLib Library	£189.00
†R&R Report Writer/DOS	£195.00
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CIRCLE NO. 485

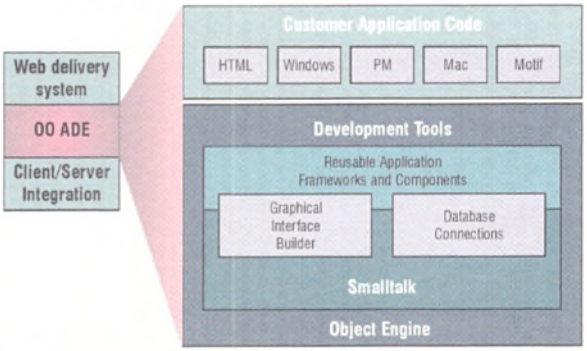
Access Developers Conference

The 1996 Microsoft Access Developers Conference will be hosted by European solution provider Prince, in association with Seattle-based Leszynski Barker International. Two separate events are being held in London and Frankfurt in early March.

The three-day conferences are intended as in-depth technical education events for developers using Access for Windows 95 and Access 2.0. Conference sessions will also be relevant to users of related technologies such as Microsoft SQL Server, Visual Basic and those employing Microsoft middleware such Data Access Objects and ODBC. As part of their fee delegates will receive a copy of F Scott Barker's *Access 95 Power Programming*, plus a CD-ROM of sample code and technical white papers. A 10% discount is available if you book before 9th Feb.

◗ *Fee: £725.* ◗ *When & where: 5, 6 & 7 March, Earl's Court.* ◗ *Bookings: 0800 834445.*

VisualWave may make surfing more fun



A new application framework and toolkit from ParcPlace-Digitalk enables programmers to develop 'live' server applications for the World Wide Web without having to resort to low-level HTML and CGI (Common Gateway Interface) coding. Based on ParcPlace's mature Smalltalk product (see *Smalltalk: from the 70s to the 90s*, p. 25), the new VisualWave framework provides drag-and-drop GUI painting that automatically generates HTML, plus back-end connectivity to Sybase, Oracle and DB2 databases.

Other features of VisualWave include automatic widget-to-GIF conversion, allowing charts, maps and other custom views of data to be displayed on the Web, and the concept of user 'sessions' to maintain state during a visitor's entire interaction with a Web site. OLE and CORBA support is planned.

◗ *Platforms: Windows 3.1, 95 & NT. SunOS, Solaris and HP-UX due this quarter. http://www.parcplace.com.*

Informix to buy multimedia DB company

Approximately 12.9 million shares of Informix common stock, worth some $400 million, are to be issued to acquire Illustra Information Technologies, supplier of 'dynamic content management' database software and tools. Industry analysts have reacted with shock and surprise at Informix's parting with such a sum for a fledgling company like Illustra founded in 1992.

Robin Bloor, of UK company Bloor Research, is not surprised. He has estimated that Informix's acquisition will mean a two-year 'time to market' lead for the vendor over competitors, thanks to the ability of Illustra's flagship product, Illustra Server, to store a wide variety of complex data types. With the Web driving a rapidly-growing market for information management, the ability to store diverse data such as 3D graphics, video, audio, HTML and spatial co-ordinates may give Informix an edge. Illustra's technology will be integrated with Informix's parallel database system, Dynamic Scalable Architecture (DSA).

Illustra Server uses optimisation technology during the querying of records involving BLOBs (Binary Large Objects). The technique involves prioritising aspects of its search so that less computationally-intensive criteria are used first to prune the result set. Combined with 'data blades', routines that check complex objects for content, the approach can yield performance greatly superior to a traditional RDBMS.

◗ *Illustra: http://www.illustra.com.* ◗ *Bloor Research Group: 01908 373311.*

BoundsChecker Service Pack

Debugging tool vendor Nu-Mega has released a Service Pack for its BoundsChecker products for 32-bit Windows. The pack enables BoundsChecker to integrate into the Microsoft Developer Studio for Visual C++ 4.0, and into Microsoft Visual Test 4.0. Also included is the ability to launch multiple instances of BoundsChecker for detecting errors on both sides of a process boundary. This will be particularly useful for debugging OLE-based applications.

Now, using BoundsChecker with Visual Test 4.0 is as simple as following the normal 'RUN' statement by the keyword 'BOUNDSCHECKER'. When BoundsChecker detects an error, it passes the information – including the error description and source code information – to the BoundsChecker notification handler in Visual Test. When the regression test is complete, all the logged information is then available for debugging.

The upgrade (version 3.01) is free, and supports both the Standard and Professional editions of the tool.

◗ *http://www.numega.com/.* ◗ *Available from: System Science, 0171 833 1022.*

NEWS

◗ Three new products from **SCO** will allow Windows desktops to integrate seamlessly with servers running all major flavours of UNIX: TermVision, SuperVision and Advanced File and Print Server. **01923 816344**

◗ **Btrieve Technologies** has launched its own ODBC drivers which perform 7 to 15 times faster than current ODBC drivers for Btrieve and Scalable SQL. **0800 965497**

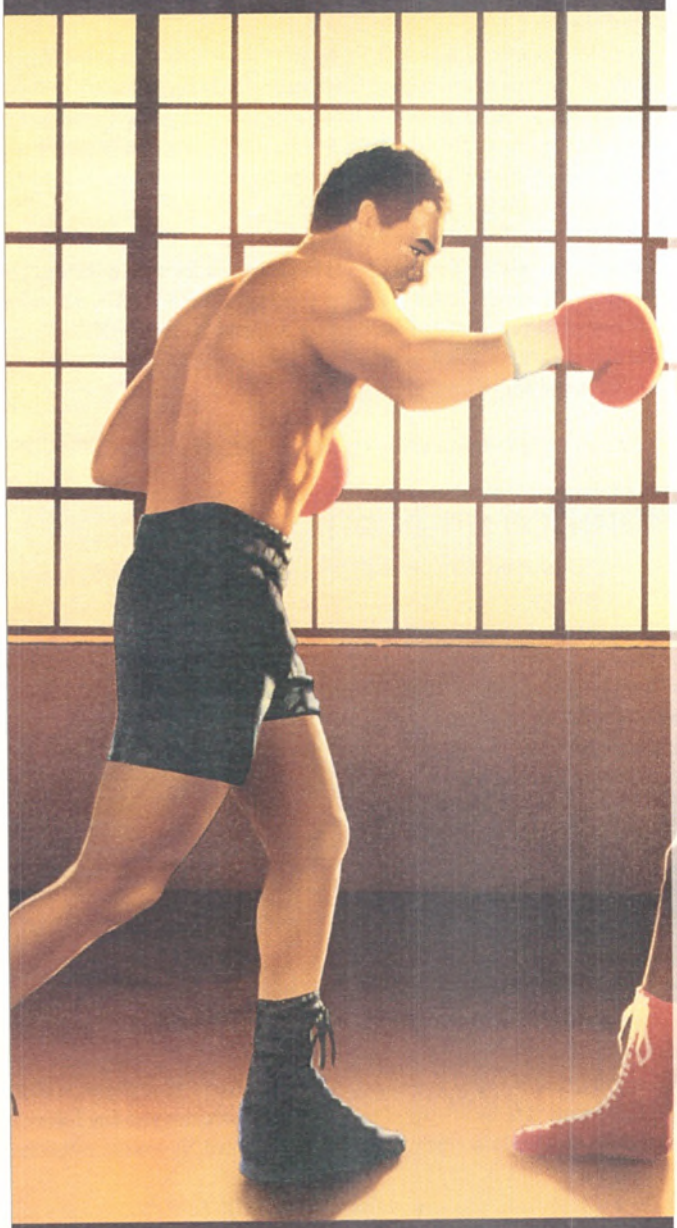
◗ **IBM** has delivered version 3 of its **VisualAge** environment for Smalltalk, with new platform and distribution support, object-oriented report writing, expanded database support and extra multimedia functions. See p. 25 for more information. Distributed by Bloomsbury Software, priced at £985. **0171 436 9481**

◗ If you want to find out why leading analysts believe **process management** is crucial to the successful development of large client/server applications, attend one of LBMS's **free executive briefings** on the subject. David Black **0171 878 8764**

◗ **Sybase** has announced **Sybase SQL Server 11**, the newest release of its RDBMS. Highlights include increased performance, near-linear SMP scalability and ISO compliance.

◗ An independent survey commissioned by the **Delphi Group** reveals that IT skill shortages are adding around 21% to costs in British businesses. The jobs are out there! **0171 440 2000**

SYBASE Vs ORACLE



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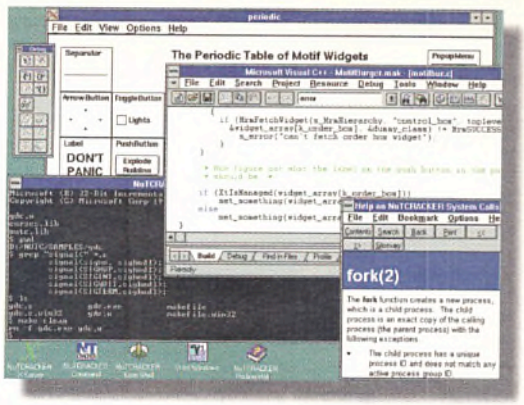
CIRCLE NO. 486

Nutcracker 1.5: a Unix to NT porting tool



It all started when Informix won a US Coast Guard bid to provide a system for Unix *and* NT. DataFocus wrote Nutcracker, the porting tool without which Informix would never have delivered its system on time. Virginia-based DataFocus is the company that wrote the POSIX subsystem for NT.

To port an application from Unix to NT, two roads are possible: the POSIX way or the Win32 way. For Unix developers, POSIX is easier to write for than Win32, but unfortunately Microsoft didn't want NT's POSIX subsystem to include any networking, multi-threading or GUI support. This seriously limits the appeal of this approach. Instead, Nutcracker 1.5 provides a set of DLLs which extend the Win32 interface. These DLLs interface with Win32, except in the case of hard links which goes directly to NT.

According to DataFocus, little modification to existing source code is required to yield working code under NT. To port a Unix daemon to an NT service might require a few modifications, but to port the X version of Mosaic to NT, DataFocus only had to modify a few lines in the make file and one line in the source code (a fork).

Nutcracker 1.5 ports C++ and Fortran applications, and interfaces with VC++, VB and MFC. It is available on Intel, Alpha and MIPS platforms, with a PowerPC release planned for this quarter. The basic SDK (about £2000) supports 500-odd APIs and includes a porting guide, the MKS toolkit, and other utilities. The X/SDK (about £45,000) is a superset with added support for X/Motif, X-Server (X11R6) and Wintif, a Windows look-and-feel for Motif applications. The User Environment (£80-£300 for one unit) consists of the run-time DLLs, Unix tools, X-Server and Wintif libraries.

Distributed by:

Personal Workstation Software (0171 231 0333) *Scientific Computer (01293 403636).*

International conference on agent technology

PAAM96, a conference and exhibition sponsored by the European Union on the practical application of intelligent agents and multi-agent technology, is to be held in London in April of this year. The event will showcase industrial and commercial applications of agent-based software and include presentations from various leading companies employing the technology.

Highlights of the conference are keynotes by Pattie Maes (MIT Media Lab), Robin Smith (BT), Nick Jenning (University of London), Bob Kowalski (Imperial College) and Mike Georgeff (Australian AI Institute). The Call for Papers closed on 26 January, but there may still be time to arrange a demonstration, workshop or tutorial if you are working in a relevant area.

'Talk to my agent' may soon take on a new meaning.

http://www.demon.co.uk/ar/PAAM96/index.html. agents@pap.com. *Tel: 01253 358081.*

Visual Basic enters on-line arena

Microsoft has announced a forthcoming Visual Basic Script language, a cross-platform subset of Visual Basic to be provided as part of the Microsoft Internet platform. It will be licensed at no cost to application, browser and tool vendors.

Visual Basic Script, similar in concept to the JavaScript language from Sun Microsystems and Netscape, allows developers to link and automate a variety of objects to create active Web pages, including OLE objects and Java applets. The language is to be proposed to the W3 Consortium and the Internet Engineering Task Force (IETF) as an open Internet scripting language standard. A source reference implementation will be posted on the Internet.

Bristol Technology and MainSoft Corp will provide implementations for HP-UX, IBM AIX, Solaris and Digital UNIX.

http://www.microsoft.com.

TSAPI for CT-Connect

Dialogic will be adding TSAPI capability to CT-Connect, the company's CTI gateway. A TAPI-only version of CT-Connect was released last August; the new version is scheduled for this quarter. By supporting both Microsoft's TAPI and Novell's TSAPI, CT-Connect will let desktop users control telephony functions from a TAPI- or TSAPI-enabled PC connected to a Windows NT server running CT-Connect. Prices range from $3000 to $15,000 depending on the number of users and OS supported.

Contact: Dialogic on 01252 844000.

Globebyte has shipped a new version of its **Maestro** RAD tool for Lotus Notes, supporting VBXs, OCXs and native Delphi and C++. Distributed by QBS. **0181 956 8000**

Version 2.0 of **UnderWare's** bug-tracking **Track Record** software is now available, providing an optional login facility and OLE automation. A true client/server version is also shipping. $240 per user. **001 617 267 9743**

NeuFrame, a neural network modelling tool from **Neural Computer Sciences** exploits OLE automation to allow 'knowledge' solutions to be integrated into Visual Basic applications. £749. **01703 667775**

Novell's annual European technical conference BrainShare '96 will take place in Nice, France, from 21-25 April. Visitors will be able to attend over 100 technical 'break-out' sessions presented by Novell architects and engineers. **01344 724444**

Computer Associates has announced the **CA-OpenIngres\ICE** database solution (Internet Commerce Enabled) for UNIX and Windows NT. 'Everyone's polishing the faucet,' said chairman Charles B. Wang regarding the Web. 'We're providing the plumbing.' **01753 577733.**

A new 32-bit OCX called **Sax Webster Control** published by **Contemporary Software** allows developers to add WWW connectivity to their VB 4.0 applications for just £110. **01727 811999**

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CIRCLE NO. 487

Letters

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

EXE Awards

Dear Sir,

The January '96 edition had an interesting headline on page 10, '*EXE* Software Developer of the Year'. The competition seemed to be an improvement on previous years and seemed to offer the opportunity of more and easier involvement. Then I got to the 'fee of 850 pounds' with '100 pounds required to get the spec'.

I feel this fee to be excessive. No reason is given as to why a fee is charged and what happens to the fee.

Who is the competition aimed at? The implication from the title is it is aimed at individuals rather than companies. If so it is aimed at individuals with deep pockets. So I think the title should be changed to: '*EXE* Software Developer with a spare 850 of the Year'.

Paul Edwards-Shea
Email address supplied

Thank you for your comment on the 'improvements'. It was not an easy decision to change the formulae but we are convinced it is for the best. Regarding the participating cost: first, the overall fee is less than what we charged last year (£1000) and to our knowledge much less than what participation in other challenges usually cost. We do not make any profit (we do our best not to make any loss, either). All the money goes to organising the event (renting the hall, electricity...) – and to the charity.

The £100 for the spec should be considered as a deposit. We consider the Big Issue Foundation to be an important cause and want to concentrate our effort on developers who are keen to participate. *EXE* and Ovum will offer their time for the writing of the spec and for judging the awards.

On your last point, our experience shows that individuals or teams can easily get sponsored by the publisher of the development tools they use. To reflect this situation we have created two awards, one for developers and one for the tool itself.

The listing tells the whole story

Dear Sir,

I wish to congratulate Jules on his piece about the growing complexity of programming (in the January's edition of *EXE*). I have long been amazed at the gullibility of the programming profession as they are sold more and more complex ways to perform essentially the same job. In the past when code was kept simple (if only to ensure that it would fit in memory!) we all reused pieces of code. Sometimes this involved using an editor, but since the code was compact and simple, this was no problem. Nowadays, code reuse requires a whole extra layer of complexity which probably introduces enough extra bugs that nobody will want to reuse the code anyway!

Part of the trouble is that new techniques are hyped and sold long before anyone can evaluate whether they really manage the problems they purport to solve – or indeed whether they create other problems. The result is that as each 'fix' is found to be inadequate another is simply added. Thus, we went from C to C with single inheritance, to C with multiple inheritance. Then templates were added to try to fix the language. Even templates are not enough, and the standard template library is being added as a further layer of abstraction.

As Jules pointed out in his article, Windows programming has also become absurdly complicated by successive efforts to make things easier. Although the move to WIN32 has simplified coding by the introduction of a flat address space, many of the newer API functions are ferociously hard to use. How many times have you seen a statement of the form 'function `Abc` is obsolete, new programs should use function `AbcEX`' – invariably the new function has several more arguments, some of which point to structures which also need to be filled in, and if you decide to use the `AbcEX` function your code becomes correspondingly larger and more opaque. Microsoft is also pushing the idea of programming with multiple threads – this will offer endless scope for non-reproducible bugs when two threads try to manipulate the same object and the result is determined by the exact timing of the hardware timer interrupt! Yes, I know that if you follow the rules this will not happen – but bugs do not follow rules!

Most of Salford Software's customers are Fortran programmers. Unlike many 'professional' programmers, such people are solving complex mathematical and engineering problems and find the artificial complexity of GUI programming an irritating distraction.

To cater for such people (and other enlightened programmers) we developed the ClearWin+ library for Fortran and C/C++. With ClearWin+, windows are created using format strings – just as I/O was performed on teletypes in C and Fortran. Each control has a two-letter format code (eg `%BT` is the format for a button) and there are other format codes to perform various layout functions (eg `%CN` is used to centre controls in a window).

Our users only need to learn those format codes that they require to create their applications. The result is that even quite complex Windows applications often require less that 100 lines of GUI-related code. Moreover, our customers can print out their programs and examine them in the knowledge that the listing tells the whole story – no tool is required (other than an image editor to create the bitmaps and icons), so there is no black box of computer-generated code to worry about.

While ClearWin+ cannot make GUI I/O quite as simple as traditional teletype I/O, I am reasonably confident that any remaining complexity is intrinsic, rather than being merely the result of a very badly defined interface.

I am sure the pushers of complexity have many years of fun ahead of them, but ultimately I hope common sense will prevail.

David Bailey
Software Development Manager
Salford Software
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CIRCLE NO. 488

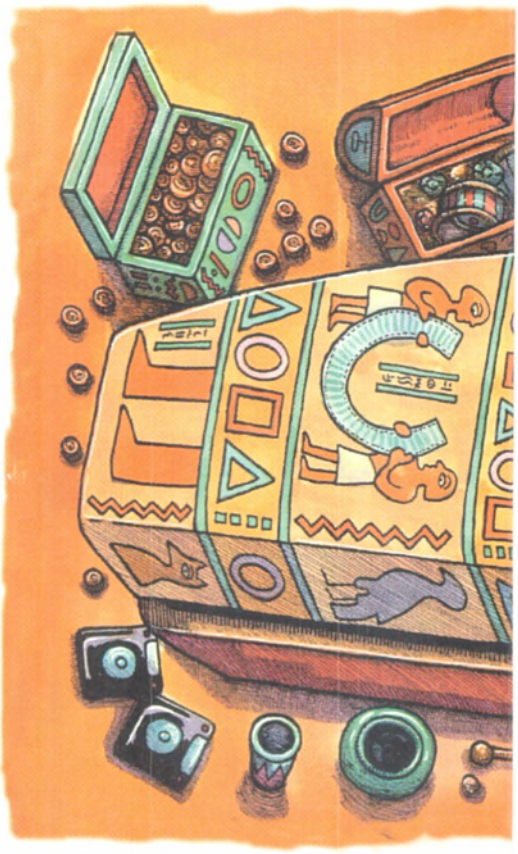
The rewards of

Persistence – the ability of objects to outlive their application – comes free with Smalltalk, but must be bolted on to other OOPLs. **Mary Hope** discusses the pros and cons of some C++ approaches.

My interest in persistence and OOPLs dates from when I was doing my MSc and had to do an assignment in Smalltalk. The assignment required a design and fairly basic implementation of a banking scenario. The spec made no reference to saving the objects created. But I was young(er) and more ambitious then and aspired to saving the various customers and transactions to a file. The next few weeks were spent searching for Smalltalk books, of which there were very few at the time, and wondering why none of them addressed the issue of saving to a file, and hacking to try and find a way of opening a file and saving the data. I gave up in despair with that deeply unsatisfying feeling of being defeated. The only good news was that later the penny dropped and I realised I had been asking the wrong question. Smalltalk automatically gives you persistence as it saves the whole image, including objects created.

Thus the time-honoured routine of opening a stream to a file, testing that the link was established, redirecting the data and closing the stream was not necessary.

But Smalltalk is the exception. Persistence is not generally given away for free with an OOPL; you have to graft it on. The rest of this article will look at some of the ways in which this can be done with C++.



Life after death

The term 'persistence', in this context, means that some or all of the objects created by an application are stored so that they exist after the program has finished and can be reused when the application is rerun. This poses particular problems with object-oriented programming languages. Storing things in files has been around since 'data processing' was a trendy term, so what is special about persistence with OOPLs?

There are three main difficulties. The first is that a stored object has to remember what class it is. The class of an object may be separate from the data in the object, but has to be stored so the object can be correctly reconstructed.

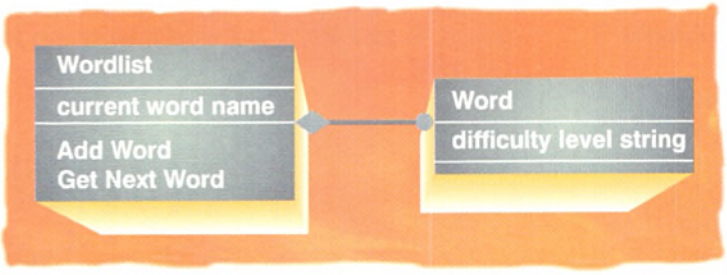


Figure 1 – Example class with sequencing information

persistence

The second is that the attributes of an object will frequently include pointers to other objects. A pointer is the address of a location in memory. There is no point in storing a physical address onto, say, a hard disk unless the whole address space can be recreated when the program is rerun, which is asking too much to be practical. A workaround must be found for this.

The final problem is related to the previous one. The use of pointers to other objects often implies that the 'pointed to' object is referenced several times by various objects. Some mechanism is needed to ensure that objects that are multiply referenced are only stored once.

So how to achieve all of this? There are at least four strategies:

- Write your own class that deals with all the persistence issues, and inherit from this class as required.
- Buy a class library that includes such a class.
- Use a relational database. This gives the added facilities of transaction management.
- Use an object-oriented database.

Writing your own class

This is not a well-documented procedure. You will probably look through your C++ books in vain to get some guidance on writing a class that gives you persistence. Certainly there will be a chapter on the `iostream` classes and file handling, but the examples will save only simple data types or one type of class. In fairness to the authors of such texts, I can see why! The most lucid 'how to do it' instructions I have come across are in a paper memorably titled *How to Roll Your Own Persistent Objects in C++* (by John J Shilling, *Journal of Object Oriented Programming*, July-August '94, pp. 25-32). This method advocates that each persistent class should have three methods:

```
virtual void saveData
      (ObjectStream &aStream) const;
virtual void restoreData
      (ObjectStream &aStream);
virtual long classId (void) const;
```

`ObjectStream` is a straightforward class that supports input and output streaming for the basic types `int`, `char`, etc, and also for objects of type `Object`. As you might guess, all persistent classes are derived from `Object`. The `classId()` method returns a unique identifier for the object's class. The `saveData()` method systematically passes the object's data to the `ObjectStream` object. The first piece of data is the class ID, determined using the `classId()` method. Next, the data from the object itself. Variations that `ObjectStream` and `Object` have to cope with include:

- Objects that contain instances of other classes. These are saved in just the same way, ie class ID followed by the data of the object.
- Objects of derived classes. The class ID and data of the base class is saved first followed by the class ID and data of the derived class.
- Pointers to simple data on the heap. The size of the field is inserted followed by the data.
- Pointers to non-shared objects. This is fundamentally similar to saving a contained object.
- Pointers to shared objects.

This last challenge is the most interesting, as the system has to ensure that the same object is only saved once, and that all references can be successfully reconstructed. The solution to this is to add a `Dictionary` object to the `ObjectStream` class. This works by keeping track of the addresses of objects that have been saved. If a pointer is to an object that has not been saved already, the object is saved and a record made in the dictionary. If the object has already been saved, a reference to the appropriate dictionary entry is inserted. Restoring the data to recreate the object is essentially a reversal of the saving process with some interesting twists and turns.

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While Shilling's article shows that it is possible to roll your own class to give your objects persistence, you have to consider under which circumstances this is worth doing. Obviously a prerequisite is that you are a better-than-average C++ programmer. The author's justification for 'rolling your own' is that if your application does not need the full power of an object-oriented database, you can save on 'project cost and execution overhead'.

Buying in a class library

Arguably the best-known provider of class libraries is Rogue Wave. In their *Tools.h++* library there is a significant section providing classes and functions to support persistence. Persistence is achieved by deriving classes from `RWCollectable` and defining the `saveGuts()` and `restoreGuts()` virtual functions. One of the acid tests for a class offering persistence is whether it can deal with multiple pointers to the same object: Rogue Wave passes. The library also claims to store and maintain the relationships between these persistent objects. Back in April '94 I reviewed the *Tools.h++* library for *EXE* and made some classes persistent by deriving them from `RWCollectable`. My recollection is that getting the classes to work was very straightforward. Certainly, using a class library such as this, development time would be far less than the first option of creating your own classes. But of course you pay for it.

Using a relational database

Whereas it is unlikely that a programmer left to his or her own devices would give much consideration to mapping an object-oriented design onto a relational database, there may be corporate pressures to 'use the system we have'. Maybe because it is tried and tested, or because it is used throughout the organisation, or because it integrates with a legacy system. For a variety of reasons the reality seems to be that an increasingly common way to make objects persistent is to map them onto relational databases.

The drawback is that some work has to be done to convert the object model into the tables required for a relational database. To all intents and purposes we can consider a class to be equivalent to a table and an object to a row or tuple. However, to pre-empt correspondence from database enthusiasts it should be mentioned that C J Date (one of the original database gurus) believes this equivalence is wrong. He maintains that a class is analogous to a domain and that there has been a misunderstanding. But this is an academic point and can be put to one side. When putting objects into an RDBMSs there are potentially five issues that need to be considered: keys, data types, associations and aggregations, sequencing information and inheritance.

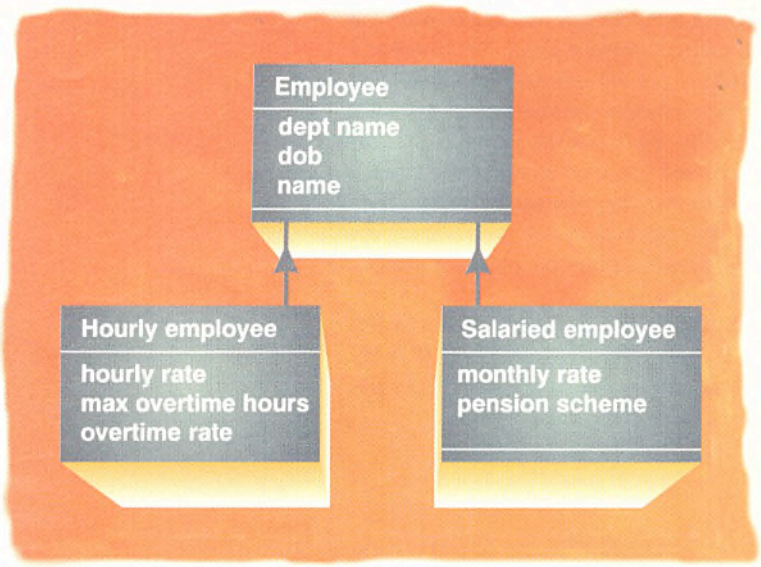

Figure 2 – Class hierarchy to be stored in an RDBMS

Keys

While objects have unique identities, tuples in a table have unique keys. A key, made up of one or more fields, needs to be created. In some cases existing attributes may uniquely identify each object, but it may be that an extra field has to be added to serve this purpose. While a non-key attribute may contain a null value, it is essential that the attributes designated as the key do not.

Data types

A RDBMS has a limited number of data types. If the attributes of the object correspond to the data types available then they can be mapped directly across. But, for instance, an array of integers is not supported by most databases, and so would have to be reduced to one of the available data types.

Associations and aggregations

In an object model an *association* is generally a remembered relationship. Conversion to tables is fairly mechanical. There are three possibilities to consider.

- *A one-to-one association.* If there are semantic reasons for keeping the classes independent, then make each class into a separate table and choose or create a primary key for each. In one table, add the primary key of the other table as a foreign key. Or, just merge the two tables and decide on a primary key.
- *A one-to-many association.* Make both classes into tables and choose or create a primary key for each. Add the primary key of the 'one' table to the 'many' table as a foreign key.
- *A many-to-many association.* Make both classes into tables with primary keys. Create a third table with a key consisting of the two primary keys of the participating tables.

An *aggregation* is a stronger form of association: one object is the 'whole' and the other object(s) are 'part of the whole'. It is often known as the 'has a' relationship. The relationship is *transitive* (ie if a is a part of b and b is a part of c, then a is a part of c), asymmetric (ie a is a part of b but b is not a part of a) and implies propagation of operations (an operation such as move or delete applied to the whole will be propagated down and applied to the parts). Generally speaking, in C++ an aggregation is implemented by the 'whole' object containing the 'part' object or a pointer to it. There is no automatic mechanism to bring about propagation of operations.

Although the mapping of classes to tables seems relatively simple, we have not addressed the problem of an object that is multiply referenced, that is, to which pointers are maintained by several other objects. How do we ensure that data within the multiply-referenced object is only saved once rather than for each time it is pointed to? The simple solution is that within an object a pointer to another object is replaced by the key of the referenced object. Further issues, such as how a pointer is translated into a key, lurk behind this simple answer, but the general approach is clear.

Sequencing information

Classes and tables have different philosophies about holding sequencing information.

There is no difficulty holding sequencing information within a class. For instance a class may include a `WordList` object from which words are retrieved in a particular order. The words may be stored in an array or a linked list. But however the class is implemented, the order can be built in. However it is one of the basic premises of relational databases that the ordering of tuples is irrelevant.

Consider the class model shown in Figure 1. If this were to be stored in an RDBMS, one would have to add an attribute to hold the sequence of the `Word` entities.

```
Wordlist_Table (Wordlist id, name,
                current word)
Word_Table (Wordlist id, string,
            difficulty level)
```

When an application needed to access the rows sequentially the relational database would recompute the order of the words using an `ORDER BY` clause.

Inheritance relationships

One of the most obvious mismatches between classes and tables is inheritance. For instance, how can the hierarchical relationship shown in Figure 2 be mapped onto a relational database? There are three possible ways of doing it.

(a) *Make each class a table.* As there are three classes, we get three tables:

```
Employee(emp id, name, dob,
    dept name)
Hourly_employee (emp id,
    hourly rate, overtime rate,
    max overtime hours)
Salaried_employee (emp id,
    monthly rate, pension scheme)
```

Although this has the advantage of being simple, semantic information is lost. It is up to the application to recreate the supertype/subtype relationship correctly.

(b) *Each subclass gets a table with the superclass thrown in.* This is known as 'rolling down'. Here the superclass is replicated in each table. So we get:

```
Hourly_employee (emp id, name, dob,
    dept name, hourly rate,
    overtime rate, max_overtime_hours)
Salaried_employee (emp id, name, dob,
    dept name, monthly rate,
    pension scheme)
```

(c) *Only the superclass gets a table, but subclass attributes are included.* This is known as 'rolling up', and results in one large table containing all the attributes of all the subtypes:

```
Employee (emp id, name, dob,
    dept name, hourly rate,
    overtime rate, max overtime hours,
    monthly rate, pension scheme)
```

Although this is a simple solution, it is a waste of space. All instances of the supertype have to be assigned null values for attributes inapplicable to them. A further drawback involves reading the data back from the RDBMS and recreating the objects. With this 'rolling up' approach, the code to read objects is particularly lengthy. In outline it has to:

- Read in all the details to a temporary `Employee` object;
- Identify what type of employee object has to be created;
- Recreate an Hourly employee or a Salaried employee object.

In essence, adding persistence to your objects by storing them in a relational database is a *flattening* operation. If the class structure is simple and an RDBMS is used throughout the organisation this may be the preferred option.

You will look through your C++ books in vain to get some guidance on writing a persistent class. In fairness to the authors of such texts, I can see why!

Using an OO database

Adding persistence via an object-oriented DBMS will probably be the option of choice in a 'green field' development involving complex objects where transaction management controls are required. The promise of OODBMSs is that they combine the object-oriented features of encapsulation, inheritance and polymorphism with the database features of security, data integrity, concurrency control, easy to use declarative query language, etc. They often throw in some extras such as version control.

In practice OODBMSs offer excellent OO features, and their database features are now well on their way. But they are still evolving. The ODMG (Object Database Management Group) standards body has released the first version of a standard, ODMG-93. But we all know about first versions. There are many indicators that OODBMSs are still immature, including fundamental disagreements about their architecture.

The current market leader, Object Store, advocates a virtual memory mechanism, whereas competitor Objectivity uses smart pointers; some OODBMSs make all objects potentially persistent, whereas others differentiate more clearly between transient and persistent objects; and so on. Yet another reason for holding back on using an OODBMS is the received wisdom that the market cannot sustain all of the current vendors, and some will eventually sink without trace.

The good news is that adding persistence with an OODBMS is simple and you do get all the standard database functionality. The most common mechanism to convert C++ code to OODB C++ code is to modify any classes that you want to be persistent so they are derived from a specific class, usually called something like `PersistentObject`, that has all the required functionality. There may be some relatively minor code changes, eg changing some of the data types to the database's version. The code then goes through a precompiler and the usual compiling and linking. If you are lucky you get an executable. This is the seamless way to add persistence.

Four ways

There are at least four ways you can add persistence to your C++ code. If you are poor, enjoy programming and do not require the level of transaction management provided by a database you could write your own classes to give persistence. If you are less poor or less competent at programming you could buy in third-party classes. However if it is important that the data is managed as well as stored, you need the facilities of a database. Given a free choice an Object-Oriented Database Management System is the simplest and most seamless way of stitching on persistence. But if there are organisational pressures to use a pre-existing relational database all is not lost. There are ways of flattening your objects into tables. ■

Mary Hope teaches software development at Thames Valley University. She can be emailed as Mary.Hope@tvu.ac.uk.

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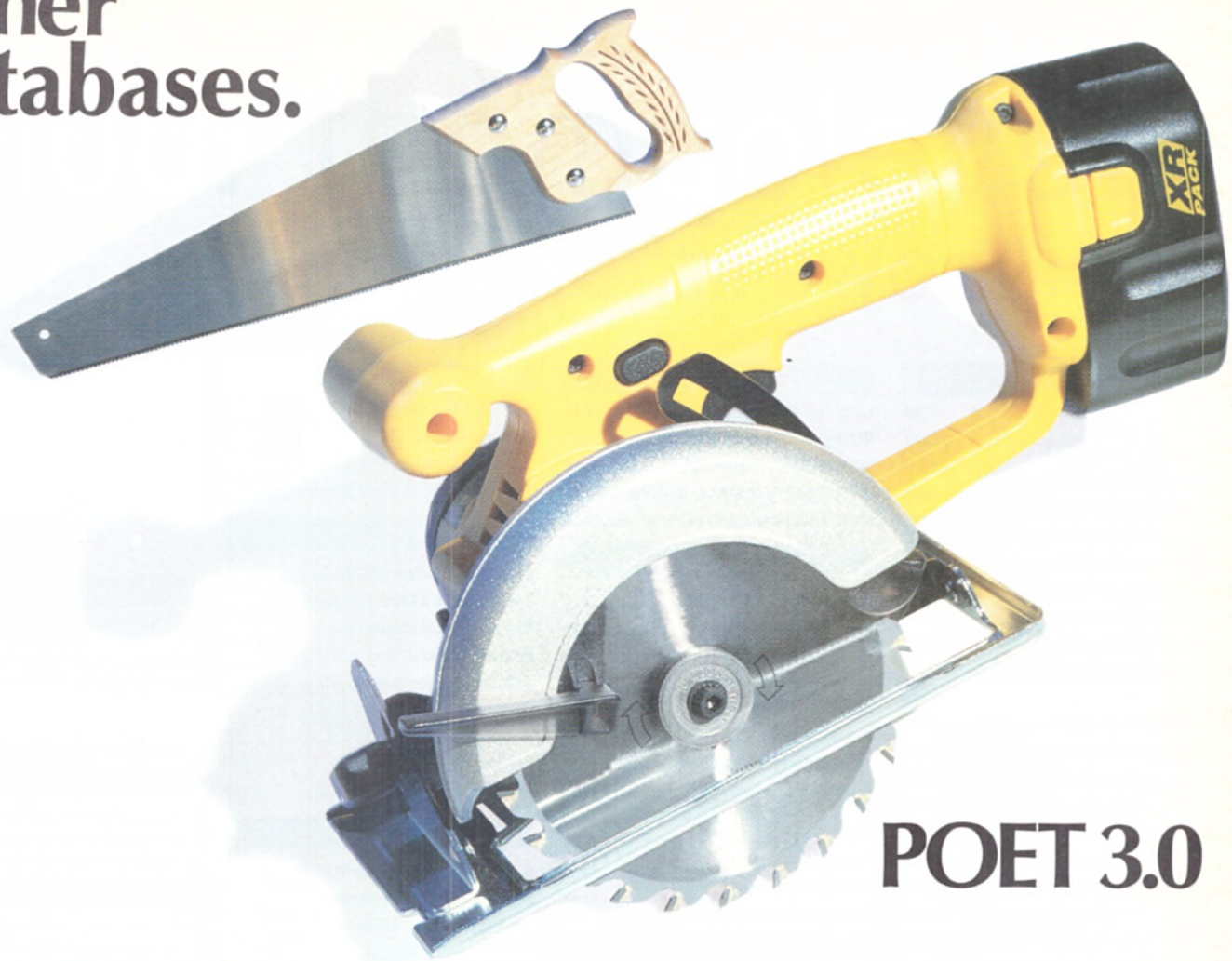

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CIRCLE NO. 491

Smalltalk from the 70's to the 90's

Having worked with Smalltalk since 1987, **Steve Edwards** witnessed Smalltalk's emergence as a corporate development language.

Smalltalk has been around since the early 70s. A long time! Early versions were considered to be very resource-hungry, but that is history. The commercial offerings available today from vendors such as ParcPlace-Digitalk, IBM, VMARK, and QKS compare very well to other development tools. The marketplace has evolved too, ParcPlace, the originator of Smalltalk, recently merging with Digitalk. In 1994, IBM announced VisualAge and IBM Smalltalk. If anybody had asked me in 1990 if IBM would ever have its own Smalltalk, I would have said 'no way!' Although Smalltalk has been a viable development system for some years, the arrival of IBM Smalltalk has added further credibility to the language as a corporate development tool. It is no surprise that large corporations have started to use it for mission-critical software development.

An IDC report on Smalltalk (Reference 1), illustrates further the benefits to be gained by the adoption of Smalltalk. It estimates the growth rate of the Smalltalk market to be close to 60%.

Programmer productivity, improved reliability and easier maintenance are among the primary benefits highlighted. A growing number of features and add-ons make Smalltalk the natural language of choice for many large-scale applications. These include client/server, visual programming, mainframe and Internet / Web products.

What is Smalltalk?

Smalltalk, the first significant object-oriented language (*after Simula – Ed*), incorporates the object-oriented concepts of message-passing, encapsulation, classes, inheritance and polymorphism (See *Practical object-oriented programming*, p32). Object-oriented software systems provide their overall functionality by means of a set of interacting objects, each with its own set of procedures. Integrated development environments usually consist of workspaces for 'exploratory' programming, class *browsers* (see Figure 1) that allow the viewing and definition of classes and procedures (methods), *inspectors* that allow developers to look at and change the state of objects at run-time, and a debugger which allows a complete trace of actions up to some error condition or break-point. References 1, 2 and 3 provide a good introduction to the nature of the language.

The syntax may look strange to a novice, but after a short period of familiarisation is seen to be expressive and easy to read. The range of control structures is rich and includes some that are quite high-level (see Listing 1).

Smalltalk comprises a large integrated class library which includes a set of fundamental classes (basic data types): numbers – `Integer`, `Float`, `Fraction`; magnitude classes – `Date` and `Time`; collection classes – `Array`, `OrderedCollection`, `SortedCollection` etc; and stream classes that support file I/O. All of these classes offer a high level of built-in functionality, freeing the programmer from mundane tasks. Beyond these basic classes, Smalltalk also includes graphics and windowing classes allowing the straightforward construction of complex user interfaces. Smalltalk provides other classes to access information in relational databases, although this is often an optional extra. Some Smalltalks also include a visual programming environment to further ease and speed up the development of user interfaces and object interactions.

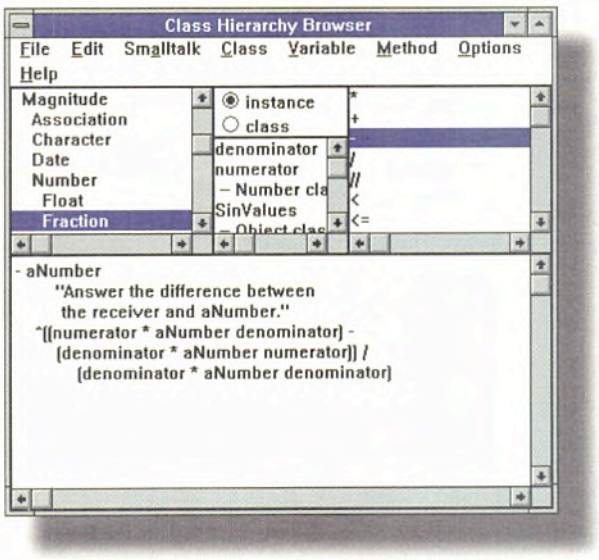

Figure 1 – Traditional Smalltalk class browser

Smalltalk is a 'pure' object-oriented system and as such, virtually enforces an OO approach to development, unlike hybrid languages such as C++. The notion of an object is all pervasive – the compiler is an object; methods when compiled become `CompiledMethod` objects. Even classes themselves are objects, giving rise to the notion of metaclasses. As a result, Smalltalk is an elegant and consistent system.

Product range

Products available include: *VisualWorks* and *Visual Smalltalk / Enterprise* (ParcPlace-Digitalk), *VisualAge* and *IBM Smalltalk* (IBM), *SmalltalkAgents* (QKS), *Object Studio* and *Enfin Smalltalk* (VMARK). These all have the same basic syntax and an exceedingly similar set of fundamental classes. The language tools are also similar: all provide class browsers, inspectors and debuggers. However, the classes and development tools that relate to user-interface components, database access and visual programming are all different. Platform availability of these products is also varied (see Table 1).

Various factors determine the level of portability of Smalltalk code. Classes developed for domain objects, ie those that model 'the business', such as customer or account classes, are essentially portable between the different Smalltalk environments. Classes involved with user-interface provision or database access, are highly, if not totally, portable between different platforms with products from the *same* vendor. However, such classes probably require substantial reworking for porting to a different vendor's product. For large corporate software systems, the high level of portability evident for 'business model' classes is most significant.

The ParcPlace-Digitalk VisualWorks range provides image-level portability, in

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Smalltalk

that once software has been compiled, the executable can be moved across to any other supported operating system and run immediately without any need for recompilation. This is subject to the purchase of driving software for the target platforms.

Which is the best Smalltalk? That is not an easy question to answer. There are many factors to take into consideration when choosing a product: robustness, speed, image footprint, operating system support, built-in class support, availability of appropriate add-ons, database access, user-interface builders, visual programming tools, team programming capabilities and, of course, price. ParcPlace VisualWorks (see Figure 2) is considered the most robust but expensive. The IBM VisualAge / Smalltalk combination is excellent, particularly for its effective visual programming environment, and offers a totally transparent path to distributed Smalltalk (and soon support for the MVS platform). The Object Studio / Enfin combination is notable for its integrated synchronous CASE tool. SmalltalkAgents introduces some useful features for modularising applications. These comments only just scratch the surface. If you have to make a decision, prioritise your factors and check them out against each product for yourself!

Visual programming

The term 'visual programming' is used to describe a wide range of tools, with quite different capabilities: language environments with window-builders (some of which may produce classes and stubs for user-interaction procedures); object-oriented analysis and design CASE tools (some of which not only produce corresponding code, but can also keep code changes synchronised with changes in CASE notation); and code animation systems.

I have coined the term 'Visual Software Construction' (VSC) to describe a category of tool that takes the visual programming paradigm one stage further to include the visual programming of business logic. Two vendors offer VSCs. ParcPlace-Digitalk provides PARTS within its Visual Smalltalk environment and IBM provides VisualAge (see Figure 3). These two products are quite similar as they both offer a palette of prefabricated parts, visible and non-visible, which can be dropped onto a canvas and interlinked with other parts. The interlinking lines determine the run-time behaviour of the software system under construction. Parts available on the palette typically belong to the following categories: user-interface components (windows, buttons, entry fields, static text, notebooks, folders), basic object types (`OrderedCollection`, `Object Factories`), multimedia parts (playback windows, control-button sets) and database-access parts. Some of these categories (eg multimedia and database access) are optional extras.

This type of development tool allows the production of systems in much less time it would take using traditional languages and systems. As an example, a developer can have a reasonably complex user interface, linked with a database-access part, accessing a relational database in just a few minutes!

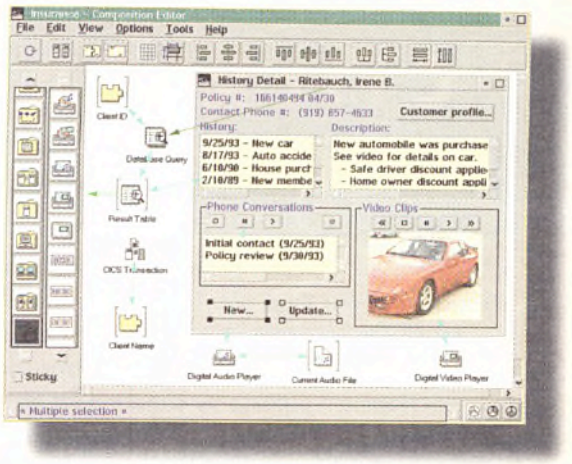

Figure 3 – IBM VisualAge visual programming interface – Composition Editor

The ParcPlace-Digitalk products have been available for a few years, and IBM's for just over eighteen months. Now that ParcPlace-Digitalk is working on the production of a single stream of products to be released some time this year, it will be interesting to see what emerges. IBM's VisualAge has certainly earned some praiseworthy press, and with the recent release of version 3, including a distributed Smalltalk option and WWW parts promised in the near future, some may find this product particularly interesting.

From client/server to distributed

A wide range of client/server and communication capabilities is available for all major Smalltalk products. Some of these are built into the base product; others are available as add-ons, either from the vendor or from a growing number of third-party suppliers. The current range includes relational database interfaces, COBOL wrappers to access legacy systems, CICS wrappers for transaction processing, APPC and EHLLAPI communications interfaces. Some of these are used by making calls from Smalltalk code, whereas more recent offerings, consisting of prefabricated parts, use a visual programming approach. ParcPlace-Digitalk's VisualWorks *ObjectLens* offers access to the native features of Sybase, Oracle and DB2, while IBM's VisualAge allows access to the AS/400, Oracle, IMS and ODBC. Object Studio/Enfin Smalltalk includes access to16-bit Open Client, Sybase (OS/2) and dBASE (OS/2). This is not a complete list of all of the client/server features of these products as the list grows all the time. If you need a particular feature, check the vendor's Web pages for up-to-date information (see the box Useful WWW pages on page 30).

The advent of distributed Smalltalk technology, however, offers an alternative to vanilla client/server approaches. For some software systems, the traditional client/server approach is not always the most appropriate and can be subject to bottlenecks and efficiency problems. Putting some of the application logic back on the server where it can access data locally is one possibility for improvement. More generally, 'right-sizing' requires that software systems be distributed to run on networks of interconnected computers to share the processing load. Distributed Smalltalk (DST) offers the ability to write most, if not all, of the software in Smalltalk, without being forced into using multiple languages. Furthermore, DST allows the development of systems that span networks, without having to learn the details of net-

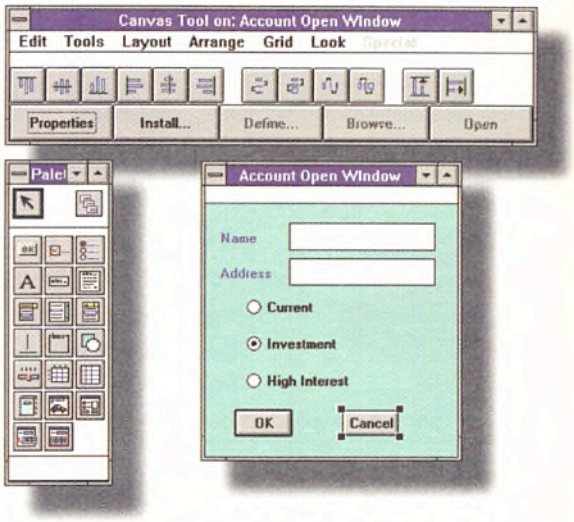

Figure 2 – ParcPlace-Digitalk VisualWorks's UIF builder

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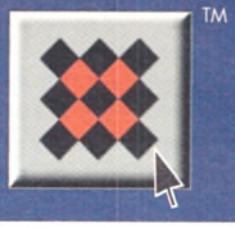

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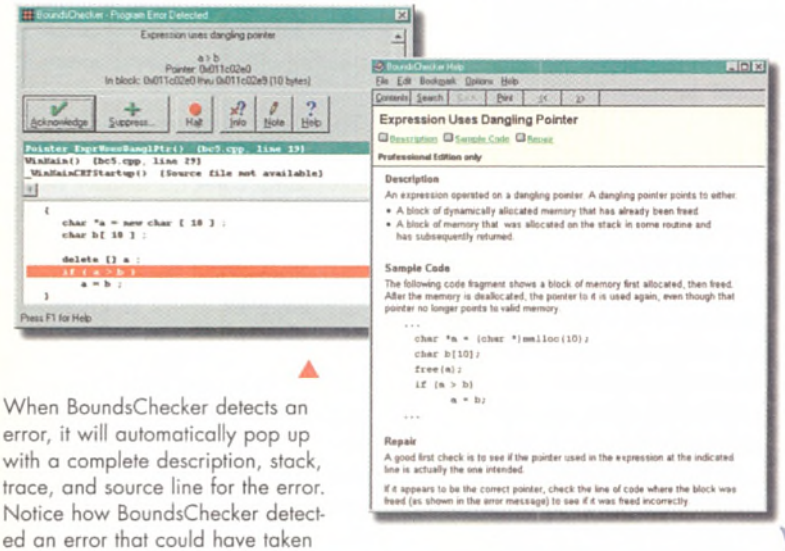

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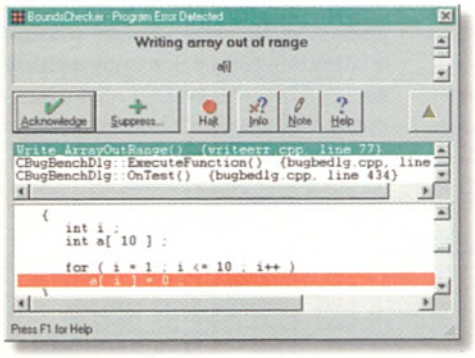
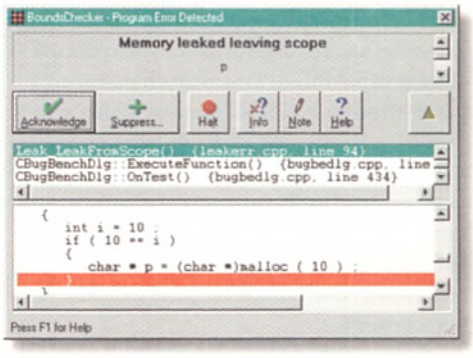


Here the array has a range of 0 to 9 rather than 1 to 10. As a result, some piece of memory would have been overwritten leading to unpredictable behavior.

Here memory was not freed before leaving the function, resulting in a memory leak. BoundsChecker detects this error instantly, because as soon as the function ends, it knows the leak has occurred. As a result, the problem is identified as it happens!



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work communication, distributed application programming, or specialised interfaces. Developers can focus on solving the business needs of the enterprise and minimise the effort of learning the mechanics of distributed programming.

Two companies with DST products are Hewlett-Packard and IBM. Both offer support for large-scale team development.

HP's Distributed Smalltalk 5.0 enables distributed, enterprise-wide Smalltalk solutions. The product builds upon and extends ParcPlace-Digitalk's VisualWorks 2.0. Being compliant with the Object Management Group's CORBA 2.0 specification, it allows run-time interoperation with other languages, applications and platforms. The use of such a product removes the need for low level TCP/IP programming.

HP DST features include an IDL (CORBA interface) generator, host and user access control, security mechanisms, distribution-support tools, remote debugging and simulated remote testing. Some further features are a shared interface repository with remote editing and lockable shared resources.

IBM Distributed Smalltalk, which integrates with IBM VisualAge, only recently available in version 3 of IBM Smalltalk, allows applications to be 'split' in many different ways, supporting both client/server and true peer-to-peer designs.

IBM's DST provides two alternative approaches to distributed programming (see Figure 4):

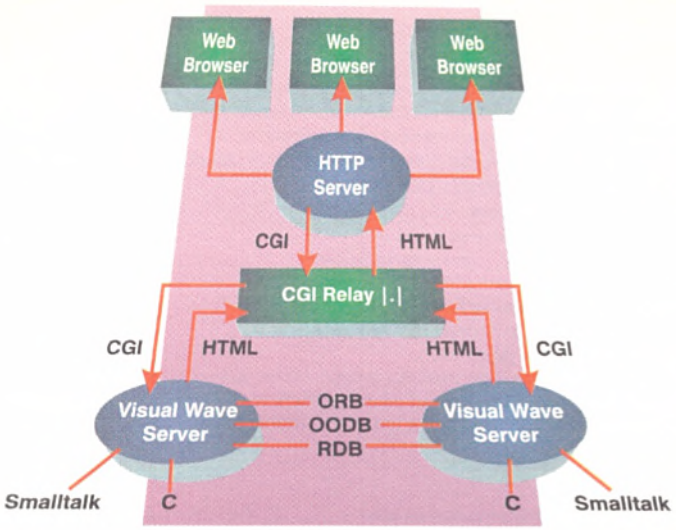

Figure 5 – ParcPlace-Digitalk VisualWave architecture – WWW development environment

- via IBM's CORBA-compliant SOM (System Object Model) and Distributed SOM;
- using the 'Distributed Object Space' which takes advantage of 'Smalltalk everywhere' to provide true local/remote transparency by extending the Smalltalk model across a network. This extends to distributed automatic garbage collection.

The Distribution Toolkit includes remote Transcript and workspace windows, remote inspectors, browsers and a debugger; a distribution configuration editor (to modify the distribution matrix), activation support, name server support, a remote message probe, an event profiler and a runtime configuration tool. Security features are also available.

Internet and the Web

Smalltalk vendors have not been slow to react to the interest being shown in commercial uses of the Internet and the World Wide Web. Add-on products are available today from ParcPlace-Digitalk and in the near future from IBM.

Each consists of a set of Smalltalk classes and parts, with associated tools designed to support the development of applications which can be installed on a World Wide Web server. With these add-ons, client interaction is done though standard Web browsers. Both are designed to hide the complexity of HTML form design and CGI (Common Gateway Interface) programming. (See the article 'Using programs as Web pages' in *EXE* November '95, page 45.) In addition to the provision of standard static WWW docu-

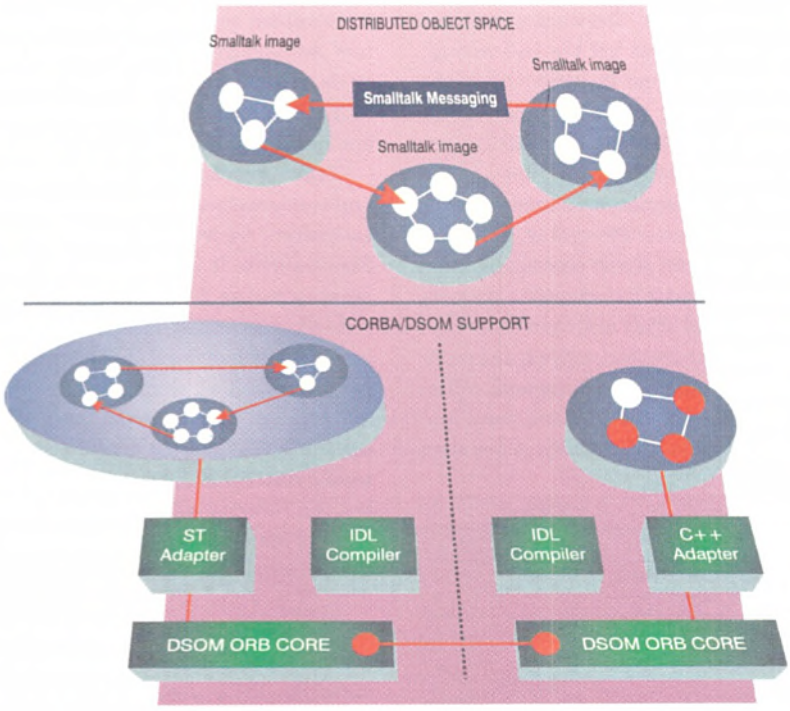

Figure 4 – IBM Distributed Smalltalk. Two mechanisms for inter-machine object communication: CORBA and 'Distributed Object Space'

```
Output string to the transcript window 5 times
with line-feed:

5 timesRepeat: [
   Transcript show: 'Steve'; cr
]

Find the sum of numbers entered by a user,
finishing with the value 0:

   | sum value |

sum := 0.
[value ~= 0] whileTrue: [
   value := DialogView request:
            'Enter value'.
   Value := value asNumber.
   Sum := sum + value
].
^sum

In an array of strings, find the string with
the maximum length:

   | array maxString maxSize |

maxSize := 0.
Array := #('a' 'bc' 'def' 'xy').
Array do: [:string |
   string size > maxSize ifTrue: [
      maxString := string.
      MaxSize := string size
   ]
].
^maxString
```

Listing 1 – Simple Smalltalk code examples

Useful WWW pages and contacts

- Smalltalk Industry Council: *http://www.webpress.net/stic/*
- Smalltalk comparisons: *http://www.internet.net/cgi-bin/info3?/1741/SMALLA.DAT*
- Smalltalk Newsgroup: *news://comp.lang.smalltalk*
- Smalltalk ANSI Standard: *ftp://info.er.usgs.gov/pub/smalltalk/Index.html* or *http://www.x3.org/tc_home/x3j20.html*
- OMG: *http://www.omg.org*
- IBM: *http://www.software.ibm.com*
- ParcPlace-Digitalk: *http://www.parcplace.com*
- QKS: *http://qks.com/*
- VMARK: *http://www.vmark.com*
- The Object People: *http://www.objectpeople.on.ca*
- Steve Edward's home page: *http://ourworld.compuserve.com/homepages/Steve_Edwards/Smalltlk*
- Smalltalk User Group UK: contact your Smalltalk vendor or Adam Garnish, the membership secretary, by email at 101472.3600@compuserve.com.

References

1. *Object Tools – Smalltalk Market Accelerates*, International Data Corporation, March 1995, IDC #9818.
2. *Smalltalk-80 The Language*, A. Goldberg, D. Robson, Addison Wesley, 1989, ISBN 0-201-13688-0
3. *Discovering Smalltalk*, W. Lalonde, Benjamin Cummings, 1994, ISBN 0-8053-2720-7
4. *Smalltalk Portability: A Common Base*, IBM ITSC Red Book, 1992, GG24-3903-00

ments and forms, live applications can be produced 'that build relationships with users, rather than simply broadcast information to them'. System development is possible without producing a line of code. Such applications would typically be connected to the company's business systems.

The ParcPlace-Digitalk product *VisualWave*, available as of December '95, also promises future connectivity to OLE and CORBA, as well as other object-oriented languages, including Sun Microsystems' Java (see Figure 5).

The IBM VisualAge *WWW Parts* technology (available during the second quarter of '96?), will be used in conjunction with the IBM VisualAge for Smalltalk visual programming environment.

Persistent Smalltalk

Is Smalltalk persistent? (Well it has been around for over 25 years!) All Smalltalk offerings lack a persistency capability that would satisfy the needs of a reasonably-sized organisation. There is often a need to store information away when closing down an object software system. This need can be answered in three different ways. (See *The rewards of persistence*, p18.)

First, if the object structures are very simple and there is an existing relational database – use a relational database interface feature. ParcPlace-Digitalk has this available with VisualWorks (ObjectLens) and an RDBI add-on for Visual Smalltalk. IBM Smalltalk developers working with VisualAge have a database query part.

If the object structures are complex and there is a need to use a relational database – spend a lot of time developing a mapping system, or use a general-purpose portable utility (such as TOPLink from The Object People).

If the object structures are complex and there is *no* need to use a relational database – consider using an object-oriented database. Object-oriented database systems from the more significant vendors such as Gemstone, Object Design International (ObjectStore), Versant and Objectivity can now be considered to be of industrial strength (or very close to). Of all of these, Gemstone is the one that embraces the Smalltalk metaphor and requires virtually no mappings: it is designed to be persistent Smalltalk.

An ANSI standard

The first draft for the X3J20 ANSI Smalltalk standard is expected to be available early in 1996, with the published standard expected 6 to 12 months later. The most significant meeting, the one that 'got the ball rolling', was convened on June 21, 1993. One of the difficulties facing the committee, since Smalltalk is much more than just a language, was determining the scope of the standard. An agreement was made to limit the standard to cover the syntax, execution semantics and a set of core common classes.

The core classes to be included in the standard are: general object and class behaviour, covering instance creation, copying and printing; booleans; numbers; characters; collections; streams and file I/O; and point and rectangle. *Smalltalk Portability: A Common Base* (See Reference 4) is a good first approximation to the expected standard. Although all Smalltalk products are very similar as far as the core classes are concerned, the full class libraries have user-interface classes, database access classes and many others that are substantially different. However, there is no questioning the value of the standard, since most application classes, particularly those that model business logic, are generally built on the core classes, using common syntax. Thus, business-logic code portability should be a natural consequence of the standard.

	Windows	*OS/2*	*Unix*	*Other*
IBM Smalltalk	3.1	Warp	AIX	(MVS Q96?)
VisualWorks 2.5	3.1 NT	2.1 Warp	AIX, SunOS, Solaris, HP-UX, Digital Unix	MacOS
Visual Smalltalk Enterprise	3.1, NT, 95	Warp		
SmalltalkAgents	(2Q96)			MacOS
Enfin 4.10.1	3.1	2.0	AIX, Solaris, HP-UX	

Table 1 – Operating system support

The object-oriented route

There are a variety of reasons why an organisation wishing to go down the object-oriented route should give Smalltalk very serious consideration: its syntax is simple; it enforces the object-oriented paradigm; programmer productivity is second to none (once developers are up to speed); portability is not a problem; it is available on virtually all platforms and is now fast enough for most end-user applications. Interfacing with other systems is straightforward and there are distributed and mainframe options.

Team programming, code management and configuration management have been conquered. All we need now is an army of Smalltalkers. It is important for management to realise that the adoption of object technology is not just about training developers in a new language. It is a total development approach which requires new thinking on project management and phasing together with different analysis and design techniques. These skills take time to develop, but the benefits will be realised, provided projects are managed with long-term objectives in mind. ■

Steve Edwards is Managing Director of The Object People, a company specialising in major Smalltalk products which provides training and consulting in OO. Call Steve on 01703 775566, fax 01703 775525, or email 100270.2334@CompuServe.Com.

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Practical object ori

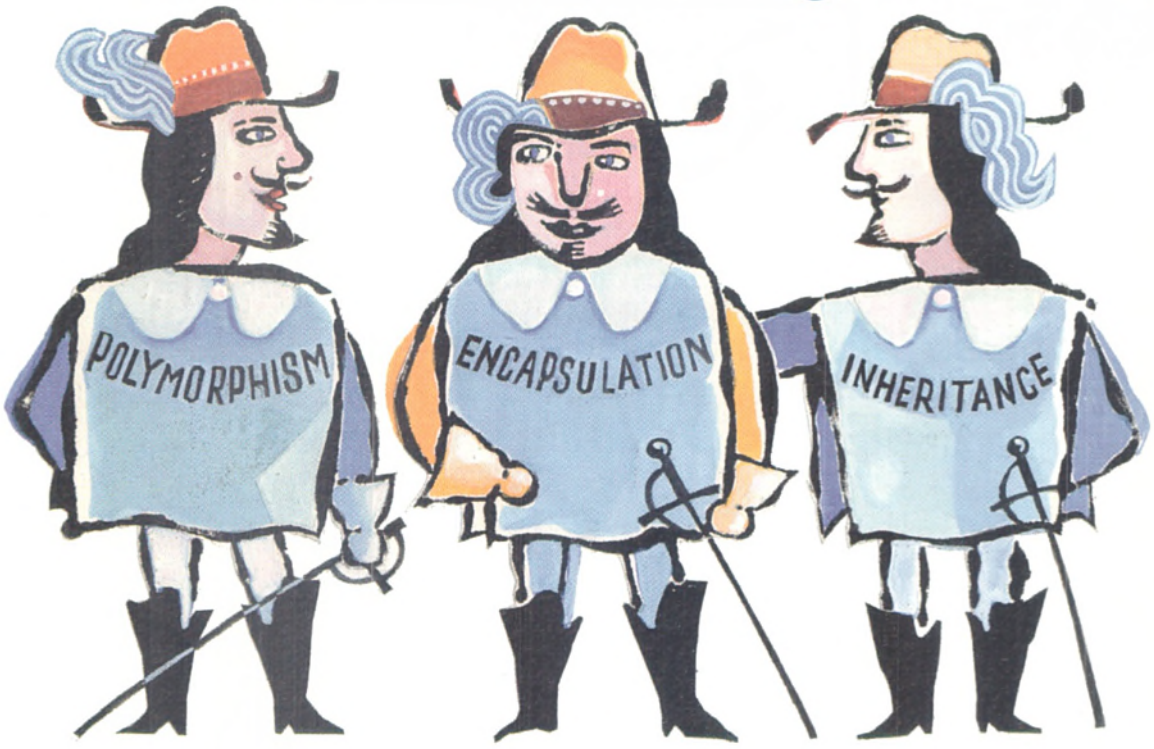

Illustration: Sergei Gagarin

In the past few years 'object-oriented' has been synonymous for 'good'. Even so, not everyone understands the basics. **Andy Brice** offers a pragmatic tutorial.

I have spent quite a bit of time recently trying to explain to people what object orientation really means, beyond the buzzwords. This article is an attempt to explain some of the 'nitty gritty' behind object orientation by comparing object-oriented and procedural programming approaches using some simple (ie contrived) examples.

As luck would have it we are provided with a procedural language and its object-oriented analogue, both widely used, in the shape of C and C++. Using both these languages, I will try to explain the practical benefits of the three cornerstones of object-oriented programming (OOP): encapsulation, inheritance and polymorphism.

Note that I am not trying to explain C++, so, as far as possible, I have omitted all features that are not directly related to OOP (eg **new** and **delete**, templates, exceptions, streams etc) and have simplified the C++ code examples as far as possible.

Encapsulation

Encapsulation is the ability to wrap up data and functionality into a single entity called a class.

Consider a list of pointers. We can implement this as a bare array of pointers (a **void*** in C is a pointer to any type):

```
void** listData;
```

This will work, but leaves the programmer to do all the housekeeping. Every time something is inserted, removed, etc, the programmer has to write the code. This results in less productivity, less maintainability and a greater chance of bugs. What we really need is a new data type with all its associated operations. So the sensible programmer codes the commonly-used operations into C functions:

File LIST.H:

```
/* list of void* (pointer to any type)
   duplicate pointers are allowed */

/* array of pointers */
typedef void** ListData;
/* index of item in list */
typedef short Index;
/* logical type */
enum Boolean {FALSE = 0,TRUE};

/* initialise the list */
void ListCreate (ListData* theList);
/* add to end of list, returns index of item
   or -1 if failed to add */
Index ListAdd (ListData* theList, void* theItem);
/* remove the theIndex'th item from the list,
   returns TRUE if succeeded */
Boolean ListRemove (ListData* theList, Index theIndex);
/* return the index of the first item in the list
   that matches theItem or -1 if none found */
Index ListFind (ListData* theList, void* theItem);
...
/* destroy the list */
void ListDestroy (ListData* theList);
```

ented programming

File LIST.C:

```
#include "list.h"

Index ListCreate (ListData* theList)
{
   ...
```

We can now use the list:

```
   ListData aList;
   float f = 1.0;
   ListCreate(aList);
   ListAdd(aList,&f);
   ...
   ListDestroy(aList);
```

This is a much better approach than using the bare data structure. The list has effectively become a user-defined type. All that tedious `malloc`'ing and `realloc`'ing has only to be coded once. However it is a rather imperfect job. We have to pass a pointer to the list we are manipulating each time we want to modify it, which is annoying and messy. Furthermore, it leaves the way open for developers to modify the data type directly without using any of the carefully tested functions that have been written. Also there are sequencing problems: if `ListAdd()` is called before `ListCreate()` or after `ListDestroy()`, all hell is likely to break loose. If we forget to call `ListDestroy()` a memory leak is likely to occur.

Passing pointers to the data structure can be avoided by storing the data internally, for example:

```
...
/* initialise the list */
void ListCreate (void);
/* add to end of list, returns index of item
   or -1 if failed to add */
Index ListAdd (void* theItem);
/* remove the theIndex'th item from the list,
   returns TRUE if succeeded */
Boolean ListRemove (Index theIndex);
/* return the index of the first item in the list
   that matches theItem or -1 if none found */
Index ListFind (void* theItem);
...
/* destroy the list object */
void ListDestroy (void);
```

File LIST.C:

```
#include "list.h"
static List itsList;
void ListCreate (void)
{
...
```

We can now use the list:

```
   float f = 1.0;
   ListCreate();
   ListAdd(&f);
   ...
   ListDestroy();
```

This is more elegant. Once we have initialised the list, we don't have to pass a pointer to it anymore. This means that no-one else can tamper with the data unless they go to the trouble of modifying LIST.C. In fact a user of the list doesn't even have to know how the list is implemented. However, this approach means that we can only have one list at a time, which is almost certainly unacceptable. The sequencing problems also remain. Procedural programming languages can only give us a partial solution to our problem because they separate data and function.

Encapsulation gets around these problems. Using it we can implement our code in C++, as:

File LIST.HPP:

```
/* list of void* (pointer to any type)
   duplicate pointers are allowed */

/* list of pointers containing up to 'short' items */
typedef void** ListData;
/* index of item in list */
typedef short Index;
/* logical type */
enum Boolean {FALSE = 0,TRUE};

class List
{
   public:
      /* create the list object */
      List ();
      /* add to end of list, returns index of item
         or -1 if failed to add */
      virtual Index Add (void* theItem);
      /* remove the theIndex'th item from the list,
         returns TRUE if succeeded */
      Boolean Remove (Index theIndex);
      /* return the index of first item in the list
         that matches theItem or -1 if none found */
      Index Find (ListData* theList, void* theItem);
      ...
      /* destroy the list object */
      virtual ~List ();

   private:
      /* the list of pointers */
      ListData itsListData;
};
```

File LIST.CPP:

```
#include "list.hpp"
/* create the list object */
Index List::List ()
{
...
```

The list is now a class, which can be used to create *objects* (as type is to variable, class is to object). Each time we instantiate (allocate the space for) a list we get a `List` object with its own data (in this case its own `ListData`) and associated functions (called 'methods'). Because `ListData` is declared as `private` it cannot be accessed from outside

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the `List` class (barring the use of `friends`, a C++ quirk which isn't relevant here) so the integrity of `ListData` is protected from outside tampering.

The only access to `itsListData` is through one of its `public` methods. The constructor `List()` is automatically called whenever a `List` object is created, and the destructor `~List()` is automatically called whenever a `List` object is destroyed, which gets rid of the sequencing problems. The keyword `virtual` is explained later.

We can now use the list much more cleanly:

```
float f1 = 1.0;
float f2 = 0.0;
/* create 2 list objects of class List */
List aList1,aList2;
aList1.Add(&f1);
aList2.Add(&f2);
...
/* destructors for the lists are called
   automatically as they pass out of scope */
```

Encapsulation allows us to hide functionality behind a well-defined interface. We can completely change the implementation without changing the interface; this minimises the dreaded 'ripple effect'. Encapsulation also allows us to wrap code into convenient packages, which makes the reuse of software a more realistic proposition.

Inheritance

Inheritance is the ability to derive one class from another.

Consider our procedural list. What if we want another type of list, but one that does not accept duplicates (ie the same pointer can only be stored once in the list)? We could create a whole new set of functions, for example:

File LISTUNIQ.H:

```
/* list of void* (pointer to any type)
   duplicate pointers are NOT allowed */

/* initialise the list */
void ListUniqueCreate (ListData* theList);
/* add to end of list, returns index of item
   or -1 if failed to add */
Index ListUniqueAdd (ListData* theList, void* theItem);
/* remove the theIndex'th item from the list,
   returns TRUE if succeeded */
Boolean ListUniqueRemove (ListData* theList,
                          Index theIndex);
...
/* destroy the list */
void ListUniqueDestroy (ListData* theList);
```

Some of the functions will be identical for the unique list and the original list. So most of these functions will make a direct call to the corresponding function for the original list. For example:

File LISTUNIQ.C:

```
/* initialise the list */
void ListUniqueCreate (ListData* theList)
{
   ListCreate(theList);
}

/* add to end of list, returns index of item
   or -1 if failed to add */
Index ListUniqueAdd (ListData* theList, void* theItem)
{
   /* check for duplicates before adding */
   if (!ListUniqueFind(theItem))
      return ListAdd(theItem);
   else
      /* this pointer already stored */
      return -1;
}
...
/* destroy the list */
void ListUniqueDestroy (ListData* theList)
{
   ListDestroy(theList);
}
```

This is very tedious to code. So we would probably omit the functions that were the same. Whichever way we're going, we'll have to be careful to use `ListAdd()` on lists that allow duplicates and `ListUniqueAdd()` on lists that don't. It would be very easy to make the wrong call.

Inheritance gets around the problem:

```
/* list of void* (pointer to any type)
   duplicate pointers are NOT allowed */

#include "list.hpp"

class ListUnique : public List
{
   public:
      /* create the list object */
      ListUnique ();
      /* add to end of list, returns index of item
         or -1 if failed to add */
      virtual Index Add (void* theItem);
      /* destroy the list object */
      virtual ~ListUnique ();
};
```

LISTUNIQ.CPP:

```
#include "listuniq.hpp"

/* create the list object */
Index ListUnique::ListUnique ()
{
...
}

/* add to end of list, returns index of item
   or -1 if failed to add */
Index ListUnique::Add (void* theItem)
{
   /* check for duplicates before adding */
   if (!Find(theItem))
      /* call the Add() method in List */
      return List::Add(theItem);
   else
      /* this pointer already stored */
      return -1;
}

/* destroy the list */
void ListUnique::~ListUnique ()
{
   ...;
}
```

The syntax `: public List` means the new class `ListUnique` inherits from `List`, which makes all its public methods available to the

derived class. The only methods we have to provide for `ListUnique` are its constructor and destructor (which are not inherited in C++) and `Add()` which we chose to 'override' (redefine in the derived class). Note, however, that in this case `ListUnique.Add()` still makes use of `List.Add()`. The placing of the keyword `virtual` in `List` allows us to override `Add()` in the derived class. The other methods that we have not needed to modify, such as `Remove()` and `Find()`, we get 'for free'. As well as overriding methods in `List` we could also add new methods that make sense for `ListUnique`, but not for `List`.

We can now use `List` and `ListUnique` without ever even knowing that one is inherited from the other:

```
float f = 1.0;
List aList;
Index anIndex;
ListUnique aListUnique;
/* expect both Add()s to work */
aList.Add(&f);  // calls List::Add()
aList.Add(&f);  // calls List::Add()
anIndex = aList.Find(&f);  // calls List::Find()
/* expect 2nd Add() to fail due to duplication */
aListUnique.Add(&f);  // calls ListUnique::Add()
aListUnique.Add(&f);  // calls ListUnique::Add()
anIndex = aListUnique.Find(&f);
/* calls List::Find() as this method is not
   overridden by Listunique */
...
```

Inheritance makes it easy to customise existing classes without changing the original code. For example `List` might have been written by someone else. I can override any virtual method to suit my own purposes without touching LIST.C or jeopardising any existing code.

In practise inheritance hierarchies are often many levels deep.

Polymorphism

Polymorphism is the ability of two objects of different classes to respond differently to the same call ('message').

Consider our list. We may want to be able to read some information from a file into a list. The list may or may not allow duplicates. With our procedural list we might write this as:

```
/* read n integers from file and add to list */
void populateList (ListData* theListData, FILE* fp,
                   short n, Boolean allowDuplicates)
{
   short i;
   for (i = 0; i < n; i++)
   {
      int* r = (int*)malloc(sizeof(int));
      fscanf(fp,"%d",r);
      if (allowDuplicates)
         ListAdd(theListData,r);
      else
         ListUniqueAdd(theListData,r);
   }
}
```

This is rather ugly and error-prone because we have to remember to set the right flag. Even worse, if we add more types of list we will have to go back and add more branches to the `if` statement. Polymorphism provides a neater solution:

```
/* read n integers from file and add to list */
void populateList (List* theList, FILE* fp, short n)
{
   short i;
   for (i = 0; i < n; i++)
   {
      /* should really use 'new' here */
      int* r = (int*)malloc(sizeof(int));
      /* should really use streams */
      fscanf(fp,"%d",r);
      theList->Add(r);
   }
}
```

C++ implements polymorphism by allowing a pointer to a class to store the address of an object of that class *or any class derived from it*. So in the example above `theList` can be an object of class `List` or any class derived from `List`, eg `ListUnique`. The `Add()` method called will depend on which class `theList` belongs to. If `theList` is of class `List` then `List::Add()` is called; if `theList` is of class `ListUnique` then `ListUnique::Add()` is called. New classes can be derived from `List` which do, or do not, override `Add()`, and `populateList()` will automatically invoke the correct method, without even requiring re-compilation. This sort of flexibility is achieved by deferring the binding of function names to addresses (which is normally carried out at link-time) until run-time. The C++ keyword `virtual` is an instruction to the compiler that this behaviour is to be allowed for a method.

A change of mindset

OOP provides powerful techniques for modelling the world (which in the final analysis is what programming is all about). Encapsulation allows data and functions to be wrapped together in a more convenient form. Inheritance and polymorphism provide ways to exploit the similarities and differences between classes. Appropriate use of these techniques lets us produce the same functionality with less code, which means less maintenance, less bugs, and less problems porting – on the grounds that the most maintainable, bug-free and portable code is the code you never wrote. As code can be arranged in separate classes that map more closely onto real-world entities it should also be much easier to maintain.

Many programmers, when first exposed to OOP, have exclaimed 'but we were doing that in assembler / Fortran / Cobol / C some 30 / 20 / 10 years ago!' To a large extent, they are right. OOP doesn't allow us to do anything that we couldn't do in any other procedural language. Indeed some C++ compilers process the C++ into C and then compile that. However object-oriented programming does allow us to do many things much more easily. The argument for using C++ instead of C is the same as that for using C instead of assembler (or a Turing machine, come to that). The larger and more complex the system you are creating, the more compelling the arguments for OOP become. What is more, these benefits can be had for little penalty in terms of speed or memory performance.

The basic ideas behind OOP are not too difficult to grasp. However experience shows that the change of mindset from procedural to OO is more difficult. Programming a class is much easier than choosing the right class with the right interface in the first place. If you decide to make the switch from the procedural to the OO paradigm make sure you get training in OO analysis and design as well as OOP. Nobody (with any sense) said OO was going to solve all our problems... ■

Andy Brice is Senior Staff Consultant for the environmental division of Intera Sciences.

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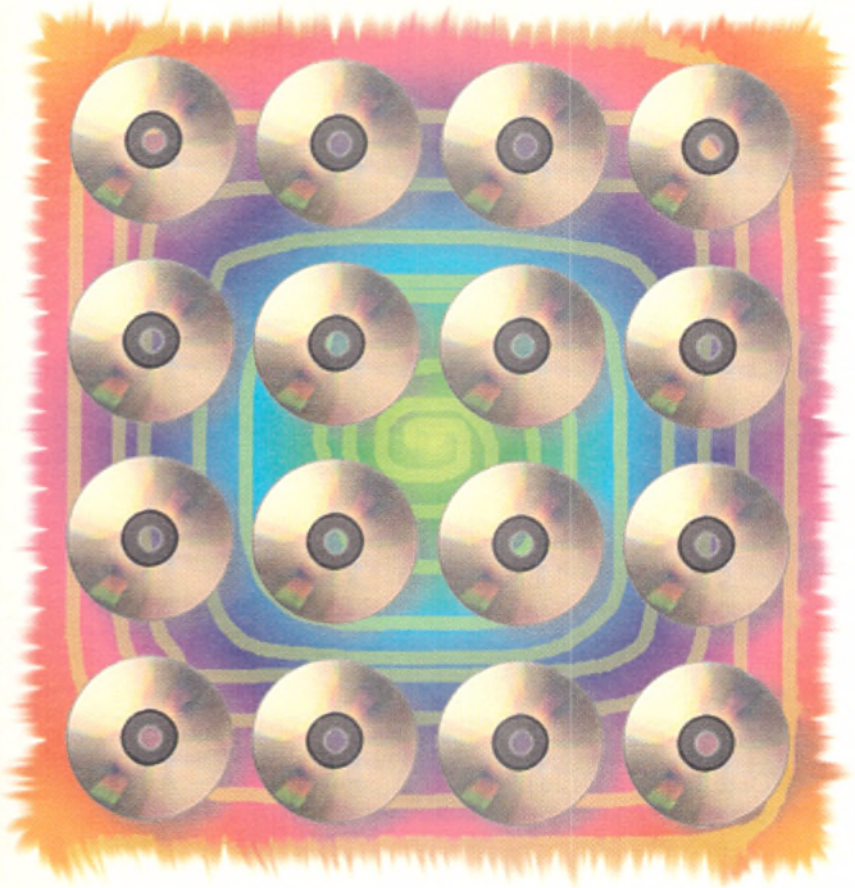

Playing audio CDs

What did you do when you bought your PC a CD-ROM drive? For **Gavin Smyth**, it was obvious: write a Visual Basic application to control it via the Media Control Interface.

When I eventually succumbed to the temptation and bought a CD-ROM drive for my PC, it came with a very basic utility that just allowed me to shove an audio CD in the drive and play it from the start. I decided that writing an application to give access to the music by track titles would be an interesting way to learn about programming multimedia applications. All the CD-ROM drive control is done by using Microsoft's Media Control Interface (MCI).

The first decision to make was choosing the language in which to write the program: Visual Basic, C, or even Microsoft Access. Although a significant amount of the program is database manipulation, I rejected the last option fairly quickly since Access is a rather heavyweight application with which to write this simple program. Device controls tend to be easy to program in C (well, easier than programming in Basic); however, the MCI is sufficiently high level that little interaction is actually required. This was not a strong enough argument to sway the decision on languages. Another major component of the application is the user interface, and that is a lot easier to program in Visual Basic! It turned out that the whole program is quite short, about 250 lines of code.

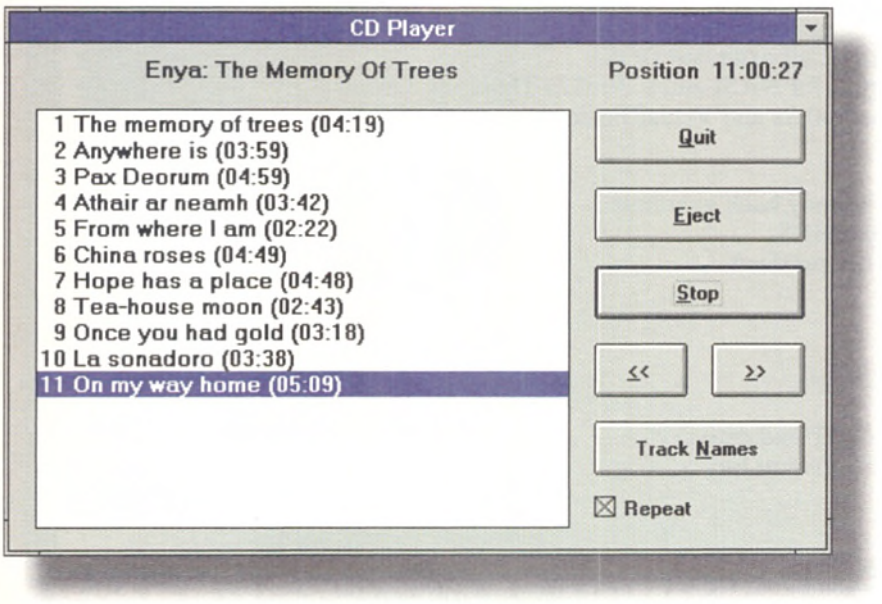

Figure 1 - CD player main screen

The fundamental extras I wanted were the ability to select tracks to play from a list of titles (ie not just numbers) and the automatic identification of a CD when inserted. When a CD is first played, the program described below allows the user to type in all this information. Subsequently, the program recognises the CD and extracts the previously saved list of track titles. Audio CD control is achieved via the fairly simple MCI. The overall program flow is modelled as a finite state machine (FSM), shown in Figure 2. The track information could have been stored in a simple flat file structure but I chose to use Visual Basic's database interface: hence the database itself can be read (or updated) via any of the standard Windows database programs since it is in Access format.

MCI

Within Windows, audio compact discs are just one type of 'media device'. A set of functions abstracts the control of all these devices from the vagaries of the different pieces of hardware. There are three possible ways to control and manipulate media devices from Windows (ignoring direct hardware interaction).

First, you can use Visual Basic's MCI VBX – this provides a set of 'tape player' buttons to automatically control most of the common activities, such as play, stop and skip tracks. It allows the programmer to concentrate on other aspects of the program. However, there is a problem with some caddyless CD-ROM drives (mine included) where, if the drawer is open, the *eject* button closes the drawer and immediately opens it again. Last time I looked for information on this, Microsoft and the drive manufacturers were still investigating. (Microsoft Knowledge Base entry Q116451 describes the problem and a clumsy workaround.) I also had difficulties setting the time format. (I do not know if this is a generic problem, or just happened with my drive.) An added drawback of this high-level driver is that performing some activities via the restricted MCI control interface is quite tedious: it takes many statements, say, to determine the length of a particular track.

At the other extreme, you can use 'direct' access functions – there is a C function library to control media devices, using structures to pass information to the drivers and back. This is all quite efficient, but is awkward to use from Visual Basic. Had I been writing in C, I would have chosen this method.

```
Declare Function mciSendString Lib "mmsystem"
( ByVal lpstrCommand As String,
  ByVal lpstrReturnString As String,
  ByVal uReturnLength As Integer,
  ByVal hWndCallback As Integer) As Long

Sub mciCommand (cmd As String)
  Dim status As Long
  status = mciSendString(cmd, "", 0, 0)
End Sub

Function mciRequest (cmd As String) As String
  Dim status As Long
  Dim ret As String
  Dim i As Integer

  ret = String$(20, 0)
  status = mciSendString(cmd, ret, 20, 0)

  For i = 1 To 20
    If Asc(Mid$(ret, i, 1)) = 0 Then Exit For
  Next i
  Rem The -1 below is a bit lazy, but I know
  the end of
  Rem the string will never be hit anyway
  mciRequest = Left$(ret, i - 1)
End Function
```

Listing 1 - MCI routines

```
Rem State values
Const sOpen = 1
Const sClose = 2
Const sGot = 3
Const sStop = 4
Const sPlay = 5
Rem State variable
Dim state As Integer
Sub setState (s As Integer)
  Rem Use hourglass pointer for duration
  mousePointer = 11
  state = s
  Select Case s
    Case sClose
      mciCommand "set cdaudio door closed
                  wait"
      tmrUpdate.Enabled = True
      cmdPlay.Enabled = False
      cmdRight.Enabled = False
      cmdLeft.Enabled = False
      cmdEject.Caption = "&Eject"

    Case sOpen
      mciCommand "set cdaudio door open"
      tmrUpdate.Enabled = False
      cmdPlay.Enabled = False
      cmdRight.Enabled = False
      cmdLeft.Enabled = False
      cmdEject.Caption = "&Load CD"

    Case sGot
      discSignature
      loadTrackList
      cmdEject.Caption = "&Eject"
      cmdPlay.Caption = "&Play"
      cmdPlay.Enabled = True
      cmdRight.Enabled = True
      cmdLeft.Enabled = True

    Case sPlay
      mciCommand "play cdaudio"
      cmdPlay.Caption = "&Stop"

    Case sStop
      mciCommand "stop cdaudio"
      cmdPlay.Caption = "&Play"
  End Select
  mousePointer = 0
End Sub
```

Listing 2 - FSM procedure

An example of an MCI command, to play tracks five and six of a CD, is:

```
play cdaudio from 5 to 7
```

All MCI commands consist of an initial keyword (`play` in the example above), a device name (such as `waveaudio` for `.WAV` files, `avivideo` for `.AVI` files, or, of course, `cdaudio` for audio CDs – these names appear in a `[mci]` section in `system.ini` with their corresponding drivers), and any parameters required by the command. There are other commands for opening and closing the door; setting and getting the position; reading the number of tracks; initialising and shutting down the device entirely, etc.

Most commands have two optional parameters: `wait` and `notify`. The former causes the command to block until the action is completed. This is useful in, for example, waiting until the CD door has shut before trying to read the disc. (At other times, `wait` is definitely not wanted: had it been specified in the example above, control would not return to the main program until track six had finished!) The latter causes a message to be sent to a specific window when the activity has completed – not really usable directly from Visual Basic, though it must be said that the MCI VBX does support notification properly. However, experimentation seems to suggest that it takes a long time for a notification to be sent, and the workaround I use, just polling the device on a timer, results in no perceivable loss of performance.

Disc positions can be expressed in a number of different time formats. The most useful are:

- `ms` for milliseconds,
- `msf` for minutes, seconds and frames (in the format `mm:ss:ff`),
- and `tmsf` for tracks, minutes, seconds and frames (in the format `tt:mm:ss:ff`).

In the latter two, trailing zero fields may be omitted. In the `tmsf` format, the number 5 behaves as 05:00:00:00 meaning the start of track five, as used earlier in the example. The time format is selected using, for example:

```
set cdaudio time format tmsf
```

Once a time format is selected, it remains in force until next set.

In Visual Basic, MCI commands are executed via the function `mciSendString()`. Its declaration is shown at the top of Listing 1 and its arguments are the command to execute, a string for any response, the size available for the response, and a handle to a window for notification messages (not used here). The return value is an error status, zero meaning the command was processed successfully.

To make the function easier to use, I encapsulated it in a couple of routines,

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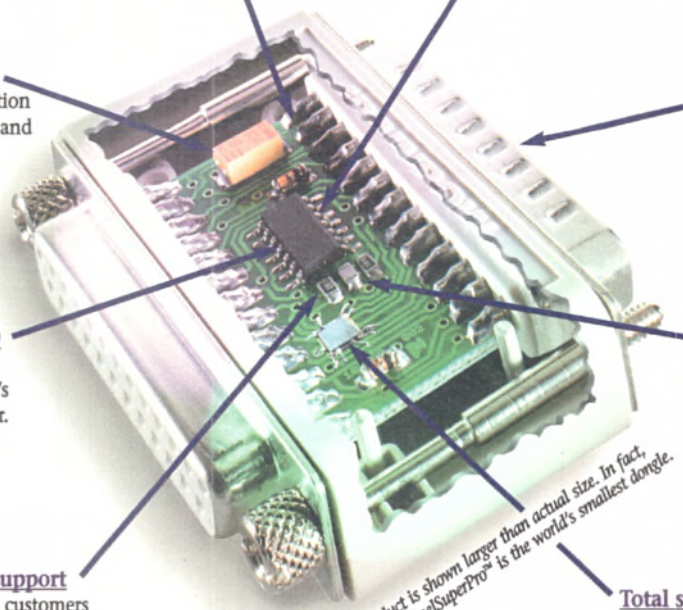

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shown in the rest of Listing 1: `mciCommand()` just sends a command, and `mciRequest()` does the same thing but also expects a response. In the latter case, it was easier to make the function return the response string. Since `mciSendString()` fills in a standard C null-terminated string, I have to manually trundle along it to determine the end point, otherwise `mciRequest()` would always return a 20 character string, with all but the first few being nulls (ASCII zero).

Incidentally, this sort of thing is much more insidious than you might think because the null characters do not appear on the screen, so inspection does not highlight the problem at all until you look at the string's length.

To request the number of tracks and play tracks 5 and 6, I use:

```
mciCommand "play cdaudio from 5 to 7"
numTracks = val(mciRequest("status cdaudio number of tracks"))
```

Remember, `mciRequest()`'s return value is a string, hence the use of `val()` to convert it to an integer.

Note that, in the two routines, the status value returned by `mciSendString()` is ignored. During development, I was using a slightly modified form of the procedure:

```
Sub mciCommand (cmd As String)
  Dim status As Long
  status = mciSendString(cmd, "", 0, 0)
  If status <> 0 Then
    MsgBox cmd & Chr$(10) & status, 48,
           "MCI error"
  End If
End Sub
```

Had there been an error, this variant of `mciCommand()` would have told me about it. (I had a similar variant of the `mciRequest()` function, too.) The only errors I came across were development ones such as mistyping the command string, or the device still being open after a previously aborted run.

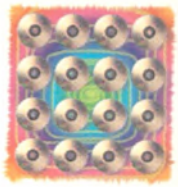
So far, I have concentrated on audio compact disc, but one of the nice things about MCI is that what I have just described is more or less all there is to it! Other devices, such as video, are controlled in almost the same way. For example, the lines:

```
mciCommand "open f:\mickey.avi type
avivideo alias mickey"
mciCommand""play mickey"
```

will play the video clip `mickey.avi`. The `alias` option associates a shorthand name with a device for further use. Other MCI commands may be found in the body of the CD player program. Parsing the string commands is performed by MMSYSTEM.DLL, which must be present somewhere on the path, typically in the Windows system directory.

Program control flow

The program interface is shown in Figure 1. Track titles are presented in a list box and there are buttons to start and stop the CD, to open and close the drawer, etc. The window has no system menu or maximise box: that way I avoid having to handle window resize requests within Visual Basic. To keep the number of buttons down, I chose to make some buttons perform two functions – the same button opens and closes the drawer for example – but that is just an implementation detail. Here are some requirements I had for the program:



```
Sub cmdEject_Click ()
  If state = sOpen Then
    setState sClose
  Else
    setState sOpen
  End If
End Sub

Sub cmdLeft_Click ()
  Dim t As Integer
  t = Val(Left$(mciRequest("status cdaudio position"), 2))
  If t > 1 Then skipToTrack t - 1
End Sub

Sub skipToTrack (t As Integer)
  mciCommand IIf(state = sPlay, "play cdaudio from ",
                                "seek cdaudio to ") & t
End Sub
```

Listing 3 - Eject and skip functions

```
Sub tmrUpdate_Timer ()
If state = sPlay Then
    Dim currTrack As Integer
    currTrack = Val(Left$(mciRequest("status cdaudio position"), 2))
    If (currTrack > Val(mciRequest("status cdaudio number of tracks"))
        Or currTrack = 0) Then
      If chkRepeat Then
        mciCommand ("play cdaudio from 1")
      Else
        setState sStop
        mciCommand ("seek cdaudio to start")
      End If
    End If
    lblTrackCount = Left$(mciRequest("status cdaudio position"), 8)
  ElseIf state = sClose Then
    If mciRequest("status cdaudio media present") = "true" Then
      setState sGot
    End If
  End If
End Sub
```

Listing 4 - Timer function

```
Sub discSignature ()
Dim numTracks As Integer, i As Integer
  Dim t As Long, totalTime As Long
  Dim s As Long

  mciCommand "set cdaudio time format ms"

  totalTime = 0
  numTracks = Val(mciRequest("status cdaudio number of tracks"))

  For i = 1 To numTracks
    totalTime = totalTime + Val(mciRequest("status cdaudio length track " & i))
  Next i
  s = numTracks * &H10000 + totalTime / 1000
  Me.Tag = s
End Sub
```

Listing 5 - Disc signature calculation

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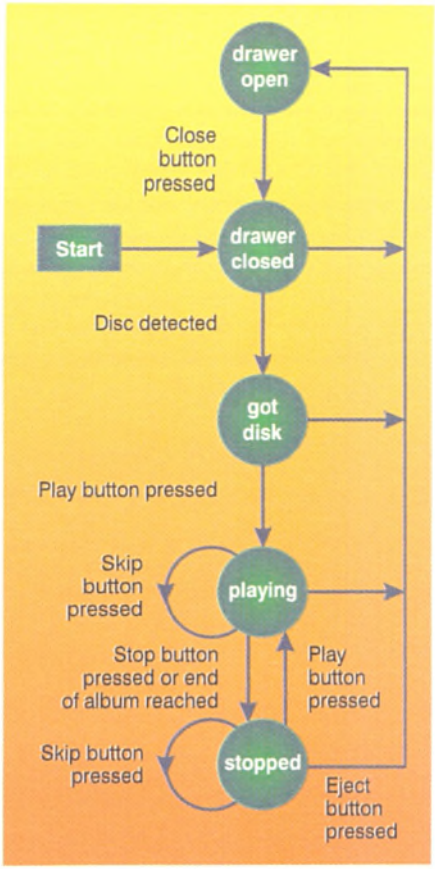
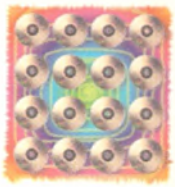


Figure 2 - CD player FSM

- When the *eject* button is pressed, send the `open drawer` MCI command and disable all buttons but the *quit* and *close drawer* ones.
- When the *close* button is pressed, send the `close drawer` MCI command and get ready to read the disc details – note that the *play* button is not yet enabled because the program does not know if there is a disc in the drawer.
- When it has determined that a disc is present, enable *play*, *eject*, etc.
- When the *play* button is pressed, disable *play* and enable *stop*.
- When the *stop* button is pressed, disable *stop* and enable *play*.
- When a *skip* button is pressed, or a track is selected from the list, move to that track.
- At the end of the album, stop; or, if the *repeat* button is checked, start over again.
- Finally, update the current track count as the disc is playing.

The easiest way to manage all this is via a finite state machine (FSM). States represent events like *door open, door closed* (with or without a disc), *disc detected, playing* and *stopped*, etc. Button presses and other actions cause the FSM to move from one state to another. On entry to a state, some operations are performed, such as MCI commands. The FSM specification for this program is shown in Figure 2. The current state is stored in a global variable which, for example, the skip functions can interrogate to determine if a track should be played or not.

A single procedure, `setState()` (see Listing 2), carries out all the processing. When a button is pressed, an associated function is called. Each of these functions calls `setState()` with an appropriate state value. `setState()` is not much more than a big `select` statement with a clause for each state. Splitting the `setState()` functionality across all the individual functions would not have been a good idea because some operations are caused by multiple actions, and all have to update the state variable. There would have been a lot of duplicated code. The functions in Listing 3 show how the state value is used and set when the *eject* button, or one of the *skip* buttons is pressed.



One of the trickier bits is detecting if a CD is present! On my drive, the player needs a considerable amount of time between the drawer closing and the disc being readable. This is the reason for introducing the two states 'drawer closed' and 'got disc' – the first is entered when the MCI `door close` operation is complete, at which point a timer is triggered, checking the disc every half of a second to try to read it. The shorter the timer period, the better the response, at the cost of reduced performance for other programs running simultaneously. When the program can successfully read the disc, the state is moved on. The same timer is used to check and update the track counter in the playing state. The timer event function is shown in

MCI command strings are easy to read and understand

```
Sub loadTrackList ()
  Dim t As Integer, i As Integer
  Dim sig As Long
  Dim db As Database
  Dim albums As Dynaset, tracks As Dynaset
  Dim s As String

  lstContents.Clear

  t = Val(mciRequest("status cdaudio number of tracks"))

  Set db = OpenDatabase("cd.mdb")
  Set albums = db.CreateDynaset("select * from album where
                                 signature = " & Me.Tag)

  s = "signature = "& Me.Tag
  albums.FindFirst s
  If albums.NoMatch Then
    albums.AddNew
    albums("title") = "<Untitled: " & Me.Tag & ">"
    albums("signature") = Me.Tag
    albums.Update
    albums.FindFirst s
  End If
  lblTitle = albums("title")

  Set tracks = db.CreateDynaset("select * from track where
                                 albumsignature = " & Me.Tag)

  For i = 1 To t
    tracks.FindFirst "position = " & i
    If tracks.NoMatch Then
      tracks.AddNew
      tracks("title") = "<Untitled " & i & ">"
      tracks("albumsignature") = Me.Tag
      tracks("position") = i
      tracks.Update
    End If
  Next i

  mciCommand "set cdaudio time format msf"

  For i = 1 To t
    tracks.FindFirst "position = " & i
    If i < 10 Then s = "  " Else s = ""
    s = s & i & " " & tracks("title") & " (" &
        Left$(mciRequest("status cdaudio length track " &:),
              5) & ")"
    lstContents.AddItem s
  Next i

  mciCommand "set cdaudio time format tmsf"

  tracks.Close
  albums.Close
  db.Close
End Sub
```

Listing 6 - Loading the track database

Listing 4. Note the test for the end of the album: if the track number is greater than the last or less than the first on the album, the player either stops or goes back to the beginning depending on whether the repeat box is checked. This is a rather sloppy test, but I have found that using MCI notification results in no noticeable improvement.

Database

The next step is to recognise what is on the disc and to present a track list (retrieved from a database). The database has two tables:

- `album`, with fields `signature` (long integer) and `title` (string),
- and `track`, with fields `albumsignature` (long integer), `title` (string) and `position` (integer)

The database tables are rather basic: I did not bother to have separate artist and title fields, just one string used by both. I did not create this database within VB, but used the Data Manager application which comes with VB, though it would have been possible to use Access, or any other tool that generates a database format which VB understands. The Data Manager itself is a VB program; the source can be found at *http://www.microsoft.com/kb/softlib/mslfiles/DATAMGR.EXE*.

The signature (`signature` and `albumsignature` fields) is a long integer intended to be unique for each disc, to make identification of a CD a very quick operation. I have chosen to calculate it as the total playing time in seconds in the bottom word and number of tracks in the upper word. I have simply assumed that this a unique value for each CD, though the program ought to check for collisions (ie two or more discs with the same signature value). More complex values could be used, such as a character string made up of all the track times. Alternatively, the album table lookup could check for more than one record with the same signature and try to select the correct one – it could check the individual track times of albums with the same signatures to see which matches the disc in the drive, and if the albums were still indistinguishable, ask the user to select one. However, the long

```
Sub lblTitle_DblClick ()
  Dim s As String
  s = InputBox$("Please enter the album title, or hit cancel",
                "Album title", lblTitle.Caption)
  If s <> "" Then
    Dim db As Database
    Dim albums As Dynaset
    lblTitle.Caption = s
    Set db = OpenDatabase("cd.mdb")
    Set albums = db.CreateDynaset("select * from album where signature = " & Me.Tag)
    albums.FindFirst "Signature = " & Me.Tag
    albums.Edit
    albums("title") = s
    albums("signature") = sig
    albums.Update
    albums.Close
    db.Close
  End If
End Sub
```

Listing 7 - Album title

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integer will do for the present. Each track record includes the signature of the album to which it belongs and the position, or track number, on the album. The signature calculation can be found in Listing 5. The signature is moderately complex to calculate and is used a number of times throughout the code. Because of this, I store it as the `tag` of the current form instead of continually recalculating it.

When a disc is loaded, its signature is calculated and looked up in the database: if it is not found, a dummy entry is created to provide a placeholder for later alteration. You can see how the data table is accessed via a dynaset in the `loadTrackList()` procedure (Listing 6): the set is formed of all records in the album table which have a given signature – hopefully no more than one record, though I do not check that. A similar dynaset lookup is used to extract the tracks, and placeholder entries are created if none are found. By the time the disc is ready for playing, a track listing and album title will be available for display, though they may be dummy ones created by the program. The album title is changed via the double-click action of the name label: see Listing 7. Notice how the signature is taken from the form's `tag` instead of being recalculated.

Figure 3 - Track details entry window

Updating the track list in a similar way would be somewhat laborious, so I use a separate form, illustrated in Figure 3, which uses bound controls and a data control to update all the track titles for an album. When this form is activated, it associates the data control with the track dynaset introduced earlier (in its load event handler). Moving through the dynaset fills in the bound controls with whatever is in the database. Any change made in the track title text box is automatically saved back into the database. When this second form is dismissed, `loadTrackList()` is called again to update the list box. It is interesting to note that the only pieces of code I had to write for this form were the load handler (to associate the data control with the dynaset) and the dismiss button (to unload the form again) – VB and the data controls handle everything else for me. (Had I decided to use C to begin with, the device control might have been more sophisticated, but I would have had a lot of coding to do to work with the database!)

Not slick - but quick

In this article, I have developed a short program to play audio CDs under Windows. Besides showing how easy it is to control MCI devices, the application illustrates the use of databases to store track information. This program is by no means perfect (is any piece of software ever finished?) My excuse is that working around the problems within Visual Basic is more effort than would be involved in rewriting it in C! I did start a similar project in that language, but after about 500 lines of C and resource definitions, without even touching the database aspects, I gave up and reverted to VB, though the finite state machine and CD device control was much slicker in C. For an application such as this, with the bulk of the program involved in handling the display or something for which there is good VBX support, it is much easier to use VB than C. ■

Gavin Smyth is a real-time software engineer and a part-time Windows and Linux hacker.

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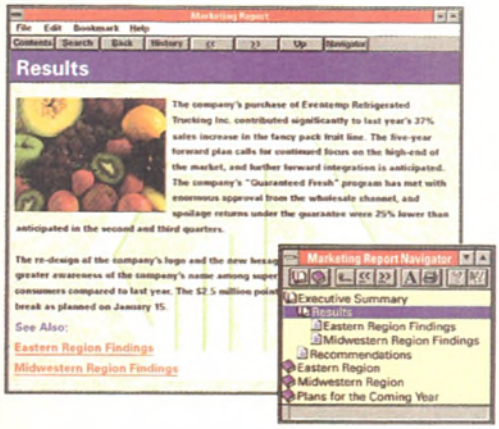

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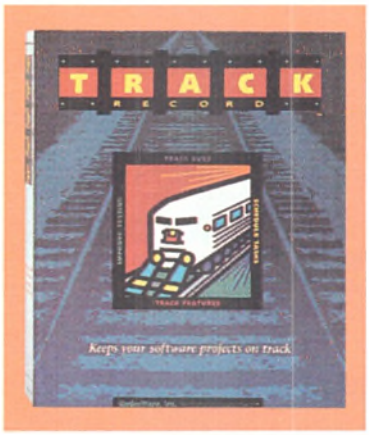

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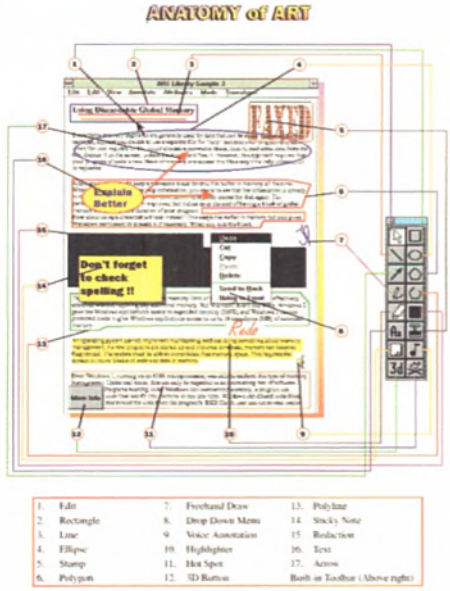

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I've finally put a colour screen on my Sun and spent some time changing my environment to take advantage of it. One of the new programs that I have started to use is `exmh`. The program acts as a graphical front-end to the MH mail handling system. You really need a colour screen, because it uses colour 'intelligently' to indicate the state of your mail. It's perhaps the first Unix mail application to provide easy-to-use support for the display of multi-media (MIME) mail.

However, `exmh` doesn't exist in isolation. To use it, you need to install various programs on your machine. I guess that `exmh` is one of those classical UNIX utilities which builds on the work of others. I feel that all of the programs are worth looking at. They should install painlessly onto your system – or perhaps will already be there if you are running one of the free PC-based Unix.

Mh

The MH mail handling system was developed by the Rand corporation. It was placed in the public domain and is now maintained by the University of California, Irvine (UCI). The current release, 3.8.3, was developed in 1994.

In the middle '80s, all mail handing programs were monolithic single applications. The same program was used to read and send mail. They didn't handle mail storage too well. Once you started to get some considerable volume of mail, old mail became buried in a single file that was impossible to search or deal with adequately.

Then came MH. It is a suite of programs that integrate well into the Unix command line environment. Rather than having one single command to deal with mail, there are several, although you only run perhaps six commands for most day-to-day use. Mail is stored with one message per file in a tree in your home directory. Conventionally the root of the tree is `Mail`, I have always renamed the root to `.Mail` so that it doesn't appear on the standard output from the `ls` command. Mail is stored in named folders that are actually sub-directories of your main mail tree.

The basic set of MH commands is made up of `inc`, `scan`, `show`, `rmm`, `comp` and `repl`. There are some 'housekeeping' commands: `prev`, `next` and `refile`.

The `inc` command moves the mail from the place where the mail system delivers it (usually `/usr/spool/mail/`*username* or `/var/mail/`*username*) into separate files in your `inbox` folder. It tells you what it is doing when it's operating. In Figure 1, the `inc` command is adding two bits of mail to my `inbox` folder. The mail will be placed into two files called `49` and `50`. To make things easier, MH has the notion of the current message in a folder. It's shown by the plus sign after the message id number.

You can now look at the current message using the `show` program. It will pass the message through a simple formatting program which is user tailorable, so you don't need to see all the header lines that get added into the message. If the message contains a MIME specification, then it will be thrown into a viewer that can deal with MIME types. Actually, in a text environment it can be hard to deal sensibly with some types of MIME mail.

You can always look at a specific message by giving its message number as a parameter to the command, so `show 5` will show message number 5 and set the current message to that value. All MH commands understand that an argument which is a number refers to that message in the current folder. You can also specify message ranges using a hyphen to separate the values.

Most commands don't alter the current message. However, the two commands `next` and `prev` will show the next and previous message respectively, and reset the current message number.

You now might like to reply to the message: you can do that with the `repl` command. The `repl` is easy to use but is actually somewhat complicated behind the scenes. It generates a message header by formatting parts of the message you are replying to. The formatting uses a control file to pick *From*, *Reply-To* and *Cc* header lines from the original message. It then uses their values to generate a new mail header. You can eventually edit the body of the message or the headers. MH allows you to use your favourite editor if you wish. It also provides a simple input program called `prompter` that you just type into to create the message.

Having replied to the message, you may wish to delete it. You use the `rmm` command for message deletion. Actually, the `rmm` command doesn't delete the file containing the message, it renames the file to start with a comma. So message `50` will become `,50`.

```
$ inc
 49+ 18/12 Keith Bostic  How to Attend a Meeting<<Forwarded-by: harry@sta
 50  18/12 ali           Short Wave<<Any sign of that short wave frequency
```

Figure 1 – Sample output of the inc command.

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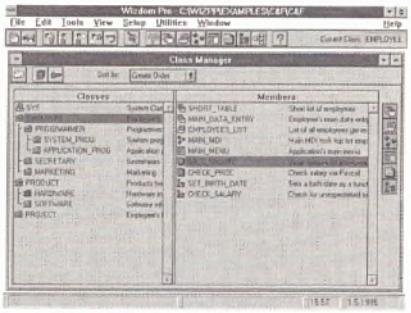

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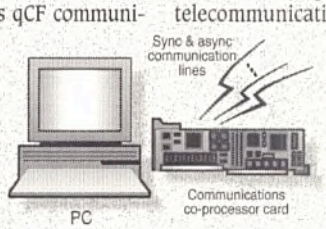

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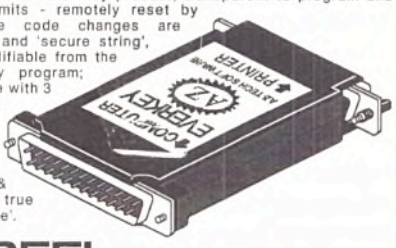

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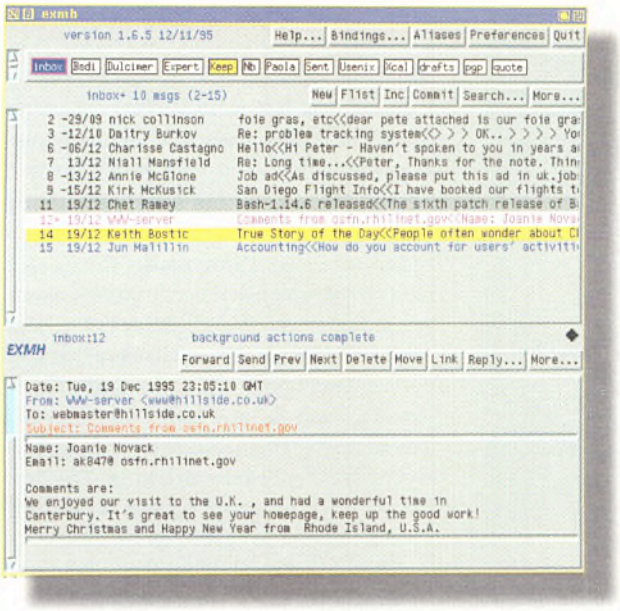

Figure 2 - General look of exmh's screen, slightly tailored from the distributed version.

About every other day, I find myself looking though the comma files for a message that I should not have deleted. It's a good feature.

The `rmm` command doesn't change the current message, which can be a pain because you usually want to remove the current message and read the next one. I have a shell script called `rmm+` that is simply a call to `rmm` followed by a call to `next`.

If you want to keep the message, you probably don't want it cluttering up your inbox, and the `refile` command can be used to move the message to another folder. MH interprets a string preceded by a plus as the name of a folder).

Context-based

There is considerable implied context in all MH commands. Take the `refile` command; `refile` and `keep` moves the current message in the current folder to a new message ID in the folder called `keep`. It will create the folder if it doesn't exist. Actually, it will ask permission first, in case you mistyped the folder name. By default, the `refile` command will delete the original message after having moved it. There's an option to `refile` which ensures that a hard link is created. This means that the message can appear in several folders should you want that.

By now, you have forgotten what is sitting in your `inbox` folder: use `scan` to see a listing of its contents. The listing looks like the output from `inc` that we saw earlier (Figure 1). It will use the current folder, unless you give the command a folder name: `scan +keep`

Finally, you might just like to send a message to someone with the `comp` command. It reads a user-tailorable mail template so you can add your own header lines and your signature. Again, you can use your own favourite editor, if you wish.

This brief description of the basic commands doesn't really do justice to MH. The user interface is very well thought out so that you have very little to type when issuing commands; the system provides context for those commands to operate. In addition, the system allows you to provide a configuration file, normally called `.mh_profile`. All the commands read the file on start-up. It's used to provide global information. For example, here's the start of my profile file:

```
Path: .Mail
Editor: /usr/local/bin/mh/prompter
prompter-next: /usr/local/bin/jove
```

The first line establishes my non-standard location for the mail tree. The next two lines tell the composition programs such as `repl` and `comp` that I like to use the `prompter` program when I initially call the program, and then I want to use my preferred editor for any subsequent editing.

In addition to global information, you can supply command specific data. All MH commands look in the profile file for their own name and interpret any text that follows the colon as program arguments. It allows you to set up standard options for the commands and not worry about typing reams of program arguments on the command line. For example, I like to annotate messages to which I have replied. I get the `repl` program to add some lines into the file that say who I replied to and when. For that, I add:

```
repl: -annotate -inplace
```

into my `.mh_profile` file. Now, whenever I run the `repl` command these parameters are automatically set by the command.

Well, I hope that gives you a flavour of MH. I've been using it for several years and it provides me with the mail handler of choice. The `exmh` program uses all these commands (and a few more) to front-end the MH system. In fact, `exmh` does nothing but provide you with a Tcl/Tk WYSIWYG interface to the regular MH command set.

Tcl/Tk

Tcl/Tk is actually two things. Tcl stands for *Tool Command Language* and its author, John Ousterhout, states that you should pronounce it *tickle* (although I resist this). Tcl provides a 'shell-like' scripting language with variables, loops and expressions. Tcl is interpreted and is supplied as a set of C procedures that can be embedded in applications. The idea was to provide a single language that could be plumbed into different applications making them extensible in the same way that Lisp supports the Emacs editor.

Tk is an extension of Tcl. It's a toolkit for the X Window system. It takes its look and feel from the Motif model, but does not use Motif from OSF. Tk extends Tcl by adding a set of commands for building user interfaces. You can create X applications from a simple text script of Tcl commands. The Tcl/Tk script can interface to the system using several methods. It can deal with files, Tcl provides file handling mechanisms. You can execute standard Unix commands, Tcl allows you to execute commands and obtain their output. And you can write your own C routines and embed them in the Tcl/Tk application.

I wrote about Tcl/Tk in *EXE*, in November '93. Since then, there have been a couple of new releases of Tcl, it's now at release 7.5 alpha 2. There has been also a major new version of Tk, release 4.1 alpha 2. Several of the old features have been reworked in places to make the language more coherent. The changes mean that your existing applications may need conversion for the new Tk. However, the code changes that you need to make are well documented, so the change-over is not difficult.

I have found the new Tcl/Tk an improvement on the old one. The problems that I used to have with cut and paste into a Tk widget have gone away. The new version deals with the *Compose Key* on my Sun keyboard, it's been important to be able to get the full Latin-1 character set into my address database application. There are a bunch of new features that I have yet to make use of, like the ability to include images in a general purpose way in widgets.

Finally, the FTP site contains ports of Tcl/Tk for the Macintosh and also Windows (both NT, 95 and good ole 3.1). I've taken a peek at the Windows 3.1 port. It comes as a binary pukka Windows install kit that went up on my Windows 3.1 system very easily. It's a very alpha release, so don't expect it to be all singing and dancing yet. It allows only one Tcl/Tk application to be running on the system at any one time, so I judge that it is not ready for the big time yet.

Finally, exmh

As I write, there has been a new release of `exmh` too, version 1.6.5. It went up on my machine painlessly. Brent Welch, the author of the program, provides an easy-to-use front end for installation. The install program, itself, is written in Tcl/Tk.

Getting the software

You can get MH using anonymous FTP to `ftp.ics.uci.edu`, look in the directory `pub/mh`. If you want to read about MH, then the best document source is the User's Supplementary Documents book from the 4.4BSD Manual set published by O'Reilly and Associates. It's ISBN 1-56592-076-7. *(Another good source is MH & xmh, Email for Users & Programmers from O'Reilly, ISBN 1-56592-093-7 – Ed.)*

There is now a Web page aimed at Tcl/Tk aficionados, it's located at `http://www.sunlabs.com/research/tcl`. You can get the latest releases of Tcl/Tk from `ftp.smli.com`. There are mirrors on `sunsite.doc.ic.ac.uk` in `/computing/programming/languages/tcl/tcl-archive/ftp.smli.com`. Another interesting Tcl/Tk site is `ftp.aud.alcatel.com` which contains the Tcl contributed archive in the public directory `/tcl`.

You can get **exmh** from the aforementioned Tcl/Tk FTP sites or alternatively using anonymous FTP to `ftp.sunlabs.com` in `/pub/tcl/exmh`.

Figure 2 shows **exmh** as I use it. Users of **xmh** will recognise the general look of the screen. In fact, I have tailored it slightly from the distributed version. Tailoring is mostly done using the menu that drops down from the *Preferences* button on the top line of the display. I have added a blue background to the scroll bars and lightened the grey used in the screen display. I've also swapped the scroll bars to the other side of the **exmh** window. The remaining buttons on the top line of the display give help, and allow you to establish your own set of key bindings and to set up some private MH address aliases.

The **exmh** window is split into three. The top line of rectangular boxes shows my folders. The current folder is shown in blue. I'll come onto the yellow one in a while. I don't have many folders, so I configure the display to show them all. It's possible to have a slightly different display that contains a cache of frequently used folders (it is then positioned just under the normal list of folders display). The middle window displays a list of the messages in the current folder, and the bottom one shows the current message.

The current folder is selected by pointing with the mouse at the appropriate folder box and clicking the left button. The MH **scan** command is used to generate the active display shown in the main area in the top half of the display. In the image, the current folder is **inbox**. Mail that I have read is shown in light grey and mail that I have marked for deletion is displayed in darker grey. The blue text is a message that I haven't looked at yet. The white line with red text is the current message shown in the message area in the bottom half of the screen. The yellow message line and the yellow folder box above marks a refiled mail message. Refiling the current message is very simple, you simply point at the destination folder and click with the right mouse button.

The row of buttons above the folder message list perform operations which relate to folders. The *New* button will create a new folder. The *Flist* button will refresh the folder display in the top line, this button is needed if the set of folders change without the knowledge of the current **exmh** application.

The *Inc* button simply calls the MH **inc** command to load mail from your spool mailbox into the **inbox** folder. Actually, you can configure a background helper process to wake up periodically and run **inc** automatically. Time is saved because you don't need to wait for **inc** to be run.

The *Commit* button is a good feature. None of the actions that you specify on mail messages, deleting or refiling them, will happen until you hit *Commit*. I tend to deal with mail in batches, reading a mail message and marking it for deletion. *Commit* then clears things down ready for some new mail. This button provides an easy way to undo things if you make a mistake.

The *Search* button allows a search of all the mail in a folder for specific characteristics, perhaps mail from a particular person or mail with some word in the title. The *Search* button uses another standard MH command, one that I have not described above, called **pick**. Finally, the *More* button causes a menu to drop down with several other useful options.

The area between the folder and message areas is used to display status messages. It also contains the big black friendly diamond that allows you to move the partition up and down between the two areas. You will find that **exmh** makes a point of remembering positional information. So once you have altered the placing of the central bar, it will appear in that position whenever you start the program again.

Under the folder

The message area shows the current message. I have elected to setup some special tailoring so that the From and Subject header lines appear in blue and red respectively. Above the message area is a set of buttons that also map onto standard MH commands (the *Send* button maps onto the **comp** command, *Prev* and *Next* map onto **prev** and **next**, *Move* and *Link* are variations on **refile**). The *Forw* button forwards the mail to someone else. *Delete* marks the current mail message for deletion, turning the appropriate line in the folder display list to dark grey. *Reply* brings up a small menu that supports different reply styles, depending on the From, To and Cc lines in the original mail. The menu is configurable, so other flavours of reply can be optionally slotted in. The final button, *More*, brings up a menu of less used choices that can be applied to a message.

There are several things that I like about the **exmh** interface. First, it makes intelligent use of colour to prompt you about the different actions that you can take on your mail. Second, it will track what you are doing and take sensible default actions. For example, the *Delete* button marks a message for deletion and then automatically displays the next message. If you have started going up the screen using the *Prev* button, then the 'next' message for *Delete* will be the previous message in the list.

Third, some thought has been given to the look of the screen. The divider that you can see between the header of the mail and its body is unobtrusive and clearly shows where the message begins and ends. The divider is used between sections of MIME mail messages. When the data in the MIME message maps into displayable text, you can suddenly see a whole mail message being displayed on the screen. Seeing the whole thing is considerably more friendly than the equivalent MH command, where each segment of the message is displayed separately.

The program has several other bells and whistles. For example, it understands that a mail header can contain a line that specifies the home page of the sender. Mail from me now contains a mail header line like:

```
X-url: http://www.hillside.co.uk
```

The line triggers a change in the status display region of the screen giving you a button to press that fires up a Web browser of your choice pointing at the URL. You can also search mail messages for URLs.

All the software mentioned in this article is available directly on the Internet, see the box 'Getting the software'. ■

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

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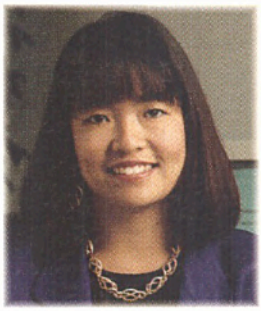

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CIRCLE NO. 507

Essential pointers

Francis Glassborow

invites you to simulate Lady Luck.

Code can fail in a variety of different ways: ultimately the blame lies with the programmer. Sometimes it can be a subtle failure in knowledge or understanding. I wonder if you can spot the problem with the following code.

The task is to write a simple program to generate a random selection of six distinct numbers from a set of 49. (Quite a popular task last year!) You want the program eventually to generate all possible combinations. As the product is for the current generation of home equipment, `int`s will be 16-bit. Although you are going to pretty it up for sale, the core of your program is:

```
int main() {
   int values[49]
   int i, select, temp;
// first initialise the array
   for (i=0; i<49; i++)
      values[i] = i + 1;
// set the random number generator from
// the system clock
   srand((unsigned) time(0));
// shuffle the array - iterate back from the
// end of the list, swapping each element
// with another element randomly chosen
// from the part of the list prior to the
// current position
   for (i=49; i>1; i--) {
      select = rand() % i;
      temp = values[i-1];
      values[i-1] = values[select];
      values[select] = temp;
   }
   printf("The six numbers are:");
   for (i=0; i<6; i++)
      printf("%d ", values[i]);
   printf("\n");
   return 0;
}
```

Don't grab your keyboard to tell me what terrible code this is; I know. In the production version, magic numbers would be replaced by manifest constants of some kind, the 'shuffle' code would be turned into a function, header files would be included, and so on. Instead, spot the fundamental flaw. It does not, and cannot, meet the design target. Can you see the problem?

C variants

Despite C's somewhat eccentric syntax, it has become immensely popular both for programming and as the basis for new languages. C++ is the most widely-known C derivative. Many of us get irritated by the problems C causes C++ because of the original design decision to respect legacy C code. Practically we must accept that this property of C++ has been one of its major selling points. It is also the cause of many problems for the designers of the C++ language and not a few problems for its users. I think that even trainers and writers might have preferred something with fewer special cases and eccentricities. However, if you have any doubts that supporting legacy code can be critical you have only to look at what has (not) happened to Objective C.

I have recently come across two other C variants. The first of these is C minus minus. The two minuses represent 'no pointers' and 'no type declarations'. This is available as an interpreted language for MS-DOS, OS/2 and Windows. If you want to try it out, the DOS version (a shareware product) should be available from Demon's ftp site (ftp.demon.co.uk) in the CUG sub-directory.

Rather more important is the newcomer from Sun Microsystems, Java. The language's designers were well familiar with C and C++ but did not feel any need to constrain themselves by supporting legacy code. World Wide Web support has been one of the major factors behind the explosive growth in use of a language that is still in beta testing and whose API was frozen only a couple of months ago. It was designed for writing applets for inclusion in 'active' WWW pages and to support an extensible WWW browser (HotJava). I have no doubt that its eventual range of use will be much wider than that. Just as both C and C++ have transcended their original design motives, and I feel confident that Java will do likewise. If you value programming languages as your working tools, take the time to find out more about this one. Not only is it an object-oriented language (rather than just a language in which you can do OO programming) but it supports multi-threaded programming and provides garbage collection too.

The Association of C & C++ Users will be covering developments in Java (*as will EXE – Ed.*) I think that it will soon become a vigorous and vital member of the C-derived family of languages.

Last month's problem

To save you from having to hunt out the last issue of *EXE*, here is the code again, but with the problem lines identified:

```
struct B {
   int i;
   virtual void report() const { cout << i;}
   virtual ~B() {}   // does nothing
};

struct D : public B {
   int j;
   void report() const { cout << i << " " << j;}
   virtual ~D() {}   // does nothing
};

int main() {
   B* bp;
   B* abp;
   B& yabp();        // line a
   bp = new D;
   abp = new D[100]; // line b
   // rest of program
}
```

The one that is not a problem

The first problem manifests at line *a*. Clearly this is a declaration of a function that takes no parameters and returns a reference to a `B` – or is it? To clarify this problem, consider some other examples based on a mythical class `BX` which contains whatever member functions are needed by the particular example. How about:

```
BX yabp(X);
```

The problem is that unless you know whether `X` is a *type* name or an *object* name you cannot determine what is being declared: a function taking an `X` and returning a `BX`, or a `BX` constructed from an object `X`. What sort of declaration `BX yabp(X);` is depends on what kind of thing `X` is.

Now for a nasty variation. Consider:

```
int i = i;
```

Syntactically legal in both C and C++, semantically this is an error because it initialises `i` with its own uninitialised contents. It is thanks to a quirk of C grammar that the second `i` is the same as the first one. This is not the place to explain the tortuous rationale that led to this monstrosity. Because C++ allows function-style initialisers the following is syntactically valid:

```
int i(i);
```

and has the same meaning.

I tried to get this outlawed from C++ but, while all agreed that it was horrible, some argued that it would break code like this:

```
class Node {
   // various members
   Node & next;
public:
   Node (Node& link): next(link){}
   //rest of class definition
};
```

Such code is already conceptually broken because this function not only looks like a copy constructor, but is a copy constructor as far as the compiler is concerned. But mandating against bad code has a very low priority, so both:

```
BX yabp(yabp);
```

and:

```
BX yabp = yabp;
```

are syntactically valid, and a C++ compiler is bound to compile such code as long as a copy constructor is available. If you really want to link nodes by reference you must write something like:

```
class Node {
   // various members
   Node & next;
public:
   Node (Node* link): next (*link) {}
   //rest of class definition
};
```

This constructor is distinct from any of the copy constructors and so will not be abused by your compiler.

Ambiguities

Now what about the following:

```
BX yabp();
```

Is this ambiguous? Actually no, but many with a C++ mindset may think that they are declaring an object of type `BX` initialised with a default constructor, rather than providing the function declaration the compiler will see. At best this leads to some obscure error messages, and at worst may even result in broken code that compiles. It is most unlikely to link but we all know how uninformative link-time error messages can be.

Returning to line *a*, the code must declare a function after all because references are not constructed: they are initialised. Nonetheless I would be happier with a compiler that issued a warning in such a case. Actually, I thoroughly dislike the C programming habit of declaring functions locally. My basic guideline is 'Do not declare things where you cannot define them.'

Is the above problem of importance? In normal (sic) source code the answer is probably *no* because the compiler can always *either* determine exactly one meaning, *or* issue an ambiguity error. However, this is not true when you are writing template code. Faced with:

```
template <class Y>
class X {
      //various
      int Prob(Y);
      // other code
};
```

How is the compiler to know if the programmer intends `Prob` to be an `int` initialised from a *value* `Y` (either an `int` or something that will convert to an `int`), or a member function that takes a parameter of *type* `Y` and returns an `int`? This problem has only been recognised recently, and a new keyword, `typename`, has been introduced to tackle it. I am glad that initial proposals to overload an existing keyword (`typedef` was a favourite) failed, though had the problem been spotted much earlier I suspect that the C phobia of new keywords would have prevailed.

`typename` may also replace `class` in template parameter lists. As soon as your compiler understands `typename` I would encourage you to use this option as it makes code more readable. I am a great believer in not overloading keywords with meanings. Which reminds me: now we have compilers that implement `namespace` I hope that many will use the anonymous `namespace` construct to avoid the use of `static` in limiting identifiers to file scope. More on this another time.

Something nasty

While line *a* was just a hook for the above commentary, line *b* is nasty. Consider the C code at the top of the next column.

Even if a poor compiler compiles this code, it will not work as you might have intended.

```
void reset (int array[], int size) {
   int i;
   for (i=0; i < size; i++)
      array[i] = i;
}

int main () {
   float values[20];
// other code
   return 0;
}
```

While we can often safely convert between single object types, this will generally not work for arrays. In the case of arrays we have not one but two problems. The first is that the compiler must be able to determine the *size* of elements so that it can walk the array correctly. `float`s and `int`s are the same size in some implementations. The second problem is that the *layout* of the objects must be compatible. This one always bites in the case of `float`s and `int`s.

Now look at line *b*. See the problem? Because `D` is publicly derived from `B`, a `D*` can be assigned to a `B*` without a squeak from the compiler. This is OK – indeed, this is vital if we are to exploit the polymorphic properties of `B` – but for the unfortunate fact that an *array* of `D`s can also happily be assigned to a `B*`. If the resulting `B*` is then (quite reasonably) treated as though it were an array of `B`s, all hell will break loose, as `sizeof(B) != sizeof(D)`.

As we are not allowed arrays of references – it's difficult to see how we could implement these without a radical revision of C++'s syntax and semantics – we must use arrays of pointers to solve this problem. These are the only reliable way of avoiding this hole in C++'s type system, as all object pointers are of the same size.

Experienced programmers will be able to decide when they can use an array of object type and when they must resort to an array of pointers. I think the rest would be well advised to stick with arrays of pointers unless they are certain that an array of objects will not cause problems. Alternatively, the Standard Template Library provides safe container classes. ■

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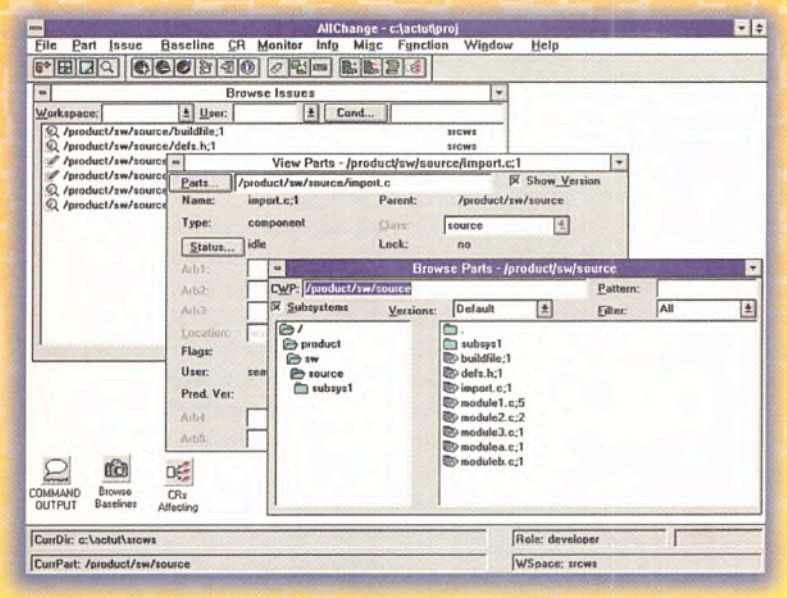

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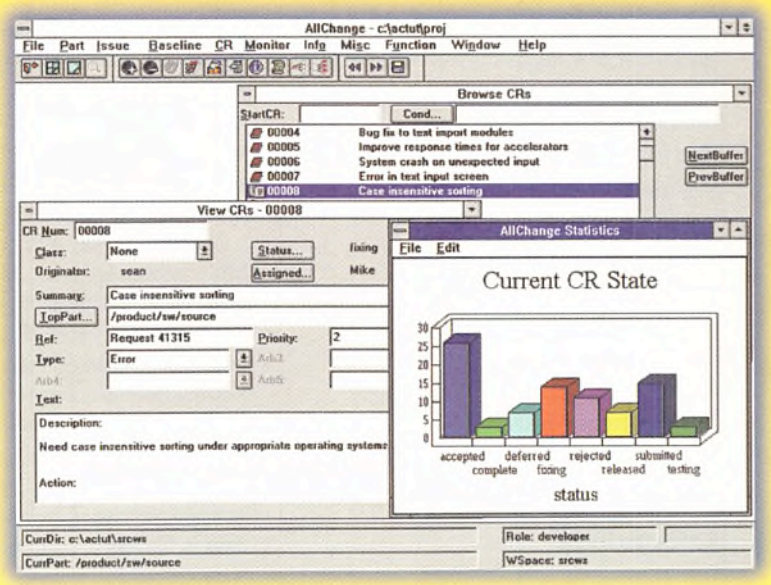

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Windows 95 Game SDK

Wherefore art thou, WinG? Microsoft has presented Windows 95 as the ideal games platform. The emphasis is now on the new Game SDK, the subject of **Dave Jewell's** exploration for this month.

For quite some time now, Microsoft has been encouraging developers to use Windows 95 as a platform for developing state-of-the-art game applications. Naturally, there are sound commercial reasons for doing this since it represents yet another area in which the software giant can gain market dominance. Despite sewing up the operating system market and achieving a near monopoly in business application software, Microsoft is not resting on its laurels. What's the betting that in less than ten years Sega, Nintendo and the like will be history while all the best-dressed games consoles will be running a turnkey successor to Windows 95?

Orwellian nightmares aside, there are good reasons why Windows hasn't yet taken the world by storm as a games platform. Paradoxically, the strength of a particular software architecture can sometimes also be its weakness. Windows was designed from the outset as a device independent system, ie all communication with video cards, sound cards, disk drives, mice, etc is performed via the appropriate device driver. For games, it's crucially important to have video performance that's as fast as possible in order to provide the sort of arcade-quality graphics that are expected today. Because of the layered architecture and the presence of a video driver of dubious quality (and believe me, some Windows drivers are truly appalling in performance terms) Microsoft decided to adopt the so-called *DirectX* approach which involves bypassing drivers and communicating directly with the hardware where it's safe to do so. At the time of writing, Microsoft has undertaken to implement the DirectX API calls for Windows NT.

The Game SDK consists of a number of routines which can be divided up into a set of functional groups as:

- *DirectDraw* enables fast, direct access to video memory. Where applicable, the DirectDraw system allows rapid access to off-screen video memory and supports any buffer-swapping capabilities of your hardware. If these facilities are present, your program can display one image while preparing another for viewing – this is a common technique for achieving much smoother animation than is possible with the 'bare-bones' Windows API alone.
- *DirectPlay* allows the easy connection of machines over a modem link or a network, thus enabling you to build multi-user adventure games and the like. (Of course, there's nothing to stop you using this for more serious purposes too...)
- *DirectSound* is, as the name suggests, an API for producing sound effects in your games. As with DirectDraw, hardware capabilities such as mixing can be exploited if present.
- *DirectInput* is used to provide an interface for games equipment such as joysticks. Microsoft claims that this interface will be scaleable to 'future Windows hardware input' so we'll no doubt be plugging our virtual reality helmets in here too.
- Finally, *AutoPlay* allows a program to be automatically run from a CD when the CD is first inserted into the drive. Strictly speaking, both AutoPlay and DirectInput are already part of the Win32 API specification, but Microsoft chose to include them again as part of the Game SDK.

In addition to the above, Microsoft provides a small API, *DirectXSetup*, which is

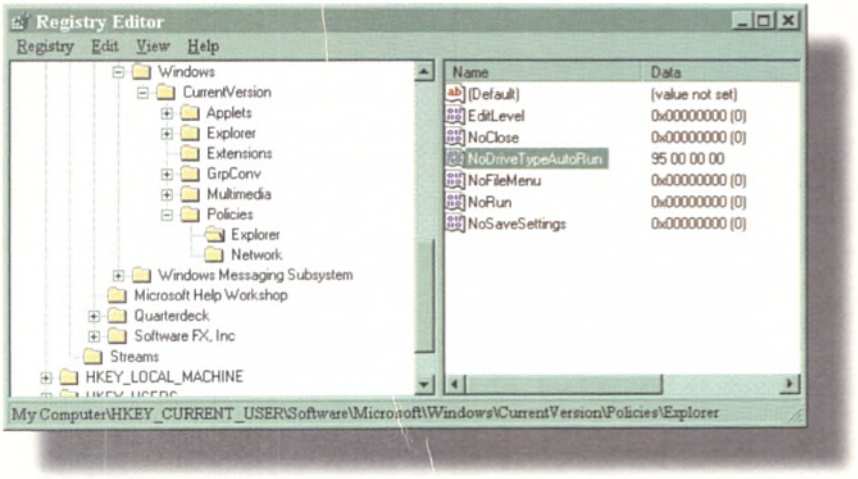

Figure 1 – According to the AutoPlay documentation, changing this entry in the Windows Registry from $95 to $91 will let you to test out AutoPlay applications as if they were residing on a CD-ROM.

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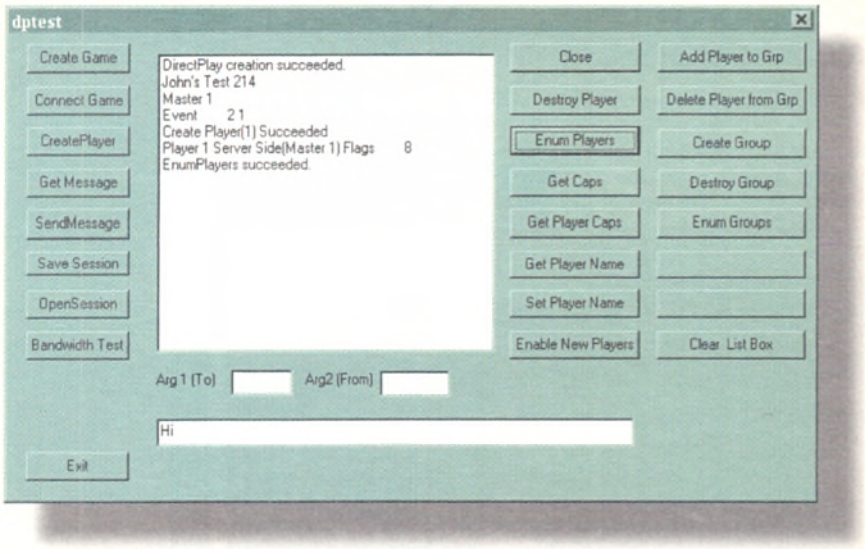

Figure 2 – The Game SDK comes with a number of useful test-bed applications which can be used to debug drivers and ensure that things are correctly configured. Now if only they told you how to write the drivers

designed to simplify the complex process of installing the various DirectX drivers onto a user's hard disk. In fact Microsoft states that you *must* use DirectXSetup rather than rolling your own installation because of the complexity of the task involved. The DirectXSetup routine takes a window handle (to serve as the parent window of any needed dialogs), a pathname where the DirectX components may be found, and a flag word which specifies which components should be installed – it takes care of the whole install process and simply returns an integer indicating whether or not the install was successful and whether a reboot is required.

DirectDraw

DirectDraw is the most important part of the Game SDK package and will work with everything from 'dumb' VGA cards right up to sophisticated display devices which support clipping, stretching, hardware bltting, page flipping and so on. The DirectDraw API is based around the COM (Component Object Model) architecture that's used by OLE. This might sound like bad news for plain-vanilla C programmers, but the interface to DirectDraw is both procedural and object-oriented. If you're not familiar with how this works, then look at the `IClassFactory` and `DECLARE_INTERFACE` macros and definitions in the OBJBASE.H include file (part of the standard Win32 SDK distribution).

As stated in the documentation, DirectDraw isn't a high-level graphics API. The emphasis in on speed while maintaining device independence. It cannot be compared to OpenGL which is a sophisticated 3D rendering package. Like NT, DirectDraw introduces the concept of a HAL (Hardware Abstraction Layer) which sits between the device-dependent driver code (lower level) and the device-independent routines (higher level). In DirectDraw, the HAL is responsible for allocating, freeing, moving and transforming display memory and for reporting device capabilities back to the high-level code. Whenever a certain capability is not present, the higher-level code takes responsibility for emulating the missing functionality. It can be either an integral part of the display driver software or a private DLL that communicates with the display driver. In any event, it is implemented by the chip or board manufacturer. The HAL code must be written for speed – all parameter validation is assumed to have been done by the higher-level DirectDraw code.

A number of different objects are used by a DirectDraw application, some of them being:

- The `DirectDraw` object itself. This represents the actual display device.
- `DirectDrawSurface` objects. These represent an area of display memory which may or may not currently point to visible frame memory on the card. If not, the memory corresponding to a `DirectDrawSurface` will usually be mapped onto spare video memory, but it can also be mapped onto the PC's normal system memory. `DirectDrawSurface` objects are used to implement overlays and texture maps.
- A `DirectDrawPalette` object representing a 16- or 256-colour palette. A palette has to be attached to a drawing surface before it comes into effect.

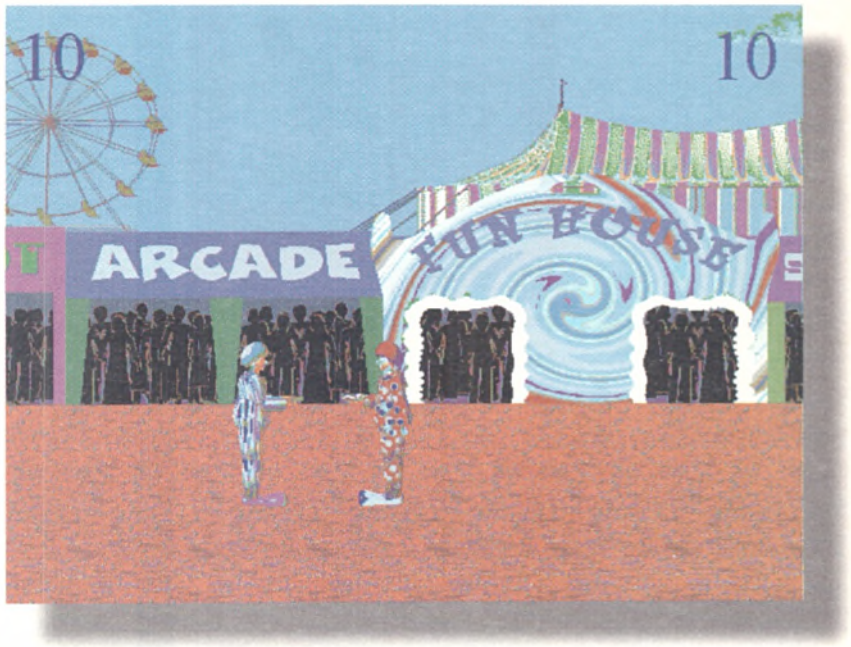

Figure 3 – Not another stupid clowns and custard pies game! An excellent example of what you wouldn't want to do with the Game SDK routines.

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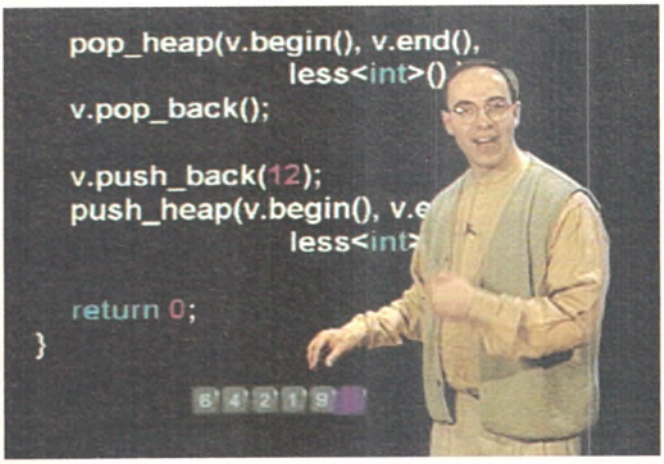

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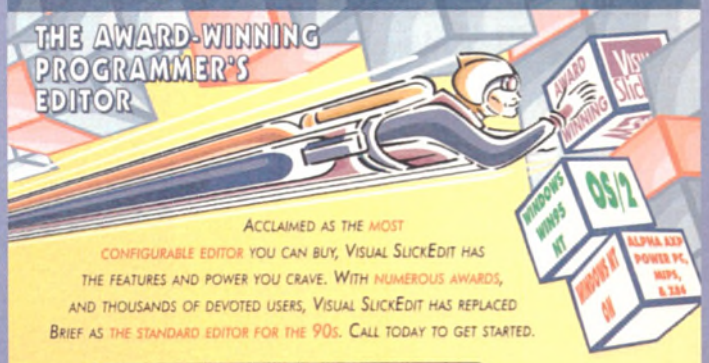

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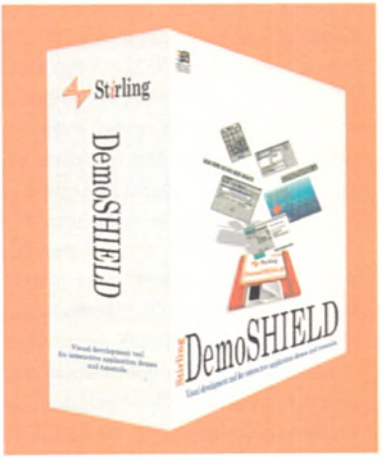

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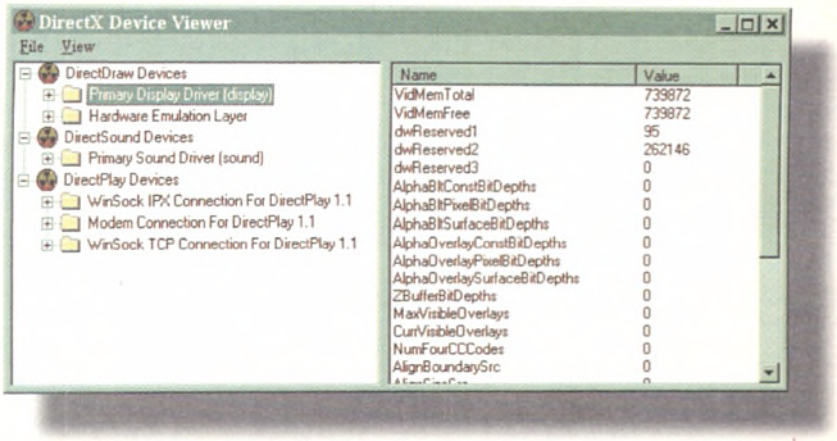

Figure 4 – The DirectX Device Viewer is another useful utility bundled with the SDK. It provides a hierarchical 'registry-style' view of a DirectX configuration.

If you have the QuickRes software installed (part of the Windows 95 Plus pack) you'll know that it's possible for Windows 95 to change display mode on the fly, something that wasn't feasible with earlier versions of the system. DirectDraw supports this functionality through the `SetDisplayMode` member of the `DirectDraw` object. However, it is possible for one application to have ownership of the display. In this mode, other programs can perform drawing operations in the normal way, but only the 'owning' application can change the display mode or the palette.

Perhaps surprisingly, `DirectDrawSurface` objects belonging to an application can have their corresponding surface memory unexpectedly freed. This can happen when another application performs a display mode change or acquires exclusive access to the display card and frees all currently allocated surface memory. When this happens, DirectDraw routines return a code `DDERR_SURFACELOST` to indicate that the surface no longer exists. This is why it's important for an application to check the function return codes for many operations. If surfaces are lost in this way, then the application can call the `Restore()` member function to recreate the lost surfaces and reattach them to the `DirectDrawSurface` objects.

As an example, and to give a flavour of how things work, here's a fragment of code showing how a blt operation might be performed:

```
ret = lpDDSPrimary->BltFast

          (x, y, lpDDSSrc, &rcRect,
           DDBLTFAST_NOCOLORKEY);
  if (ret == DDERR_SURFACELOST)
     restoreAll();
```

In this example, the `BltFast` routine is being used to blt an image onto the primary drawing surface corresponding to the `lpDDSPrimary` object. The first and second parameters specify the destination co-ordinates while the next parameter specifies the source drawing surface. `rcRect` gives the location of a rectangle on the source surface – this defines how much of the image gets bltted onto the destination. Finally, the last parameter determines the type of operation to perform. In this case, it's a normal blt. You can also perform transparent blts using the colour key of the source or destination. This can be used, for example, to prevent the background colour of an image from being copied to the destination.

If you get an error of `DDERR_SURFACELOST`, then a typical `restoreAll()` routine might look something like this:

```
HRESULT restoreAll (void)
{
   lpDDSPrimary->Restore();
   lpDDSOne->Restore();
   lpDDSTwo->Restore();
   DDReLoadBitmap(lpDDSOne, szBitmap);
}
```

DirectSound

The DirectSound routines are concerned with direct access to any available sound hardware in a fast but device-independent manner. Like DirectDraw, the DirectSound package is based around a COM interface with the sound card being represented by an `IDirectSound` object. You can also set up objects which correspond to primary and secondary sound buffers. These buffers exist, conceptually, even if they have no direct hardware implementation on a particular sound card. The primary buffer contains the 'mixed' sound which has been created from one or more secondary sound buffers.

Each secondary buffer represents a single sound source and can be switched on or off independently of the other buffers. You can create secondary buffers under program control and DirectSound will try to store those buffers in the memory of the sound card, if possible. A secondary buffer can contain the entire sound to be played (a static buffer) or it can be set up as a streaming buffer. In the latter case, it's the application's responsibility to keep writing data into the buffer as it's required. You do this by locking the buffer, performing a write operation and then unlocking it.

The DirectSound subsystem allows multiple applications to share sound hardware and will automatically keep track of which application has the input focus. As you switch from one program to another, sound from the active application will be made active while that from an inactive program will be muted.

DirectPlay

The DirectPlay system is used to enable one or more machines to communicate over a network or serial link. The basic idea is that the DirectPlay architecture shields the game writer from the complexities of whatever transport protocol is being used. DirectPlay is based around a simple client/server model. The game application itself interacts with DirectPlay which, in turn, binds dynamically to whatever DirectPlay service providers might be installed under Windows 95. These service providers are what form the link to the outside world. Two service providers (for serial comms and local networking) are provided as part of the Game SDK.

To determine what service providers are available, an application first calls `DirectPlayEnumerate()`, passing it a pointer to a callback function and an application-defined context which can be used by the callback function any way that the programmer wishes.

For example, you can allow the user to select a service provider by passing the callback function a pointer to a list box which it would then populate with a description of each service.

Once the wanted service provider is known, you call another routine, `Direct-`

`PlayCreate()`, passing it the driver identifier. This tells the DirectPlay DLL (DPLAY.DLL) to load the DLL containing the service provider code and initialise it. A new instance of a `DirectPlay` object is also created. You can then use this object to call the `EnumSessions()` routine which tells you what game sessions are currently under way. You can display these in a listbox (as for the service providers) and invite the user to join a particular session. Alternatively, a user can kick off a new session of his or her own.

There are other routines for enumerating other players that are available, discovering the capabilities of each player (in terms of communication parameters, not game playing ability!) and so forth. Each player has both a formal name and a 'friendly name'. You can send messages to a specific player or broadcast a message to all players in a particular session (by using an ID of zero). A message can be completely arbitrary and is implementation-specific – you merely supply a pointer to the message and specify the length of the message in bytes.

When receiving messages, the system maintains a message queue so that continuous polling is not required. An ID of zero is used to indicate a system message which has been sent by the name server, a special virtual player. Such system messages might be sent when a new player joins or leaves a game.

DirectInput

The DirectInput API is designed to cope with a wide variety of joysticks and other input devices including graphics tablets, light pens and touch screens. Both analogue and digital devices are catered for with up to six different axes and 32 buttons! Because of the burden placed on the system, DirectInput can simultaneously handle a maximum of four 2-axis sticks or two 4-axis sticks. However, with digital joysticks it's possible to have up to sixteen devices in operation at the same time – perfect for that big family gathering at Xmas time...

A number of different API calls are provided for querying and responding to input. Briefly:

- `joyGetNumDevs` returns the number of connected joystick devices.
- `joyGetDevCaps` returns information about a specific joystick device.
- `joyGetPosEx` queries a joystick for position and button status.
- `joyConfigChanged` tells the joystick driver that settings have changed.

The various DirectInput routines map onto the 32-bit WINMM.DLL which then thunks down into the 16-bit MMSYSTEM.DLL when necessary.

*Figure 5 – Have you heard the one about the man who worked in a doughnut factory? Probably just as well... This demo draws a rotating doughnut in a window. The rendering is **not** done with DirectDraw – it's just bltting sections of an existing bitmap.*

AutoPlay

As mentioned before, the AutoPlay facility is really part of the standard Win32 interface but Microsoft has included it in the Game SDK for the sake of completeness. If you distribute an application on CD-ROM, it *must* be AutoPlay-enabled if you want to qualify for Microsoft's infamous Windows 95 logo requirements.

Making use of AutoPlay is very easy. Basically, you just have to arrange for a file called AUTORUN.INF to be present in the root directory of your CD-ROM. Here's the AUTORUN.INI file from the MSDN CD.

```
[autorun]
open = autorun.exe msdncd13.mvb
icon = msdn.ico
```

In the above example, the name of a file to execute (with command line parameters) has been specified as well as which icon to use to represent the CD-ROM on the desktop.

Typically, many applications will kick off an installation routine via the AutoPlay facility but this isn't likely to be the best choice for an arcade-style game which requires a lot of large .WAV files, bitmaps and so forth. A non-technical consumer may well regard his or her PC as nothing more than an overgrown games console: just stick the CD-ROM in the drive and get cracking! I'd suggest that you add a registry item to indicate whether or not the program has been installed onto the hard disk. If so, you can just execute the installed version. If not, display a brief message asking if the user wants to copy everything to the hard disk. If not, you can just fire up the game directly from the CD-ROM.

Implementation notes

As it stands, the Game SDK is implemented through a number of small 32-bit C++ DLLs, DSOUND.DLL for DirectSound, DDRAW.DLL for DirectDraw and so on. The DirectDraw subsystem uses a 16-bit DLL called DDRAW16.DLL. This DLL, in turn, requires the presence of DIBENG.DLL, the Microsoft DIB engine. This demonstrates how the Game SDK grew out of the earlier WinG work which was also reliant upon the DIB engine.

Being, at heart, something of a propeller-head, I was interested to know how one might go about writing a service provider DLL for use with the DirectPlay subsystem. To my surprise, I couldn't unearth any information on this topic in the Game SDK. The version of the SDK I was using is the one that came as a Premium Release with the October MSDN Level 2 distribution. My impression is that it isn't quite complete. I imagine that the needed information will be provided in a subsequent release of the SDK or else will be merged into the Windows 95 DDK. For what it's worth, a little monkeying around revealed the fact that a service provider DLL only needs to export one routine: `CreateNewDirectPlay()`, which presumably initialises a new `DirectPlay` object for the transport protocol in question. If you're interested in following this up and can't wait for the official Microsoft information, you might like to take a peek at some of the supplied service providers. DPSERIAL.DLL, for example, implements a serial link using the TAPI DLL, which happens to be a 16-bit library. Hmmmm... I wonder if the Game SDK qualifies for the Microsoft Windows 95 logo? ■

When not posing as a propeller-head, Dave Jewell is writing a new book on using Delphi with the Windows API, to be published by Wrox Press later this year. You can reach Dave as djewell@cix.compulink.co.uk.

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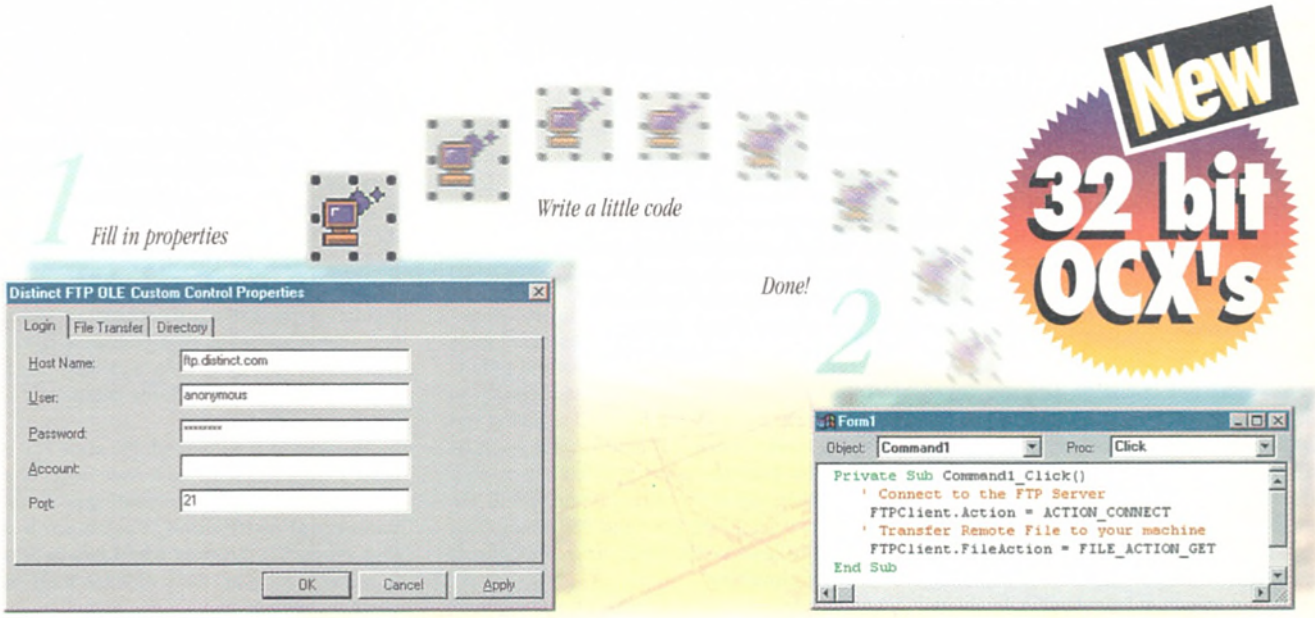

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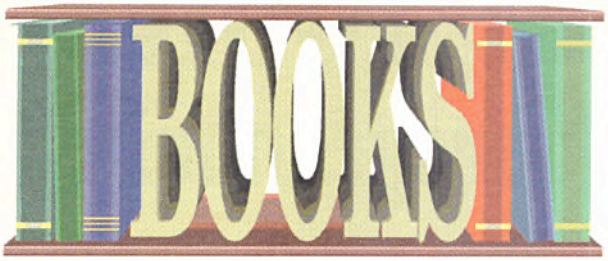

Pitfalls of Object-Oriented Development reviewed by **Philip Harris**

With *Pitfalls of Object-Oriented Development*, Bruce Webster has set out to warn people of the 'sinkholes, swamps and ravines' which await them in this field. Drawing on his six years' experience of object-oriented development he has put together a collection of pitfalls with the aim of helping developers, managers and executives avoid them, or extricate themselves from them if it's already too late.

The book starts with an overview of object-oriented development (including basic terminology) and of the widely-touted benefits of object-oriented design. This overview in itself is a brief but excellent introduction to object-oriented concepts and could be used as a primer for developers new to the field.

The core of the book contains 82 pitfalls divided into categories such as conceptual, political, management, implementation and coding. Each of the pitfalls is again divided into sections. Firstly a brief overview of the pitfall is given in about half a page; these descriptions could, in places, do with further elaboration. After the overview, the symptoms and consequences of the pitfall are briefly detailed, followed by methods for detecting and extracting yourself from the problem. Finally the author provides a guide to preventing yourself from falling into the pitfall being discussed.

Each pitfall takes up at most two pages. This is both an advantage and a disadvantage. The terseness prevents you from having to wade through acres of waffle before getting to the useful information but there are places where more detail would have been useful. Several pitfalls are general and do not apply specifically to object-oriented development, 'Targeting the wrong environment for commercial applications', for example, although they are no less useful than any of the others. Some pitfalls are very extreme, 'Using C++' and 'Not Using C++' being the most deliberately controversial and thought-provoking.

The last section provides a few general pointers on how to rescue a project which has fallen into the pitfalls described earlier in the book. Finally a bibliography, covering both object-oriented and general software engineering books, and a comprehensive index round the book off nicely.

Although you certainly won't agree with everything the author says and some of the pitfalls may seem blindingly obvious, this book is extremely useful. Stating what, in retrospect, seems obvious is one of the strengths of the book. By providing little nuggets of thought-provoking insight, the author helps you examine your own decisions, perhaps even resulting in a complete rethink of your entire development process (the very first pitfall is 'Going object-oriented for the wrong reasons'). This book will help to solve many of the problems it highlights, particularly conceptual problems. A manager reading the first section of the book should very rapidly be able to identify any fundamental problems with his company's attitudes and expectations.

Written in a light readable style the contents should be useful for a wide range of people, from developers implementing products for commercial distribution to consultants and even managing directors who'd like to be able to understand a bit more of what their managers are saying.

✓ **Verdict: Highly recommended**

Title:	*Pitfalls of Object Oriented Development*
Author:	*Bruce F Webster*
Publisher:	*M&T Books*
ISBN:	*1-55851-397-3*
Price:	*£22.99*
Pages:	*256*

Software Quality Management and ISO 9001 reviewed by **Rob Kings**

If you run a business supplying goods or services, and have not recently emerged from a stasis booth, then you will no doubt be familiar, at least in principle, with the quality standards of BS 5750 and the ISO 9000 series.

Now, if your business employs lots of people and looks like the sort of bottling factory they used to show through the round window on Play School then understanding ISO 9000 is not so difficult. If, however, like most people reading this, you work within a small organisation, designing and producing software products, then it is more complex.

The book sets out to explain, not only the standards themselves, but why you might want to bother and there are some good points made. Jenner is at pains to try to convince the reader that ISO accreditation is for the good of the company, and not just a requirement for tendering. All backed up with some rather dubious claims of improved performance – constantly delight your customers – well perhaps. In the not too distant future ISO 9000 conformance will be a requirement of many larger organisations (both governmental and non) so smaller companies may not so much choose to support it, but have it forced upon them.

There is no doubt that the author knows his subject well. He moves effortlessly from ISO 9000 to ISO 10013, via 9001, 9002, 9003, 9004.2, 9004.4 and 9126. Whether he takes the reader with him during these peregrinations remains to be seen. For my own part I was easily confused. However, as I stuck with the book, and moved away from the overview into the section-by-section description of the standards, I regained my grasp of the situation.

Part of the problem is that ISO 9001 is not particularly about software. The full title is 'ISO 9001 Quality Systems – Model for quality assurance in design, development, production, installation and servicing'. Despite its title and extensive software-related bibliography, neither is this book. I would rather have had a more technical discussion including possible software products (perhaps even as an appendix) which could help with ISO accreditation. Having said that, this book is well intentioned and I do not know of any other books that are more appropriate to the subject of software standards.

This is a difficult read; at times I really struggled. It also suffers from the bane of management books – poor graphics. Whilst labouring over this book I have read several others, any or all of which I would rather have been reviewing. A phrase that keeps cropping up is *management commitment* and in order to read, digest, and implement the contents of this book you are certainly going to need plenty of that.

✓ **Verdict: Hard going at times but ISO 9000 is coming, ready or not.**

Title:	*Software Quality Management and ISO 9001*
Author:	*Michael G Jenner*
Publisher:	*John Wiley & Sons*
ISBN:	*0-471-11888-5*
Price:	*£29.95*
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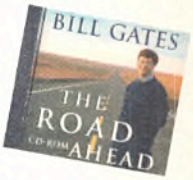

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London	Analyst Programmer	C and/or Dataflex - 2 yrs exp	to £19K	EX/9108
Middlesex	Software Engineer	C, Unix, Relational Database exp	to £23K	EX/9180
Gloucs	Analyst Programmer	C, OS2 - min 3 yrs exp	£25K+	EX/9338
Stockholm	Software Engineer	C, Unix, Informix or similar	to £23K	EX/9999
Devon	Analyst Programmer	RPG400, Unix/AIX, Oracle	to £18K	EX/8625
Berks	Software Engineer	C, Unix - min 2 yrs exp	to £20K	EX/8114
Jordan or Dublin	Software Engineers	C, Unix, Informix or similar	to £23K	EX/9995
West Sussex	Software Engineer	Robotics, 3D CAD, Realtime	£neg	EX/9045
London	Software Engineer	Oracle v7, SQL Forms	£neg	EX/9203
Kent	Software Engineer	Smalltalk	£neg	EX/9204
Surrey	Programmer	C++, Windows	to £22K	EX/8820
Herts	Programmer	C++, Unix	to £15K	EX/8616
W. Sussex	Software Developer	QNX, C, Realtime	£neg	EX/9994
W. Midlands	Software Developer	C/Windows moving to C++	to £35K + car	EX/9389
Hants	Software Engineer	R & D Group, C Realtime + Protocols	to £26K	EX/9375
Surrey	Product Developer	C, Unix, Graduate	to £18K	EX/9083

CONTRACT

London	Software Developer	C, Unix	3 months	EX/9271
W. Midlands	Programmer	Windows, C	3 months	EX/9387
Surrey	Programmer	C, C++ Windows NT	3 months	EX/9064
London	Analyst Programmer	C++, Motif	Indef	EX/9322

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PERMANENT OPPORTUNITIES

PC Developers

- C/C++/VISUAL C++
- MFC/ODBC/OLE
- WINDOWSNT
- VISUAL BASIC/ACCESS
- OOD/OOA
- MOTIF/GUI

The development of PC based applications has increased massively across all business sectors in recent years and this growth is set to continue given exciting developments such as Windows 95 and the continuing links between RDBMS and PC GUI applications.

The increased activity in this sector has resulted in progressive, dynamic organisations requiring staff with a variety of skills for a similarly varied range of roles/responsibilities. Ranging from pure Programmers up to Senior Project Managers (and beyond!) Elan can give suitably qualified professionals windows of opportunity which will provide a challenge and stimulus enabling you to reach your full potential.

Elan are currently recruiting urgently for Blue Chip companies in the following areas:

- *Banking*
- *Insurance*
- *Manufacturing*
- *Financial Services*
- *Publishing*
- *Retail*
- *Consultancy*
- *Transport*
- *Communications*

Positions vary widely both in terms of geographical location and the nature/level of technical and business knowledge required but, critically, we are looking for committed, ambitious developers in all areas which enables us to give you real choice and opportunity in your next career move.

If you are skilled in any of the areas outlined we can provide you with the option to capitalise on your present knowledge and further develop your technical and business skills.

To find out more about our urgent requirements in the PC Development arena, or other areas, call Colin Etheridge on 0171-830 1408, or mail or fax your CV quoting ref: EXE1.

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93 Newman Street, London W1P 4DS.
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Your next move is our priority

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VISUAL C++ AND MFC IN THE NORTH WEST

Linnhoff March

As a leading process design technology company, we require an experienced Windows programmer to assist with the development of our commercial software products.

Candidates should be self-motivated, with good attention to detail and concern for quality. The following characteristics are also essential:

- A good honours or post-graduate degree
- Minimum 2 years Visual C++ and MFC
- A thorough understanding of object orientated software engineering and design
- A flair for the design of user friendly interfaces
- A good understanding of commercial software issues

The successful candidate will have the opportunity to work in a challenging and rewarding environment covering all aspects of the software development life cycle. Salary will be according to age and experience. Write with full CV and current salary details to:

Dr. V. R. Dhole, Linnhoff March Ltd.,
Targeting House,
Gadbrook Park, Rudheath, Northwich,
Cheshire, CW9 7UZ

Software Technical Writer

POET Software, a leader in the field of Object-Orientated technology, is seeking the right individual to produce the user documentation for the latest generation of its Object-Orientated Database Management System.

The position will involve the development of user documentation in all of its aspects, from specification to delivery of the final manuals.

The right candidate must be able to write perfect English and have a strong background in computer software with a good understanding of Object- Orientated programming, especially C++. Experience with different hardware platforms and operating systems, especially MS-Windows, Windows-NT, OS/2 and UNIX (Sun, SGI, HP) is also desired.

The position will also involve close interaction with the development team and German as a second language is a plus.

POET is located in Hamburg, Germany and provides a challenging working software environment and a competitive compensation package in a world-class software development team.

Applicants should send their resume with a cover letter to:

Jörg Tewes
Manager, Software Development
Fobredder 12
22359 Hamburg
Germany

Telephone: 49(0)40 / 609900
Fax: 49 (0)40 / 6039851
E-mail: Joerg@poet.de

POET Software

Compuware is one of the world's top 10 largest independent software houses, driving phenomenal growth through a wide range of products that increase the productivity of IT departments within corporations world-wide.

No other company has such a diversity of tools supporting the complete application life-cycle including development, testing, deployment and systems management. And no other company offers their employees the opportunity to work with such a range of environments spanning the whole enterprise – from client/server to mainframe.

As an organisation, the company name is dwarfed by the names of our products – UNIFACE, EcoTOOLS, PLAYBACK, Abend-Aid, File-Aid, Xpeditor and DBA-XPERT. Because Compuware is equally strong in both client/server and mainframe technology, so can you be.

We now seek team-playing customer-focused professionals who like to operate at the sharp end of technology to join us, initially in the following areas:

Manager Client Programmes

Open Systems

Excellent package + quality car

Unlikely to be currently earning less than £40k you will project-manage the deployment of Compuware services, on a Europe-wide basis, for what is acknowledged as probably the most significant IT installation project in Europe in 1996. As this FTSE 100 multinational corporate re-engineers its business strategy, it is moving from a proprietary architecture to an Open Systems strategy in which Compuware's products are playing a key role.

You will be responsible for defining and delivering a project plan for implementing Compuware services, co-ordinating, allocating and managing both client and Compuware resources, and acting as the primary client interface for ensuring that services exceed client expectations at every stage of the operation.

You will require at least 12 years' working within the IT industry including a minimum of 5 years' project managing or technicial account managing significant projects within large corporations, plus three years' exposure to RDBMS/Open Systems in a commercial or marketing environment. This is a high level management position, requiring excellent planning and leadership skills, as well as the ability to communicate at every level.

Technical Consultants

Enterprise or Open Systems or 4GL Development Tool (UNIFACE)

Excellent packages + quality car

These roles offer considerable autonomy, working closely with clients to design, plan and implement systems based on Compuware's product range in one of the above areas. You will work on short, medium and long-term, time chargeable consultancy projects, predominantly at client sites, to produce deliverables that add value to the enterprise.

Communication and presentation skills and the ability to manage complex projects and complex clients is as important as technical knowledge. For each of these roles you should offer a minimum of five years' technical computing experience together with two years' consultancy to external businesses.

In addition, the **Enterprise** role requires a history as a DB2 expert; 3 years' experience in the IMS/DBDC environments and at least 1 year's CICS programming experience with COBOL or Assembler.

As a Technical Consultant, **Open Systems**, you will require 2 years' RDBMS experience; a knowledge of UNIX to kernel level; and experience of configuring and installing MS Windows and experience of C.

For the same role in supporting the **UNIFACE** product, you will also require MS Windows experience, plus one of OS/2, Macintosh or Windows NT; two years' experience in one or more of the GUI development tools; experience of 4GL application development tools; and two years' experience in UNIX, VMS or OS/2.

We are also seeking a **Junior Technical Consultant (UNIFACE)** with the same breadth of technical exposure, but probably only 6 - 12 months in external consultancy.

Pre-Sales Support Consultants

Enterprise or Open Systems or 4GL Development Tool (UNIFACE)

Excellent packages + quality car

These roles support sales activity on client accounts at every stage of the sales cycle from a technical and commercial viewpoint. You will make presentations, discuss and resolve customer issues, conduct and implement trials, deliver training and liaise with post-sales support to ensure that clients experience a seamless transition to Compuware products.

These roles require excellent customer support and communication skills, though we will also consider excellent technical candidates who have no pre-sales experience but who have the potential to learn pre-sales techniques.

Client/Server

For the Client/Server **(Testing)** role, you will require 1 - 2 years' client/server experience and 1 - 2 years' RDBMS experience.

The Client/Server **(Systems Management)** role requires 1 - 2 years' working in RDBMS, 1 - 2 years' UNIX experience on various platforms and 1 - 2 years' in a systems or network management role using UNIX.

The Client/Server **(UNIFACE)** position requires knowledge of MS Windows, plus one of OS/2, Macintosh, Motif or Windows NT; 1 - 2 years' using either UNIX, VMS or OS/2; and 1 - 2 years' knowledge of GUI development tools.

Enterprise

As a Pre-Sales Consultant working with the Compuware **File and Data Management** product line you require 2 years' exposure to MVS and 1 - 2 years' of database development or support experience in DB2.

As a Pre-Sales Consultant working with the Compuware **Automated Testing** product line you require 2 years' exposure to MVS, which will include 1 year's CICS programming experience with COBOL or Assembler.

Post-Sales Technical Support Specialists

Enterprise or Open Systems or 4GL Development Tool (UNIFACE)

Excellent packages + quality car

You will support client activities after-sales, through a mixture of Help Desk telephone support and implementation work at client sites. These are roles with considerable client impact, where job-holders not only provide often the first point of contact, but are considered the technical expert in their area. These positions are ideally suited to individuals seeking to build upon their technical experience in roles that will allow them significant room for growth.

The **Client/Server** role requires 1 - 2 years' technically detailed UNIX experience; 1 - 2 years' RDBMS and preferably programming skills in UNIX Shell or C.

Candidates for the **Enterprise** position, should offer a minimum of 1 - 2 years' technical exposure in MVS and TSO/ISPF; 1 - 2 years in IMS/DBDC and 1 - 2 years' CICS programming experience.

The **UNIFACE** role needs 1 - 2 years' in a minimum of one of the following environments: Oracle, Sybase, Informix, Ingres, Progress, ODBC, Rdb, RMS, C-ISAM together with 1 - 2 years' in UNIX, VMS or OS/2.

We offer excellent salary packages, including a range of corporate benefits, plus development opportunities which are only limited by ability and your determination to succeed.

If you want to get ahead with Compuware, please send a full CV including current salary details and clearly indicating which position(s) you are interested in, to our advising consultant Paul Connor, The Connor Consultancy, Cedar House, 6 Belmont Crescent, Maidenhead, Berkshire SL6 6LW. Alternatively telephone Paul for an informal discussion on 01628 76558.
Email:paul@pconnor.demon.co.uk
Fax: 01628 76558.

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email: kathrynt@dotexe.demon.co.uk

BROADCASTING SYSTEMS

Hampshire — **Up to £35,000 + Bens**

THE COMPANY: Large international broadcasting company involved in leading edge and next generation technology.
THE POSITION: Working with the latest development tools to research and produce broadcasting products. Working in small groups on team projects.
THE PERSON: You need to have a degree and any of the following:- 'C' / C++, Visual C++, Visual Basic, MSWindows GUI, MFC, Xwindows, Windows NT/95, Embedded Software and UNIX. Ref: AW/E201

C++ MFC SOFTWARE DEVELOPERS

Cambridge — **£20-£30,000**

THE COMPANY: Young, dynamic company that design and build digital recording and editing equipment.
THE POSITION: Developers need to work in small teams designing and developing digital recording products for the Audio Video and Film industries.
THE PERSON: You should be educated to degree level and have at least 18 months experience in 'C' / C++ and MFC. Any experience of real time systems would be an advantage. Ref: AW/E202

GUI DEVELOPMENT - WORKFLOW SYSTEMS
C/C++, OS/2

Surrey — **£25,000 - £35,000**

Major development work is currently underway with the development and implementation of workflow and process management systems. Skills required by this leading company include C/C++, OS/2, MSWindows, Object Orientated techniques and networking. There are exceptional opportunities for candidates who require a dedicated career path and travel within the UK and mainland Europe. Ref: PH/E201

DATABASE SQL SERVER/C++ SPECIALIST

Reading, Berks — **Negotiable c £30,000**

This highly specialised software company has an important and high profile role for a 'Database' specialist to work as part of a highly technical team. To fulfil this role you will be degree educated with skills in C++ and real database design and programming skills in static and dynamic SQL. You will have worked at the programming interface level, with excellent programming and design skills and a technical bias towards SQL Server or Oracle. Ref: PH/E202

MOVE INTO GIS DEVELOPMENT

Cambridge — **£20,000 - £30,000**

THE COMPANY: Major Software House specialising in software tools for large mission critical systems, in particular GIS.
THE POSITION: Incorporating the very latest technology to work on advanced GIS and GUI's Software Engineers looking to advance their career.
THE PERSON: The successful applicant will possess at least 18 months experience of 'C' / C++ UNIX and some knowledge or experience of Relational Databases. Ref: JJ/E201

HELP STOP COMPUTER INFECTION

Aylesbury — **c £17,000 - £24,000 + NT**

THE COMPANY: This is the chance to work for an International Software House, who is well recognised for their award winning products.
THE POSITION: Working in the Research & Development department you will be required to analyse, identify and work on new and existing computer viruses.
THE PERSON: You will be highly motivated and able to work alone and as part of a team with good general PC skills. You must possess at least 6 months experience of 'C' with some experience in the following; 80x86, Visual Basic, UNIX Ref: JJ/E202

VISUAL BASIC V3/V4 or ACCESS

City — **£18,000 to £25,000**

THE COMPANY: Large financial subsidiary of a major British Bank.
THE POSITION: Programmer to develop financial accounting, payroll and resourcing applications using Visual Basic and MS Access.
THE PERSON: You need a minimum of one years Visual Basic or Access experience, any knowledge of SQL or financial systems would be very advantageous. Ref: DL/E202

SYBASE DEVELOPMENT

North Kent & Surrey — **£25,000 to £45,000**

THE COMPANY: Ultra successful UK owned company developing its own range of financial management systems for the international market.
THE POSITION: Developing Sybase applications for use in all of their UK offices.
THE PERSON: Degree educated with at least one years solid Sybase experience, any experience of the Sybase Replication Server, Object Orientated Methods or Software development concepts. Ref: DL/E201

CONTRACTS

Visual Basic, Access/SQL Server	Analyst Programmer	Middlesex	6 months
Visual Basic, ODBC	Analyst Programmer	N.London	6 months
Visual C++ & MFC	Analyst Programmer	S.London	3 months +
Visual C++ & NT, DCE	Analyst Programmer	City	3 months +
'C', Sybase, UNIX	Analyst Programmer	City	6 months
Visual C++ & Bonds, UNIX or Windows useful		City	3 months +
'C'/C++ UNIX& Sybase (GUI)	Analyst Programmer	City	6 months +
Visual C++ & NT Senior A/P	Team Leader	City	6 months

VISION COMPUTER RECRUITMENT

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70A High Street, Stony Stratford,
Milton Keynes MK11 1AH
Telephone: 01908 260910
Fax: 01908 260098
Email: mail@visioncr.telme.com

the soft corporation

Specialists in Software Development Staff Recruitment

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

As the market for Object Oriented skills gathers pace we have a number of clients designing systems in diverse application areas including: **Multi-media, Virtual Reality, natural language, DTP, Telephony, LANs, Electronic publishing, On-line information Feeds, Finance and Banking** in both Windows and NT Server.
Position available vary from traditional Programmer/Software Engineer and Analyst/Programmers to Designer/Senior Software Engineers in the overall strategic direction for end-user organisations.
£17-£35K + benefits — **REF: SC/01/EXE**

WINDOWS OR X-WINDOWS/BANKING — ALL LEVELS

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

C AND C++ PROGRAMMERS — ANALYST PROGRAMMERS

Excellent opportunities exist for bright graduates with one year + experience. Personal background requires a solid understanding of the project life cycle and a commitment to high quality coding. You will be trained in all aspects of Investment Banking, relational databases, 4GLs and Object Orientated Design. A good opportunity for a second career move.
£17-£25K + Banking benefits — **REF: SC/03/EXE**

CAMBRIDGE - MANY, MANY EXCITING OPPORTUNITIES

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

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

Additional experience of: SQL, Forms, C and C++ required. We currently have client companies including Management Consultancies, Systems Houses, Systems Vendors, Bank and Finance clients looking for candidates with: Relational Database design, Database tuning, Systems Administration, DBAs, Pre/Post Sales and solid programming knowledge and expertise. Please call to discuss your particular requirements.
£18-£40K + benefits — **REF SC/05/EXE**

C/C++/VISUAL BASIC/UNIX/WINDOWS 95/NT SERVER — DEVELOPERS

Software House and End Users in Finance, Banking, Manufacturing, Commercial, Scientific and Government application environments require excellent C skills. Both Windows development skills W3.1 SDK, NT, X-Windows and Visual Basic or strong C, C++ solid operating systems and good application knowledge are again much in demand. Software development experience is the key, and being able to deliver high performance, high quality, well specified software in competitive time scales. Opportunities vary from small to large software companies involved in expert systems, GUIs, Image Processing, GIS, EIS, Communications, Networking and Object Orientated Databases. Graduates through to senior software engineers/team leaders are required. Please call to discuss.
£14-£35K + benefits — **REF: SC/06/EXE**

UNIX/VMS/WINDOWS 3.1/95/NT MFC/C/C++ — ALL LEVELS

A degree in computer of natural science, two years solid C/C++ programming experience and a sound understanding of UNIX, VMS or MS-DOS are required to work on large scale programs with user interaction. You will need an intelligent problem solving approach to work and be a quick learner to programmer software in an X-Windows, Windows SDK or NT environment, port software to different systems and liaise with customers to drive through product improvements. Excellent career opportunities for the right candidates.
£16-£28K — **REF: SC/07/EXE**

LONDON/HOME COUNTIES WINDOWS SDK/NT DEVELOPMENTS

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

Strong programming skills in C or C++ and Windows NT are pre-requisites for these positions. Experience in some of the following areas is also required: Windows 3.1/95, Windows NT, Windows SDK, MS C 7.0, MFC, Visual Basic, Visual C++ and Microsoft NT. Also desirable are Windows XVT libraries or networking skills. **REF: SC/08/EXE**

SOFTWARE ENGINEERS-SENIOR SOFTWARE ENGINEERS

Various Client/End Users, Software Vendors and Software Houses dedicated to strategic implementations of leading edge technology and integration of applications across different hardware and operating systems platforms require candidates to degree level with a scientific/technical development bias and 1-3 years experience. There are two main options
TECHNICAL DEVELOPMENT: Continued use of UNIX, VMS, MS-DOS, Windows NT (SDK, NT or X-Windows and Toolkits), Networking and Communications with companies offering technology based careers and management responsibility.
COMMERCIAL DEVELOPMENT: Using technical based skills already developed, but offering opportunities to apply analysis and design skills rather than remain 'a technical guru' in various environments including finance. Please call to discuss your particular career, growth and potential.
£12-£25K + benefits — **REF: SC/09/EXE**
VISUAL BASIC SKILLS MUCH IN DEMAND - PLEASE CALL TO DISCUSS — **REF: SC/10/EXE**
HANTS/LONDON - VIRTUAL REALITY DEVELOPERS - MFC, C++ - to £35K — **REF: SC/11/EXE**
LONDON COMMS SPEC X25, X400 £40-60k — **REF: SC/12/EXE**
C, C++/MFC - Countrywide — **REF: SC/13/EXE**

the soft corporation
Third Floor, 7-15 Roseberry Ave, London EC1R 4RP
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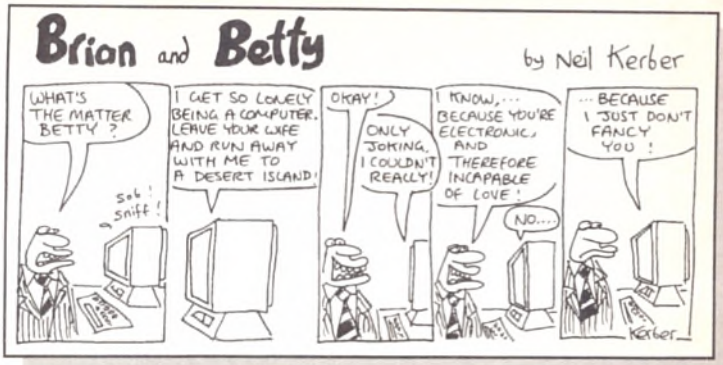


Cool

Remember the IBM ad with two nuns discussing the relative merits of OS2 Warp and *Wired*? Well Ctrl Break believes that they may have got the idea from the scribe monks of the Monastery of Christ in the Desert, Santa Fe National Forest. The monks have found a commercial application of their skills through the Internet.

Although the Monastery itself is beyond the reach of all but the most determined visitors, the monks have combined the use of cellular phones and solar-generated electricity to reach the world with their own Web site. They are now offering their services to design sites for others.

Previous clients include a travel reservations company, a Christian singer and Jungian conference in Switzerland.

The monks point out that they are simply continuing the tradition of work begun centuries ago by the scribes who created and copied scripts on clay tablets, then papyrus, parchment and eventually paper. 'After all', comments their home page, 'we've been making pages for 1,500 years'.

http://www.christdesert.org/pax.html

The Lawnmower Man Cometh

Neural Technologies Ltd (NTL) have won this year's DTI SMART award for innovation to develop a data visualisation tool combining Virtual Reality with Neural Networks. NTL aims to develop a virtual environment within which business data can be searched and manipulated. It could bring a whole new meaning to the office tales of love-trysts amongst the filing cabinets.

The Lawnmower Man Cometh #2

BT Director Patricia Vaz recently demonstrated a fully working prototype of BT's 'Office on the Arm'. The arm console includes a miniature colour screen and mouse pad, and the visor puts a large computer screen image for viewing private documents or intricate graphics in front of one eye. Voice recognition software avoids the need for typing and GSM mobile phone links enable direct links with the office and the Internet. Whilst the application of technology is impressive, Ctrl Brk is not looking forward to the day when work becomes an all-encompassing experience.

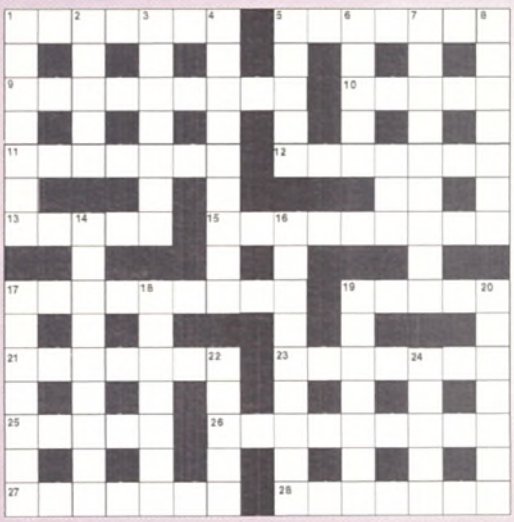
The kiss of death?

IBM has recently announced that four PC manufacturers in Russia and Poland have signed OS/2 Warp preload contracts. 'We are pleased with the overwhelming success of OS/2 Warp in Eastern Europe' comments Dan Lautenbach. Ctrl Brk, however, can still remember the popularity of Skoda jokes and fears the worst.

Enchantress of the data

The MOD has been working on the development of a design program, modestly entitled GODDESS, which visualises naval warships and submarines in 3D and predicts their future performance. Ctrl Brk can foresee several possible uses for this kind of assessment program within central government – and further afield. In the personnel sectors, for example, would-be employees could submit their CVs for prior inspection, enabling the spin-off program TRACEY to construct a 3D model outlining character strengths and weaknesses. Personnel staff could then weed out any undesirables by determining such factors as, say, who would be most likely to keep a sign on their desk with the motto 'You don't have to be mad to work here... but it helps'. This may have Big Brother connotations to some, but there are times when you have to be cruel to be kind.

PRIZE CROSSWORD



ACROSS

1. Unit of chemical array? (7)
5. Relation of George (7)
9. 0110 or thus (9)
10. Temporary permanent store in short (5)
11. Release the international flip-flop (7)
12. Reserved unit of program language (7)
13. Input data with a large key (5)
15. Midwifely ... (9)
17. ... team leader goes round the first but may go round too far (9)
19. Dirty base with the French coding art (5)
21. Way out value to put in the test list (7)
23. Hefty bit of housekeeping (7)
25. Highly competent in a small department (5)
26. Rich? Use it somehow for stepwise experience (9)
27. Morally right about being almost in 22 (7)
28. Fully takes over dismantled iron lungs (7)

DOWN

1. Carry out a file of this magazine? (7)
2. Beat the world with a spreadsheet (5)
3. One who makes values the same apparently round the middle? (7)
4. Eighth nob comes unstuck below the waist (9)
5. Rest the ultimate button (5)
6. Toy been able to make eight bits (3,4)
7. Go wrong every sixty minutes (3,5)
8. No unstable chip is wandering (7)
14. 5% of the century (9)
16. Methodical approach to a block of data (9)
17. Run a system in the theatre? (7)
18. Doubting Thomas (7)
19. Carrying out a search with a helicopter it seems (7)
20. What England does of all (7)
22. Such alcohol is liked by bar coders (5)
24. Restores the French brown by birth (5)

SOLUTION TO JANUARY'S CROSSWORD

ACROSS: **1.** OPERAND **5.** RECORDS **9.** FORTRAN **10.** TRAFFIC **11.** IDIOT **12.** MAP **13.** TURBO **14.** EUGENIC **16.** SADISTS **18.** PROGRAM **21.** OPTICAL **24.** OFFAS **26.** NOT **27.** DURUM **28.** EXECUTE **29.** MEANEST **30.** TAKINGS **31.** MONITOR

DOWN: **1.** OFFLINE **2.** EARNING **3.** AFRIT **4.** DYNAMIC **5.** RETYPES **6.** CHART **7.** REFORMS **8.** SECTORS **15.** NOR **17.** DOT **18.** PROTECT **19.** OFFPEAK **20.** MONKEYS **21.** OPTIMUM **22.** CURRENT **23.** LIMITER **25.** SPURN **27.** DRAIN

STOB

The All-New Adventures of Verity

Morse Code

'Help in collaring malicious programmers may be at hand from Ivan Krsul and Eugene Spafford at Purdue University, Indiana, who are developing "forensic" techniques for examining software and identifying its author'

– *New Scientist.*

The strains of *Eine Kleine Nachtmusik* (von Karajan, 1974 recording) were deafening even outside the door, so Lewis didn't bother knocking, and just walked straight in.

'Sir?'

Then louder:

'Sir?'

Morse looked up from the sheaf of printouts – the kind of printout on wide green-and-white paper that you only get from obsolete line printers, and indeed had to be printed off specially for the inspector – and switched off the CD player with a gesture of impatience.

'Well, Lewis?'

'I've got the listing of Deadly Brain Killer III, sir'.

Lewis placed a fresh sheaf of listings respectfully on the edge of the desk.

'Deadly Brain Killer III!' Morse snarled contemptuously. 'I wish these people would show a modicum of imagination.'

'It's not going so well then sir?'

Over the years, Lewis had become expert at interpreting his chief's moods.

'It looks like Traffdon's work, it smells like Traffdon's work, but there's something *wrong*, Lewis.'

He reached out a much-scribbled-on printout from the bottom of his pile.

'Take a look at this.'

'It looks like the load module, sir.'

'Yes, yes, Lewis, even I realised that. Tell me what you *see*.'

Lewis took a deep breath.

'Well, it's good quality K&R, old style function declarations, four character indent with lined-up curly brackets...'

'...*braces*, Lewis, you're not in Gosforth night

school now...'

'...lined-up braces, some attempt to use Hungarian variables but he got teed off and gave it up, a tendency to use do/while constructions, 80 character line wrap, minimal casting, poor C++ style commenting with spelling mistakes.'

'And your conclusion?'

'I'd say it's Traffdon's work. Unix programmer, only came to C++ and Windows quite late, doesn't use classes unless he has to, hates long variable names, just wants to get the job done.'

Morse put his head in his hands.

'But there is something not right, and I can't put my finger on it.'

Lewis shifted uncomfortably.

'I'm sure you'll work it out, sir. Err.. is it all right if I go home now? The wife's gone up to see her mother in the RVI, and I don't like leaving the baby-sitter.'

'Yes, yes, Lewis, you go home to your hearth and children.'

Lewis paused as he turned to go, and pointed.

'Oh look – he's got a nasty bug in his switch statement. Missed out a break.'

Morse followed the direction of Lewis's digit, then stood up in excitement.

'By God, Lewis, you've got it!'

'I have, sir?'

'No Unix C programmer would ever leave out a break, unless he meant to drop through deliberately. Now this man, Lewis, has forgotten that he needs a break at all, which tells us that he trained in a language which doesn't need them. A language which has a repeat/until construct, which he has to simulate with do/while. A language which...'

'Pascal!'

'Right. So the programmer must be...'

'...Simpkins in A-block! Of course. I'll get onto it in the morning.'

'Goodnight Lewis. And, thanks...'

As Lewis walked down the corridor, he thought he hadn't seen the Old Man so cheerful in months. Which was a good thing: after the years of success in Oxford, the dismissal for alcoholism and appointment as Code Quality Inspector at Barclloyds Bank had come as a bit of a blow... ■

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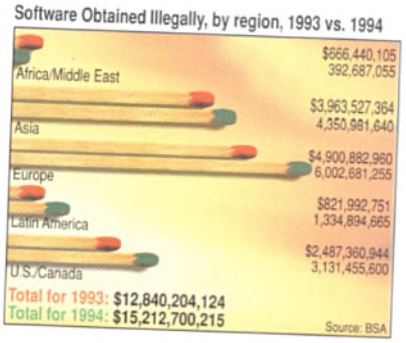

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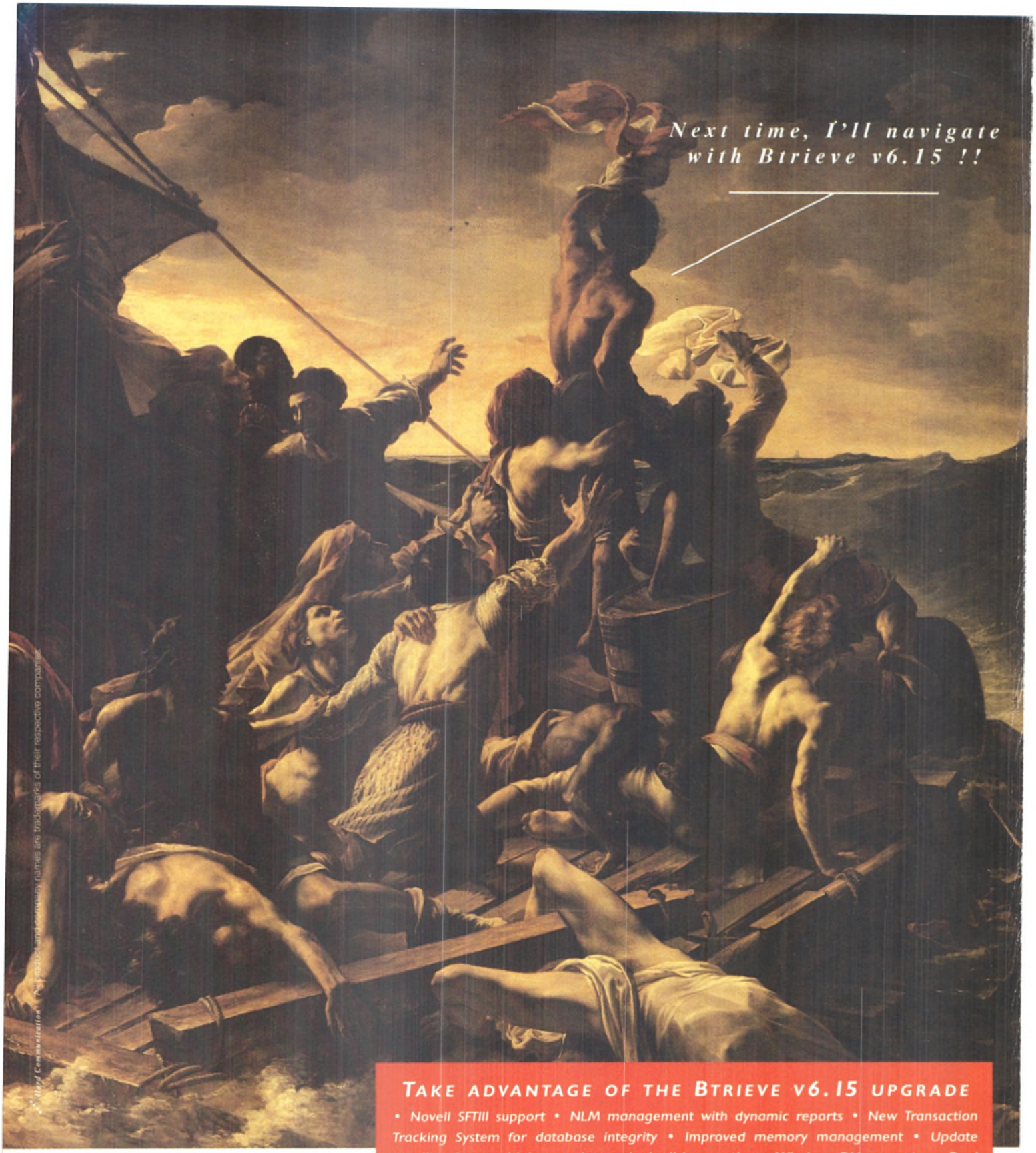

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