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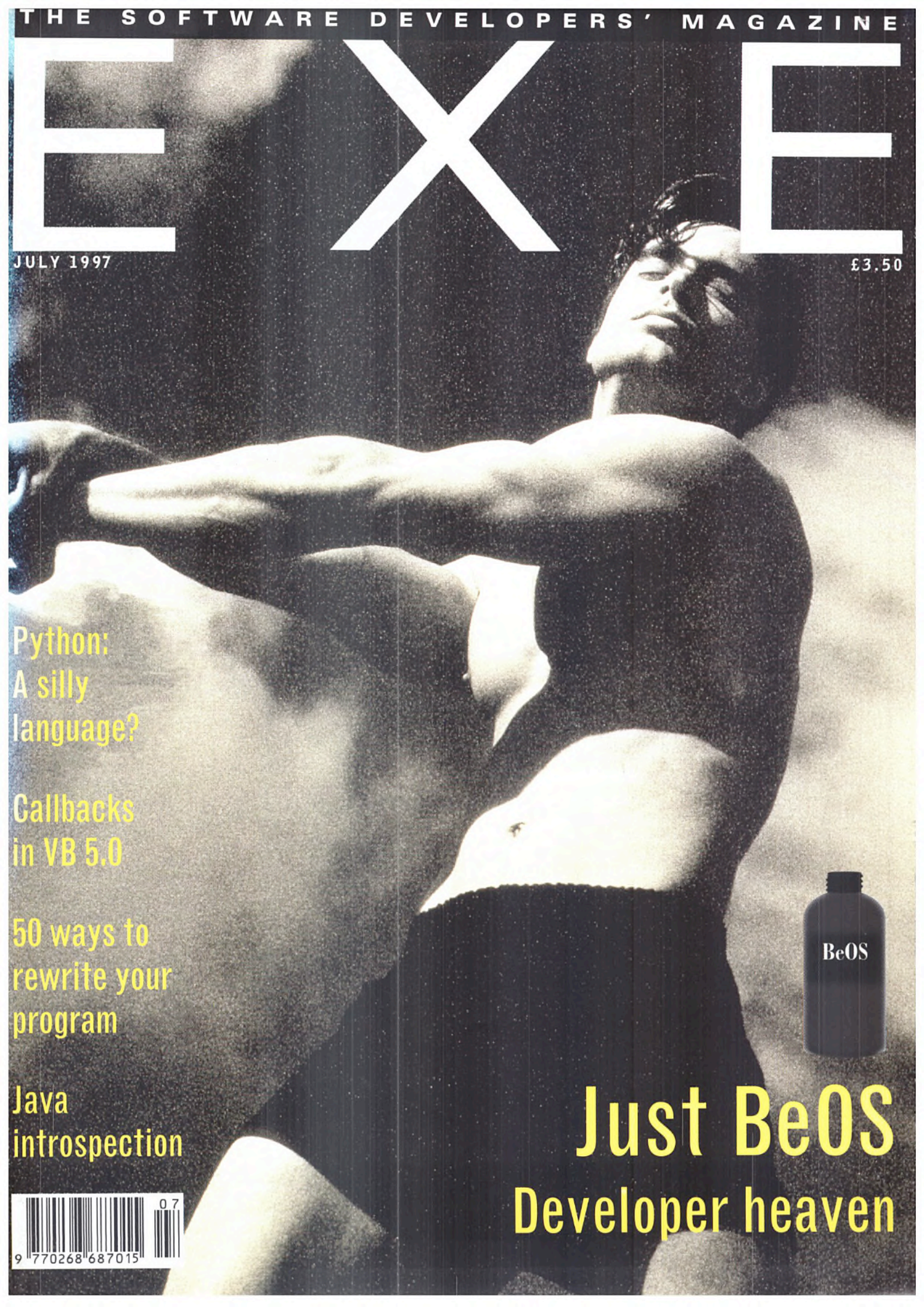
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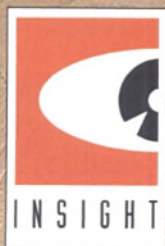
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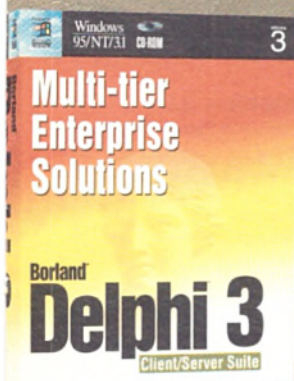
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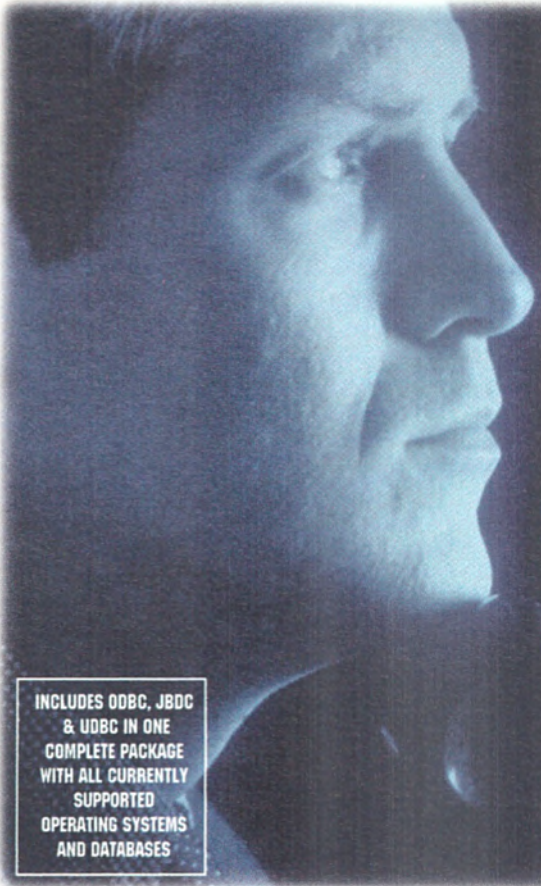
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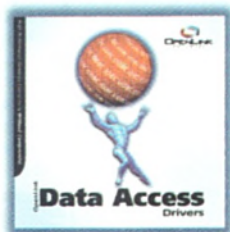
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Oh dear! Oh dear! I shall be too late!



'Well, I'd hardly finished the first verse', said the Hatter, 'when

the Queen bawled out "He's murdering the time! Off with his head!"' I won't be so bold as to suggest that all programmers should be beheaded (you wouldn't be able to read EXE) but many do murder time.

In the past month the news coverage of issues related to the coming millennium have flourished in all publications, on radio and television. Even in EXE, some issues have been mentioned: Peter Collinson looked at the problem in his May column, in this issue two letters focus on time-related problems and Mark Harman in his article on program transformation suggests a way to tackle the infamous Y2K bug. The letters hint at the fact that the software implementations of time might generate uncertainties not just on January 1st, 2000.

Programmers who used delta-time routine on VMS (originally limited to handle a 9999 days difference) had their software malfunction on May 19, 1997. As for Y2K, this limitation was well-known, it was documented by DEC. The funniest thing is that VMS' internal time representation will work until July 31, 31086.

Time obtained from the Global Positioning System (GPS) will overflow sometime around August 20, 1999. The date is stored in a 13-bit value. It is estimated that about 10^6 GPS receivers are in use today.

C's `time_t` (especially in Unix systems) will fail at 22:14:07

EST on Monday January 18, 2038 or later in January 2106 depending if you're using signed or unsigned integers.

More recent systems are still vulnerable to time problems. The HTTP cache scheme should fail in 9999 and James Gosling admitted that Java will 'run out of dates in the year 292271023'.

'If everybody minded their own business', the Duchess said, in a hoarse growl, 'the world would go round a deal faster

The 21st leap second happened on July 1st. Did you know that?

than it does.' 'Which would not be an advantage', said Alice, who felt very glad to get an opportunity of showing off a little of her knowledge. 'Just think what it would make with the day and night! You see the earth takes twenty-four hours to turn round on its axis.'

The issue is not limited to how well your particular system will handle time in the future, nor how well it can calculate the difference between two dates, one of which being in the future. It affects synchronisation between all devices (would you call an ATM 'hole-in-the-wall' a computer?) which communicate together.

When Lewis Carroll, wrote *Alice's Adventures in Wonderland* the time zones and the International Date Line had not been invented yet. GMT, the local time on the Greenwich meridian based on the position of a hypothetical mean sun, was only established in 1884. That's long before the invention of computers and of the transistor!

Same goes for the change in the definition of the GMT day: it was in 1925 that the day was to begin at midnight instead of noon. I won't even mention operating systems which believe that GMT is the same as British legal time and hence consider that GMT changes to BST in summer!

On the other hand, the computer age had already started in 1967 when the System International second was redefined as 'the duration of

first of this month. Did you know that? That means that UTC and UT are 31 seconds apart. That's not a typo – at the creation of UTC in 1972, TAI and UT were 10 seconds apart. GPS time has a constant 19 seconds offset from TAI, hence its difference with UTC is increasing with every leap second.

To deal correctly with time routines, you have to implement an accurate leap year algorithm, know which time definition you're dealing with and possibly implement provisions for leap seconds. How many programmers are even aware of all the issues related to time?

More importantly, do you document when delivering software what assumptions you have made on time issues? Has your program a contractual lifetime when you expect it to be dumped and replaced? Have you tested all your routines and all the libraries you're using to check that they implement time correctly for the expected life of your product? Y2K has generated a lot of attention and focus but it is just one consequence of possible time handling limitations and one which is not particularly difficult to take account of when compared to most others.

At least we are now reassured that even if all computers crash at the changeover between 1999 and 2000, it will very probably not happen at the exact same time. *David Mery*

(Thanks to Lewis Carroll who was concerned with where the day begins all his life, and to the RISKS mailing list, <http://catless.ncl.ac.uk/Risks>, full of fascinating information and very high signal-to-noise ratio.)

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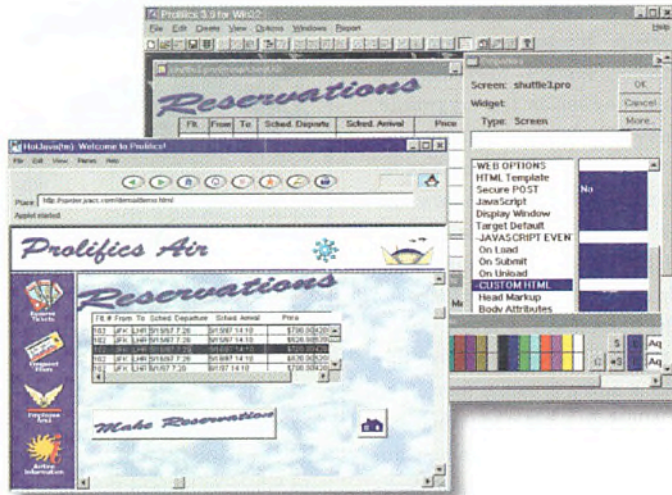
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Prolifics 3.0 from prolific Prolifics

Not content with being the only software company EXE knows of to have built a three-tier client/server application from scratch over lunch in a Soho restaurant, Prolifics is putting the finishing touches to version 3.0 of its eponymous client/server application development environment. This is the third version of Prolifics to be released in less than 12 months – version 2.0 was a service release only – and, claims the company, offers significant improvements over other similar Java solutions.

Java FailSafe is designed to deal with browsers which cannot support Java (or where the has turned Java support off). When the Prolifics application server detects that Java code will not run it automatically defaults to a pure HTML version of the application pages, carrying out all communication over HTTP. By contrast, when Java is available communication between client and application server is carried out using a binary protocol for speed.



Transactional Java is the name for a non-JDBC transaction model carried over this binary protocol. Because Transactional Java is an extension of the TP functions already present in Prolifics 1.0, there is no need for developers to use or know SQL.

Finally, Push Transactions is a system whereby trigger events – such as the receipt by the client of a change in value of a particular variable – can set off other transac-

tions. As an example, a Prolifics application could be built to keep track of stock availability and automatically place orders when stock became available.

Prolifics 3.0 should be available on Windows NT, Solaris and SunOS in September, with versions for other Unixes and MacOS available in October. Pricing starts at £35,000 for a five-user license.

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Visual Enabler

The latest tool from Softlab is a change management tool for Windows developers aimed at larger development teams. It is tightly integrated into the Visual Studio 97 environment and covers projects in VC++, VB, and VJ++.

Visual Enabler revolves around a repository which holds details of projects. A variety of team management and conflict resolution methods are supported by the package.

The program features what SoftLab calls 'automated build' – this is the ability to build multiple configurations of projects by rolling back to previous or other developers' versions of the source. Visual Enabler is available for Windows NT and Windows 95 clients with Visual Studio. Pricing starts at £1500 per seat.

w www.softlab.co.uk
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C++ forum gets it from the horse's mouth

In case you missed the reminders in Francis Glassborow's column in recent months, the Association of C and C++ Users (ACCU) is holding a European Developer's Conference for C++ developers later this month at the Town Hall in Oxford. The array of speakers for seminars and the conference sessions is impressive: heading up the list is Bjarne Stroustrup – who originally developed C++ from C – who will be giving a seminar as well as a conference session. Neil Martin and Tom Plum of Plum Hall will be speaking – Tom is an influential voice in the C++ standardisation effort.

Other speakers include Martin Houston, Antony Kesterton, P.J. Plauser – editor of the C/C++ Users Journal – and Dan Saks of Saks and Associates. Not to mention such EXE stalwarts as Mike Banahan (who long-time readers may recall used to write a regular column alongside Francis' some years ago), Kevlin Henney, and of course, Francis Glassborow himself who will be chairing the conference.

Conference places cost £69.95 per day (£49.95 for ACCU members). The organisers, Parkway Research, can arrange accommodation. For more information please call or see their Web site. ACCU memberships will also be available during the conference with the discount claimed later.

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Stingray Software has released Objective Diagram 1.0 to support Visual C++ 5.0. The new class library, with drag and drop graphical user interfaces allows developers to draw complex graphical objects without wasting time writing generic code. 0181 956 8000.
www.qbss.com

Component Source has delivered APEX True DBGrid Pro 5.0, data-aware ActiveX Grid Control for VB 4 and 5.0. New features include advanced Data Presentation and User Interface. £180; upgrades from £90. 0800 581111.
www.componentsource.com

Also from Component Source are controls that facilitate the use of Microsoft DirectX technology from within Visual Basic. Vsdirect operates at high speed, manipulating graphics and sound hardware directly from an easy to use interface. £120; upgrade £20. 0800 581111.
www.componentsource.com

Bring HTML power to WinHelp

Version 5.0 of **O2's object database** is in beta and planned for release in Q3 97. New features include database independence, adaptive locking, page server architecture with object level locking, call back locking and a decrease in **footprint** size. 01403 211020.
www.o2tech.co.uk

Great Lakes Business Solutions' Wise Installation System Enterprise Edition includes the current versions of **Wise 5.0**, **WebDeploy**, **SmartPatch** and **SetUpCapture** for application deployment. £340. 0800 581111.
www.componentsource.com

Aimtech has released a new version of **Jamba** (v2.0), the web authoring tool that uses a non-programming environment. Jamba allows web masters and graphic designers to take advantage of Java's ability to add **animation** and **interactive navigation** to static HTML pages. £199, upgrade £49. 0171 702 1575.
www.aimtech.com

Diab Data's latest C and C++ compiler, **DDI Power Compiling Solutions 4.0**, features increased execution speed, reduced code size requirements and simplifies migration from previous 8 and 16-bit designs. 01491 410700.
www.ddi.com

Verilog's ObjectGeode latest version (1.1) for Unix, provides support for the **Z105 ITU** recommendation and **SDL 96** constructs. ObjectGeode is hoping to capitalise on the interest in **UML** (Unified Modelling Language) for developing real-time applications. 01494 465907

That Microsoft is moving from WinHelp – the standard Windows 3.x/95 help system – to HTML Help is well known. In the meantime, however, help development specialist Blue Sky Software has released WinHelp 2000, a new version of its help authoring tool which extends the existing WinHelp engine to support HTML files in the normal help window.

Basically what Blue Sky has done is add a browser module to the WinHelp system together with the tools necessary in its help authoring environment to put Web-style hyperlinks into regular WinHelp documents.

Not only does this allow help authors to mix and match traditional WinHelp with HTML code, and to put all the usual HTML 3.2 elements including plugins, ActiveX controls, and Java applets, it

ObjectX helps developers stay in control

So-called componentware is a growing field these days with every man and his granny producing ActiveX controls or Delphi VCLs which can be used with everything from Visual Basic to Delphi and Visual C++. Wall Data has come up with its own library of such controls aimed at making it easy to build applications which interface with traditional mainframe and minicomputer data and functions.

The Rumba ObjectX kit is a development of the existing Rumba Office product, a set of controls for use with Microsoft Office applications. These controls are still shipped with the kit.

ObjectX can talk to IBM mainframes, AS/400, VAX, and Unix systems. Each control features user interface components and the kit comes with sample applications and full documentation.

Rumba ObjectX for Windows 95/NT is priced at £795 per seat.

0181 476 5000



also allows the help developer to put links to additional or updated help information into the code for retrieval across an Internet (or intranet) connection.

Since Microsoft's HTML help systems – already seen in the Visual Studio 97 development suite – provide all these features, it may be hard to see what advantages WinHelp 2000 might bring. How-

ever integrating HTML help into software requires the use of different Help APIs and therefore some rewriting of the software when, perhaps, updating the help file is all an author wishes to do. With WinHelp 2000, an author could simply add the HTML-enhanced help into the existing WinHelp file without any need to change a line of program code. And since WinHelp 2000 uses the Microsoft HTML help engine for rendering, it should be possible to reuse the resulting help files across both systems and support important 'legacy users'.

WinHelp 2000 costs \$129, with a \$30 discount for users of the company's RoboHelp or WinHelp Office products. The runtime components are royalty-free.

00 1 800 459 2356

www.blue-sky.com

Eiffel gets personal

For language lawyers and codesmiths who like to dabble in the uncharted waters of less well-known languages, an opportunity has come up to try out the Eiffel compiler from ISE at a low price. **Personal Eiffel** is a full implementation of version 4.1 of the compiler, with all the features of the full product included. The only restriction is that it cannot be used to develop commercial software.

Such 'learning' editions of tools are quite commonplace since the days of Turbo C and the cut-down versions of Visual C++. Most, however, are feature-impaired in comparison with their fully commercial cousins. ISE even gives purchasers a head start to the commercial edition by discounting the price by the amount of the **Personal** edition license, which weighs in at \$69.95 for the electronic version downloaded over the Web.

Features of the 4.1 edition include EiffelBench, the Eiffel IDE, EiffelBase libraries, Windows Eiffel Library (WEL) for Windows API access, and C/C++ interfaces.

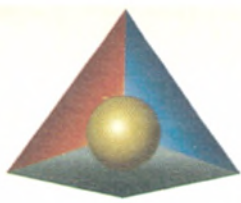
www.eiffel.com

JavaBeans go Corba

The work which began last March between IBM, Netscape, Oracle and Sun is starting to bear fruit. An agreement has been reached to bring Corba and JavaBeans closer. Corba will be enhanced to support other component models including JavaBeans.

The main goal of this collaborative work focuses on Corba/IIOP, Enterprise JavaBeans and, you guessed it, 'converging on vendor-neutral services and facilities'. A JavaBeans directory is to be created on the Netscape DevEdge Web site. Sixty-five companies have announced support for JavaBeans and 90 components are already being worked on.

www.omg.org developer.netscape.com



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OPENNT X11 SERVER				✓				
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Aware/VBX's list box/combo box control **List Pro 2.0** now contains a 32-bit ActiveX, 16 and 32-bit DLLs and a 16-bit VBX enabling developers to use List Pro with any **visual** language that fully supports such controls. £135. 01344 873434.

SELECT Enterprise for NatStar has been released by **Select Software Tools** and **Nat Systems** bringing together a component-based modeling toolset for building scaleable client/server applications with **NatStar**. 01242 229700. www.selectst.com

ARM (Advanced RISC Machines) has introduced a range of software technology to target a variety of **embedded** modem applications including PDAs, smart phones, set-top boxes, network computers, **screen telephones** and digital cameras. 01223 400423.

DataView 9.8 features **WebDataViews**, an add-on component which allows developers to animate and display **real-time graphical** applications using Netscape Navigator or Internet Explorer. Graphics can be inserted into **Visual Basic** or **Visual C++**. www.dvcorp.com

The latest incarnation of Vibe – the Java development product originally codenamed 'Eleven' – from Visix Software will appear in a number of versions. Each flavour of Vibe is aimed at a different type of development. Vibe DE, for example, is an entry-level product for basic applet and application development, while Vibe Enterprise incorporates database connectivity tools. Vibe Net is aimed at building distributed applications in Java over IIOP.

Visix is particularly proud of the GUI Java development environment which includes such notable features as 'spring-loaded' controls which resize and reposition themselves automatically across platforms, avoiding the need to use AWT's notoriously complicated gridbag layout.

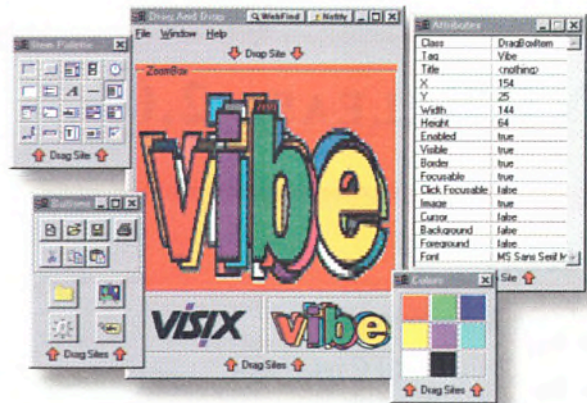
As before, Vibe has its own version of the Java Virtual Machine which incorporates a set of runtime classes derived from the company's Galaxy application frameworks. Like Microsoft's AFC

O'Reilly believes in Perl

Tim O'Reilly, of O'Reilly and Associates (ORA) fame, is enthusiastic about Perl. To paraphrase Larry Wall, Perl's creator, he considers Perl a perfect language for novice and expert alike: 'Easy things should be easy, hard things should be possible'. The learning curve for Java, however, just doesn't fit this maxim. 'Perl for dynamic Web site [development] gives a lower entry point than Java.'

ORA is so convinced about Perl that it is organising a conference on this subject in San Jose in October. According to ORA statistics, 30 to 40% of Perl book buyers are running it on Win32, and the publisher is currently finishing a Perl Resource Kit.

Furthering its reputation, ORA has been recently chosen by Be as the official publisher for series of BeOS books.



and JavaSoft's JFC, these classes give an extensive range of user-interface widgets across multiple platforms. Indeed Vibe's target platforms include many not normally supported by other vendors including MacOS and OS/2.

Although the company was the first to introduce a rich set of fully cross-platform widgets of the kind expected by end-users – such as spin boxes, tree controls and the like – it is by no means the last. But while Microsoft and Sun both claim that their foundation classes

will rule the Java waves, Visix is happy to admit that Vibe is heavily targeted at corporate developers building applications for intranets, where the necessity to have a different virtual machine from that supplied in the browser or operating system is not an issue.

All versions should be available by the time you read this, but at the time of writing no UK prices were available. The US edition of Vibe DE, however, retails at \$49.95 so expect a similarly low price here.

0717 872 5825 www.visix.com

Making progress with Websppeed 2.0

Progress Software thinks it is well placed to win the hearts and minds of Web developers with **WebSpeed 2.0**, a revised version of their client/server development environment for, as the company puts it, 'Internet, intranet and extranets'.

WebSpeed is made up of two parts: **WebSpeed Workshop** which is the actual development environment, and **WebSpeed Transaction Server**, the middleware. The company makes much of the scaleable nature of **WebSpeed**, as well as its compatibility with third party database servers, Web server, Internet firewalls and encryption systems. Supported data sources include Oracle, DB/2 and Progress, with ODBC access facilities as well.

WebSpeed 2.0 runs on NT, Solaris, AIX, and various other flavours of Unix. They should be available from July 15.

01256 208708 www.progress.com

Free ORDBMS

PostgreSQL, is a free client/server object relational database management system for Unix, has now reached version 6.1. It is not yet fully ANSI-compliant but it supports some features lacking in the ANSI standard such as inheritance. APIs exist for most languages: C/C++, Java, Perl, Python, SQL and Tcl.

PostgreSQL retains the rich data types and extensibility of Postgres and replaces the PostQuel query language with an extended subset of SQL.

www.postgresql.org

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Scalable SQL ver 4.0 from Pervasive Software (Formerly Btrieve)

New Scalable SQL ver. 4.0 has ANSI SQL support, a Visual Basic Scripting Interface, and tools for creating and executing stored procedures. Scalable SQL is based on the same MicroKernel Database engine as Btrieve, and can be used to provide high level SQL organisation to a Btrieve based application. Scalable SQL ver. 4.0 is now

available for Windows NT Server and Novell Netware. £call



CodeWright 5.0, the programmer's favourite editor, helps with tasks like;

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retained. Upgrades for Watcom 10.x user only £100.



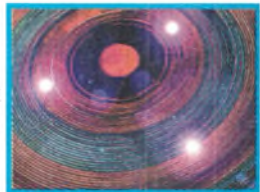
Driver::Works

Uncover the hidden world of NT Driver Development. Driver::Works includes a C++ library for NT Driver Development, extensive real-world sample drivers, comprehensive documentation and a powerful device driver code generator. Driver::Works is designed to get new developers up to speed quickly, while providing the depth needed for the most complex

driver projects. £595. Also Vtools:D device driver kit for Windows 95 - £375

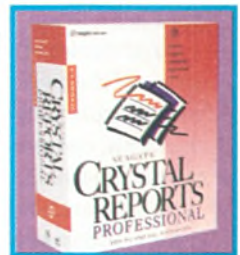
Data Junction Win 95/NT - £625

Data Junction excels at converting data from the widest range of data sources. Use Data Junction to convert from legacy COBOL systems, EBCDIC to ASCII, perform messy date conversions, work on packed data and populate SQL systems with data from diverse sources. Data Junctions point-and-click mapping of data source to data target saves 100's of hours of programming, and its extensive list of data transformations solves the toughest of data conversion problems. Data Junction Win 3.1 £189.



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A job for a nosy window cleaner

After a stressful experience, more stress. Jules is having a really bad week.

The trouble with working from home is that – you have to work at home. As the work expands, more and more of the ancestral pile is taken over, until there's nowhere left to live. Many's the time I've settled down to watch a video or an old edition of Star Trek, and the computer in the corner has interrupted, saying 'Here I am! What are you doing with that dumb, unresponsive screen in the corner, when you could be interacting productively with me? Earn a living, loser!'

After thirteen years, every corner of the house had been infested with computers, chemicals, electronics, bits of engines, and all the books and other accoutrements that any professional enterprise demands. There was no doubt about it, my gaff needed either a major reorganisation, or a replacement.

There are two things wrong with getting the builders in. Firstly, rooms have to be cleared, and accumulated clutter of archaeological proportions has to be either thrown away or packed into boxes, making the entire house dysfunctional. Secondly, the thing about builders is that they keep hitting things with hammers. At least I think they do; they may just have a tape recorder with the sounds of hammers on it, so they sound busy. Either way, building is almost as bad as moving.

Finally, the work got finished, and I got my new office. All I had to do was move in. I hung my monitors on the wall, connected up the power scrubbers, and powered up the computer. That's when it happened. The computer didn't boot. I wiggled its wires, I

thumped it persuasively, but no matter what I did, the hard disk controller crashed the post. I bought a new controller. It didn't help.

Now, I had better explain some background to you. Just like most programmers and designers, most of my estate is in intellectual property rather than physical things. Like most computer professionals, most of my intellectual property is inside my computer. I'm jealous about my data, and though I've had occasional trouble with disk drives, I have a comprehensive mirror backup system and I've never been in serious trouble before. Moving into my office, both sides of the mirror had failed, and I was looking at my entire life's work sitting in two completely slagged disk drives. Big trouble!

I can't begin to tell you how bad I felt. Over a couple of days the full, appalling, consequences of what had happened began to sink in. It was a couple of days after that before I could even begin to think about solving the problem. Thankfully, somebody gave me the phone number of Dr Solomon's disk recovery company, Authentec. I gave them a call. After four days of experts saying to me: 'People jump out of windows for less, you know' and 'Oh my God, that's baaad', it was a total boost when the receptionist answered the phone with a cheerful 'Good mmMORning'. The implication being that my problems, were now their problems, and they knew how to solve them.

'No fix, no fee' they promised, and a 20% discount if they didn't do it in 48 hours. 'All we need from you is a purchase order' she said. 'I can't give you a purchase order; everything is

on those disks'. 'No problem' she assured me. 'Can you remember how to use a pen? Handwrite a little note on some letterhead, and we'll sort out the formalities later'.

I still wasn't thinking too clearly, though my spirits were rising somewhat. I pulled the disks out of the tin and wrapped them in the first paint-encrusted sweatshirt which came to hand. I tore halfway across the country on my bike. Beside the door a sign said 'Please press'. Above it some wires hung out of the wall. I didn't press anything, instead I walked unannounced into an ample reception. Eventually someone saw me and went to find a receptionist.

The receptionist smiled sweetly, and made the same assurances that everything was under control. She did everything to put me at ease except give me a hot brandy and a foot massage. Her manner was more like that of a hospital receptionist than a computer firm. She asked for the ailing disks. She saw the sweatshirt, and after a not-quite suppressed giggle, picked up the phone and said 'I need two static bags in reception, stat'. After ten seconds, a man in a white coat ran into the reception, carefully placed the disks into the bag, and walked out again, carrying them as if they were explosive. 'I need your signature on this' she said, and handed me a form which pointed out that, if they couldn't get the data off the disks, they'd wreck them trying. (Thinks; crash teams with static bags, consent forms – this really is a hospital!)

It's surprising how long 48 hours is. The experts rallied in force to persuade me of the

futility of the recovery attempt. 'Wake up to reality, my friend; they can't mend that.' Another said simply, 'Oh shit'.

It was 47fi hours later that I got the call. A very apologetic technician told me 'I'm afraid we haven't been able to recover all your data. There are four system files which we can't get back – unless you want us to keep trying, that is'. Four files, four lousy system files! I was overjoyed. 'That's fine just how it is' I said. 'Send what you've got.' They did; to the wrong address, but that's a different story.

The experts swarmed, wanting to know how they'd done it. 'They're not telling you the truth' said one, 'they want you to think they're cleverer than they are. Look for some evidence that the case has been opened. If it has then they opened it after they'd recovered the data.' Said another: 'Bullshit'. The fact that these were the self-same people who had diagnosed my disks as terminal was, naturally, beside the point.

This whole exercise has cost me a packet, but it would have cost me everything I own if I'd listened to the experts. I hope they have the courage of their convictions when their own disks break. The technicians at Authentec obviously know their stuff, and they did it (and I, at least, don't disbelieve them). I can't thank them enough. Oh, and Laura, the receptionist, whatever they're paying you, it's not enough. ■

Jules is once again living in relative peace and harmony with his computer. Authentec is on 01869 355255. Take a tip, call them and ask for their brochure before you need it. Contact Jules on 01707 662698, or jules@cix.co.uk.



Delphi dementia

Dear Sir,

We hear rather a lot about Year 2000 problems but almost nothing about the difficulties caused by the Delphi approach to time and date storage. As a Pascal bore of many years standing, I would like to attempt to correct this.

Borland's Delphi uses a floating point number for its date/time storage, with 1.0 representing a whole day. Thus, calculating differences between times is very easy and intuitive. There are plenty of handy routines to convert to and from the format. However, the format must eventually suffer from a much more interesting and subtle mode of failure than these dullard systems which will collapse on 1/1/2000. As time moves on, the smallest increment of time being distinguished gets bigger and bigger. One could imagine a long-trusted, reliable program beginning to believe that distinct events occurred at the same time, slowly getting worse and worse. A nice case of software going rusty – or since each successive time period required to lose one bit of accuracy must always double – perhaps radioactive decay is a better analogy.

I believe that I should be given large amounts of DTI money to look into this problem as a matter of urgency, and I look forward to the support of yourselves and your readership in my application for a grant.

Will Watts
william@cix.co.uk

Pull the other one

Dear Sir,

I was interested to see your article on the Panda language (EXE, April 1997). However I must inform you that whoever submitted this piece was undoubtedly having you on. I have a great deal of experience



We welcome short letters on any subject 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

in both cryptography and steganography and I can assure you that the idea that any meaningful message could be concealed with program code, with its reliance on constantly repeated symbols and (usually) short word length, is absurd.

While images such as JPG files, which by the nature of the compression system used include a great deal of space which can be used without affecting the final appearance of the image, are ideal for steganographic applications, I find it unlikely in the extreme that any government agency would consider exposing sensitive information, no matter how well protected, across a public network. Existing diplomatic and covert channels of communication exist which could serve just as well.

As I also (unsurprisingly) speak Russian I was interested to see the 'excerpt' from Eta Vsyashutka's 'article' you printed: it appears to be made up of the first paragraphs of two different articles taken from EXE! The word 'Panda' has been inserted in places where it makes no sense whatsoever. Plus I ought to tell you that 'eta vsya shutka' means 'it's all a joke' in English.

Someone has been pulling your leg.
Prof Vyacheslav I. Malenkov
malenkov@jarre.demon.co.uk

Quake cracked

Dear Sir,

Quake has been hailed as the heroin of the Internet and I am glad to see that you haven't missed out on the addiction. Last month's article on Quake-C was an interesting departure for EXE – but congratulations on

your radical streak! Never mind the social and cultural phenomenon of Quake, from a developers' point of view I found it interesting that hackers were able to steal the Quake source code from *crack.com* last January (the company Dave Taylor started after he left ID, where he helped to programme Quake and Doom.)

The hack must have cost ID several hundred thousand dollars in lost potential code development buyers. ID of course denied any financial loss on the grounds that Quake's engine is too recognisable, making it impossible for anyone to use the code without their knowledge.

When I first heard about the stolen source I wondered where the code would turn up. There is at least one hacked version of Quake (for the Atari) already. I don't know how many developers out there have been going through the code (now practically public domain) line by line to see how they can improve their own stuff but I am sure there are more than a few.

The moral? If you're not into freeware, make sure you hire a good security person.
John Rackam

No time to relax

Dear Sir,

The year 2000 problem has had the interesting effect of focusing many parts of the industry – typically those not normally used to focusing – into a single cause. Although a significant problem, it is worth pointing out that the software development industry has been, is and probably will be, poor at handling any date/time issues. There are still a surprising

number of programmers who cannot correctly define the leap year algorithm.

The clock on systems (typically ALGOL 60 based) that has counted days since the beginning of the century as a signed 16-bit integer wrapped around a few years ago. Once the year 2000 problem is out of the way, we can look forward to the year 2038 problem when systems (most Unix and many other C based systems) that use a signed 32-bit integer (to hold seconds since 1st January 1970) wrap around.

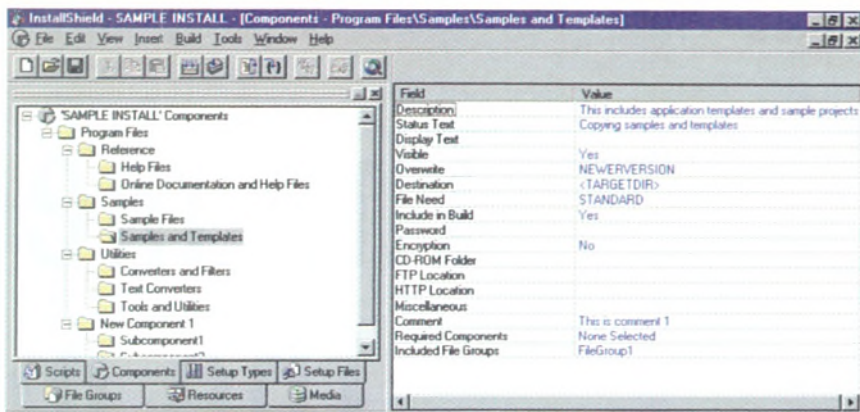
Interestingly, date handling (or mishandling) issues can be submitted as evidence in the ongoing debate as to whether or not software development is a numerate discipline. For those who believe that it is not, the facts unfortunately support this view and make a strong case that it ought to be.

It has been suggested that we should take this opportunity to look at date representation standards, such as ISO 8601. As for year 2038 we could all move up to 64-bit systems and recompile. Of course this assumes that people do not write code littered with machine dependent types. Perhaps for year 2038 the easiest approach (that would retain some binary compatibility) would be to use an unsigned 32-bit quantity, thus pushing the problem into the 22nd century.

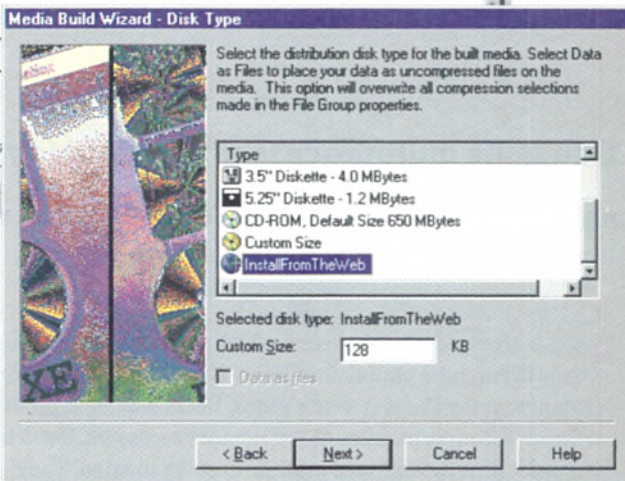
Possibly the most interesting proposal for the future is to deprive programmers of their computers: in such a state they would simply be unable to introduce such subtle bugs into software.

Kevin Henney
kevin@two-sdg.demon.co.uk

NEW PRO



Build started at March 6, 1997 10:58:06 AM.
 Calculating size of cabinet files...
 Copying InstallShield engine files to Disk 1...
 Building system cabinet file '_sys1.cab'...
 Copying uncompressed setup files to Disk 1...
 Building user cabinet file '_user1.cab'...
 Building cabinet file 'data1.cab'...
 Creating disk layout file 'layout.bin'...
 Media 'Test' created successfully.
 Build completed successfully at March 6, 1997



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CIRCLE NO. 336

The medium is the message

Due to its multiprocessor functionality, BeOS has been hailed as the OS for the media age but will it stand up to coding critics? Duncan Wilcox thinks BeOS is a developer's

BeOS is a new operating system which runs on PowerPC-based systems (though Be claims that BeOS is processor agnostic). Under development for the last seven years, BeOS was first produced for hardware based on parallel AT&T Hobbit processors. BeOS has been designed with efficiency and multiprocessing in mind. The BeOS kernel task scheduler is multithreaded, multitasking, and multiprocessor enabled. The memory manager provides protected and paged virtual memory. A 64-bit, journaled filesystem completes the core. Built over this are services including networking, graphics and audio. Finally, the kernel has C APIs, while application, user interface and other high-level services have C++ APIs.

BeOS features may fill your buzzword checklist, but for every aspect of the system Be seems to have taken a realistic, proven-technology approach. You'll find no object-oriented file system, no revolutionary GUI, no intelligent agents watching you, no push desktop, though you'll find a clean starting point for developing all of these and more.

Messaging

Developers may need to refresh their OS theory and get up to speed on threading, thread synchronisation and interprocess communica-

tion. The simplest BeOS applications start with two threads, not including their counterparts in the system servers! Contrast this with other operating systems where multithreading is available, though optional, and often not fully supported by development tools and application frameworks.

A few of BeOS' classes come a long way in simplifying multithreaded application development. The `BLooper` class encapsulates a message dispatching loop running in its own thread. Two of its subclasses are usually instantiated: `BApplication` and `BWindow`. This is how a basic application with one window starts with two threads. The `BMessage` class is the interthread and interprocess communication vehicle. These classes are the key to BeOS' application model simplicity.

A `BMessage` is a container for user data which can be added with an arbitrary name. The recipient will use the same name to find the data. Supported data types range from boolean and 64-bit integers to raw data blocks. Higher performance can be obtained through shared memory or kernel queues. The `BMessage` class is flexible, easy to use and (for supported types) typesafe. Adding a string to a message is as simple as:

```
message->AddString("parameter name", "value");
```

The simplest use of `BMessage` is user interface and system-level event handling. A button click or a menu item selection will send a `BMessage` to the application. The same happens for application activation and termination, screen configuration change, and so on. One interesting use in connection with the filesystem, is that applications can be notified through `BMessage` of changes to the filesystem, using a call such as:

```
watch_node(mydir, B_WATCH_DIRECTORY, mywindow);
```

This will let an application avoid burning CPU cycles to poll an interesting directory.

As for message content, one interesting aspect is that a similar container is used to hold totally unrelated data. The mouse click message contains values including time, position, modifier, button and click count. The key down message contains values including time, raw key code, modifier and character. Someday CPU temperature information may be added to messages. Applications would still be compatible, as they fetch the values they need by name.

`BMessage` is used for more than just messages: for clipboard data interchange and for drag and drop. Since it is only a matter of

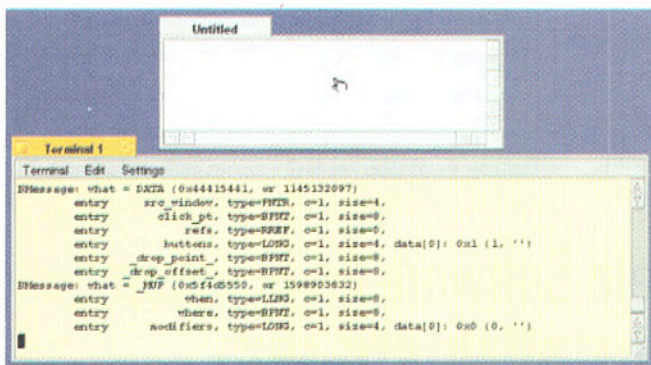


Figure 1 – The terminal window shows messages received by the document window. This is obtained through a message filter (attached to the document window) that prints messages as they are being dispatched.

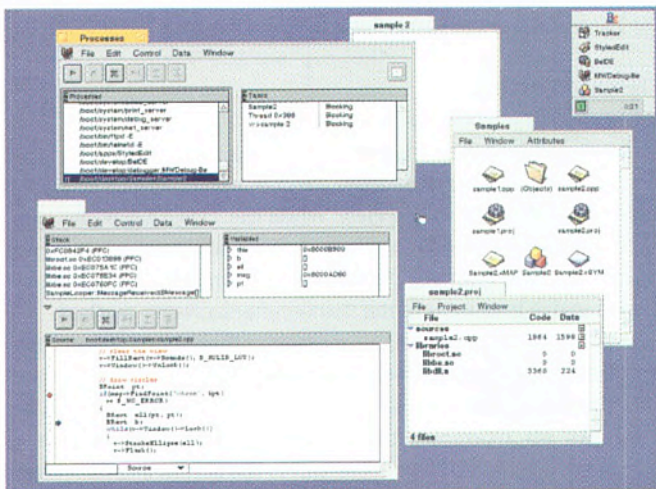
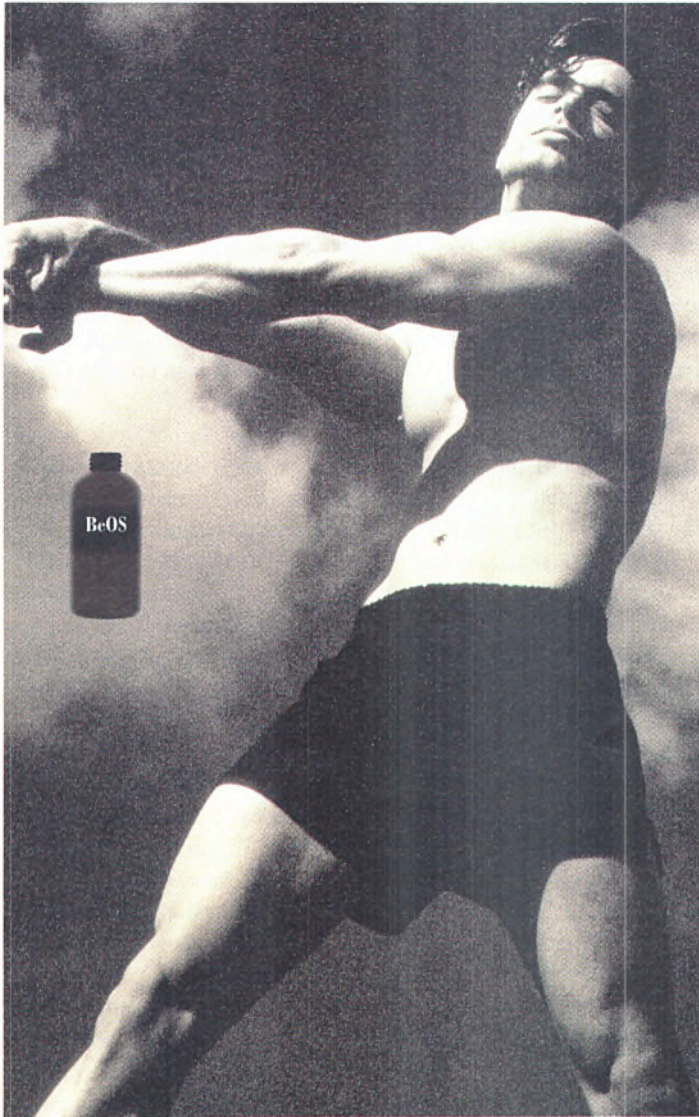


Figure 2 - The Metrowerks debugger window shows single stepping in one of the three threads of the sample application in Listing 2. On the right of the project window is the BeOS version of the Metrowerks multiplatform CodeWarrior IDE.

retrieving data from a `BMessage`, it is very simple, as Listing 1 shows. In addition the `BMessage` class has `Flatten()` and `Unflatten()` methods, to store messages in a stream (file, queue or other) and cross address space boundaries. Combined with the ability of all system classes to archive themselves by adding their core data to a `BMessage` (and de-archive by retrieving it) this gives persistence to the system classes.

Using object archiving, BeOS has implemented replicants: views which can be dragged from one running program to another; see Figure 3. Implementing replication for a custom class means implementing archiving (plus some housekeeping), which is simply a matter of deriving from `BArchivable` and adding some data to the supplied `BMessage` in the `Archive` member function:

```
long MyClass::Archive(BMessage *data, bool deep) const
{
    inherited::Archive(data, deep);
    data->AddString("add_on_signature",
                  app_signature);
    // add class data to the BMessage
    return 0;
}
```

and retrieving data from a `BMessage` in the class static `Instantiate()` member function:

```
MyClass *MyClass::Instantiate(BMessage *data)
{
    if(! validate_instantiation(data, "MyClass"))
        return NULL;
    // retrieve class data from the BMessage
    // for the constructor
    return new MyClass(/* data */);
}
```

Having done this, the custom class will be archivable. If it is a user interface view it will be draggable to other applications.

Adding a 'specifier' to a `BMessage`, turns it into a tool to script and control other applications. A specifier is the combination of a property and a route to get to the property. It directs the `BMessage` to its target within the controlled application. By targeting a specific `BLooper` (the application, a window or an application defined one), the specifier path can be shortened and single-scripting-queue bottlenecks avoided.

```
Adding a message filter like the following:
filter_result printfilter(BMessage *message,
                          BHandler **, BMessageFilter *)
{
    message->PrintToStream();
    return B_DISPATCH_MESSAGE;
}
```

to a `BWindow` through a call like:
`AddCommonFilter(new BMessageFilter`
`(B_ANY_DELIVERY, B_ANY_SOURCE, printfilter));`
 will help the curious by showing every message dispatched to the window as is shown in Figure 1.

Application structure

Listing 2 shows a minimal application which opens a window. If you look hard enough you'll notice that it has two threads. There are actually more threads in the system dedicated to the application. Specifically, every window and off-screen view has a corresponding thread in the `app_server`. The `app_server`, or Application Server, is the system server that renders drawing commands issued through `BView`

And there's more

This article focused on the foundation of BeOS APIs, but there is much more in BeOS: Unicode UTF-8 support (which is so important for non-English languages), a good TCP/IP stack, MIME type support throughout the system, a data format translation layer, a POSIX layer, a lightweight 3d kit that lets users interactively warp live video in real time, OpenGL...

More on BeOS can be found at <http://www.be.com> and <http://www.beeurope.com>.

```
...
case B_SIMPLE_DATA :
{
    entry_ref ref;
    BEntry entry;
    // find first filesystem reference,
    // open the entry and proceed if it's a file
    if(msg->FindRef("refs", &ref) == B_NO_ERROR &&
        entry.SetTo(&ref) == B_NO_ERROR &&
        entry.IsFile())
    {
        if(msg->WasDropped())
            DroppedRef(&entry, msg->DropPoint());
        else
            SentRef(&entry);
    }
}
break;
...
```

Listing 1 – Drag and drop.

```
class SampleWin : public BWindow
{
public:
    SampleWin(BRect frame, char *title)
        : BWindow(frame, title, B_TITLED_WINDOW, 0)
    {
        AddChild(new BStringView(Bounds(), "view",
            "Hello, World!"));
    }
    bool QuitRequested()
    {
        be_app->PostMessage(B_QUIT_REQUESTED);
        return true;
    }
};

class SampleApp : public BApplication
{
public:
    SampleApp()
        : BApplication("application/x-sample-app1")
    {
    }
    void ReadyToRun()
    {
        BRect r(100, 100, 250, 120);
        SampleWin *w = new SampleWin(r, "sample 1");
        w->Show();
    }
};

int main(int argc, char **argv)
{
    SampleApp *app;
    app = new SampleApp();
    app->Run();
    delete app;
    return 0;
}
```

Listing 2 – Minimal BeOS application.

instances (and their subclasses, such as the `BStringView` in the example).

Application life starts in `main()`, where the `BApplication` subclass is instantiated. Even though the `SampleApp` class does very little, it is indispensable because of its connection to the `app_server`, which is needed to put windows on screen. The `ReadyToRun()` method is called after the `BApplication` has completed initialisation. This usually includes processing of the program's arguments (icons used to launch the application or command line arguments). In this sample it is used to create a demo window, but in a more general case the window could have been created only if no argument was delivered on application startup.

The window constructor inserts a `BStringView` object in the window, that will display "Hello, World!". An important part of the window creation is the call to the window's `Show()` method (just after the instantiation) which implicitly starts the window's `BLooper` thread. The `QuitRequested()` method is a hook that will be called if the user clicks on the window's close box, or the application decides it is time to quit. In this sample it reposts the request to the application and allows the window's `BLooper` destruction. When the `BApplication`'s `BLooper` exits, execution flow returns to `main()`, where the `SampleApp` object is destroyed.

Any state variables that will be shared among threads have to be protected by a lock, of course. The APIs for locking include semaphores, atomic variables and a higher level `BLocker` object class. If what is being shared is an object, it will have to contain some locking mechanism: particularly if it is shared with the system or is under user control. The system or the user can, in fact, change the contents or worse, destroy the object, at any time. User interface elements contain some locking that must be used.

How can one add a background thread for some lengthy calculation? One solution is to call the kernel `spawn_thread()` function, but subclassing a `BLooper` adds a message loop which integrates better with the application and windows. A `BLooper` can safely communicate through `BMessage`.

Listing 3 shows a customised view that is updated from another thread. It also shows some locking logic. The code is an addition to listing 2, so the line that reads:

```
AddChild(new BStringView(Bounds(), "view",
    "Hello, World!"));
```

must be replaced with:

```
AddChild(new SampleView(Bounds()));
```

to use the customised view instead of the stock string view.

The `SampleView` is derived from a `BView` and creates a `BLooper` subclass that will work on the view. When the `SampleView` `MouseDown` hook is called, it sends an event message to the `SampleLooper` which can asynchronously perform some action. The `BLooper` processes receive messages in the `MessageReceived()` method.

If `SampleLooper` receives any message other than 'down', the default message processing method is called. This is very important and must never be left out, so that the default behaviour can be retained. As an example, the `SampleLooper` will receive a `B_QUIT_REQUESTED` at quit time. The call to the parent's `MessageReceived` method will take care of quitting.

When it receives a 'down' message, the `SampleLooper` tries to lock the window owning the view. Any operation which affects the window (including updating the contents) requires a lock, since the user might be touching it at the same time. The lock guarantees that locked data remains consistent and that pointers to objects in the





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```

class SampleLooper : public BLooper
{
    BView *v;
public:
    SampleLooper(BView *target) : v(target) { }
    void MessageReceived(BMessage *msg)
    {
        if(msg->what == 'down')
        {
            if(v->Window()->Lock())
            {
                // clear the view
                v->FillRect(v->Bounds(), B_SOLID_LOW);
                v->Window()->Unlock();
                // draw circles
                BPoint pt;
                if(msg->FindPoint("where", &pt)
                    == B_NO_ERROR)
                {
                    BRect ell(pt, pt);
                    BRect b;
                    while(v->Window()->Lock())
                    {
                        v->StrokeEllipse(ell);
                        v->Flush();
                        b = v->Bounds();
                        v->Window()->Unlock();
                        ell.InsetBy(-5, -5);
                        if(ell.Contains(b))
                            break;
                        snooze(200000); // sleep .2 seconds
                    }
                }
            }
        }
        else
            inherited::MessageReceived(msg);
    }
};

class SampleView : public BView
{
    SampleLooper *looper;
public:
    SampleView(BRect frame)
        : BView(frame, "sample", B_FOLLOW_ALL, 0)
    {
        looper = new SampleLooper(this);
        looper->Run();
    }
    ~SampleView()
    {
        looper->PostMessage(B_QUIT_REQUESTED);
    }
    void MouseDown(BPoint where)
    {
        BMessage msg('down');
        msg.AddPoint("where", where);
        looper->PostMessage(&msg);
    }
};

```

Listing 3 – Background thread.

window and to the window itself remain valid. The window should be unlocked as soon as possible, as during that time it won't respond to user and system interaction.

Through some undisclosed magic, Be's `BLooper::Lock` method will work and return false even when handed an invalid pointer, so the call is safe even if the view or the window no longer exist. If the call returns true – the view and the window are valid and locked, the view is cleared, the owning window unlocked and the game begins.

The following loop, entered after having successfully fetched relevant information from the message, will lock and unlock the window at every iteration, drawing larger circles as it goes on. The locking and unlocking at every loop allows the user to smoothly

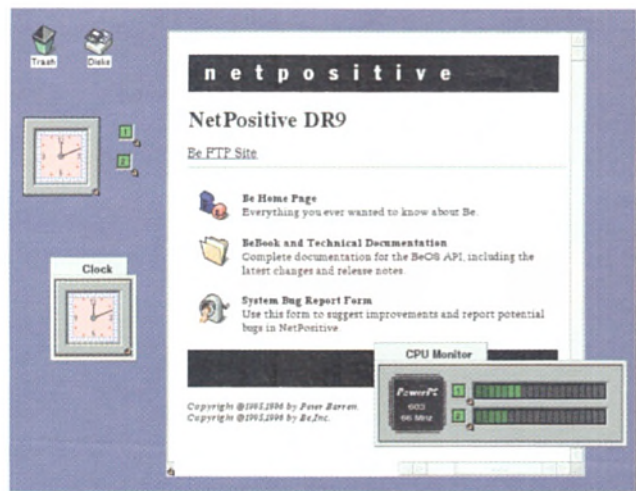


Figure 3 – The desktop is a replicant container, the little hands are 'dragers' that let users move the replicants from one application to another. Replicants shown are the 'Pulse' CPU buttons, the clock and BeOS' built-in web browser 'NetPositive'.

drag, resize and even close the window while the `SampleLooper` is drawing circles.

This sample application has three threads, plus a thread in the `app_server`. There is no explicit reference to threading or locking, except for the window locking calls. This is a real incentive to massively thread your software.

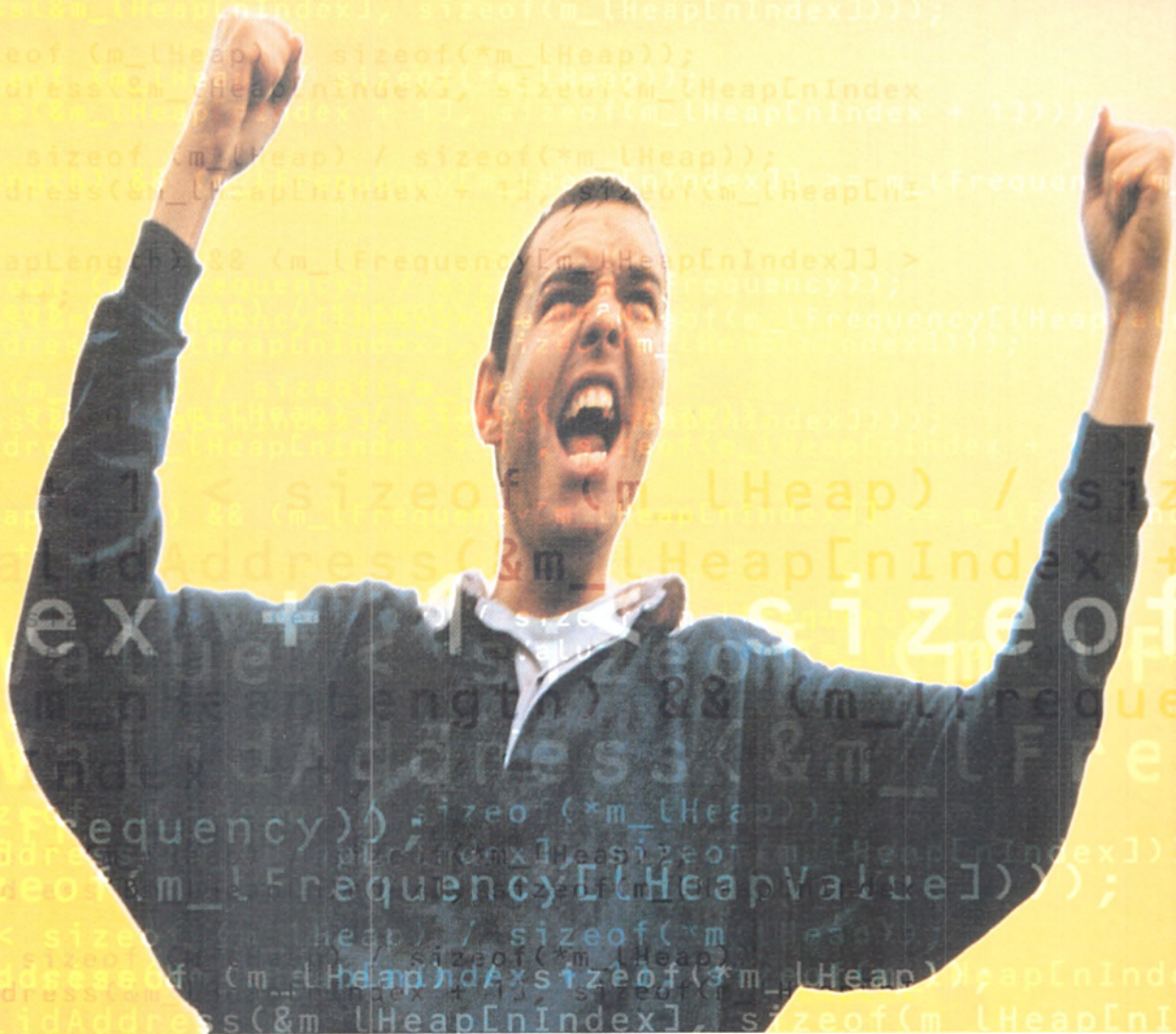
A developer's heaven

The `BMessage` flexibility and lightweight implementation let the developer code with high-level concepts while efficiently exploiting a multithreaded application design without too many debugging headaches. Replicant technology and scripting permit and encourage the development of software components that are extremely responsive and interactive due to extensive threading. BeOS word processing applications that provide text flowing around an embedded image while you drag it, spreadsheets that perform computations in multiple background threads and desktop video applications that show effects as they are applied, already exist and will soon be made available.

The BeOS application framework encourages developers to take advantage of its very efficient implementation and object-oriented APIs. BeOS was built with object-orientated APIs as a foundation, not an afterthought. Much like buggy code, bad user interface design, and applications installing themselves all over the system, slow and bloated software is going to be unacceptable to BeOS users. BeOS has made it possible, almost easy, to satisfy the requirements of the most demanding users: developers.

The BeOS is still being developed. In the current release most technologies seem to be in place. At the time of writing only the 'Advanced Access' version of the BeOS Preview Release was available. The Preview Release (code-named Developer Release 9, or DR9) should be available by the time this article is in print. The Advanced Access BeOS Preview Release is very stable; the Preview Release should improve on this even further. ■

Duncan Wilcox is a freelance consultant and programmer. You can contact him at duncan@mclink.it.



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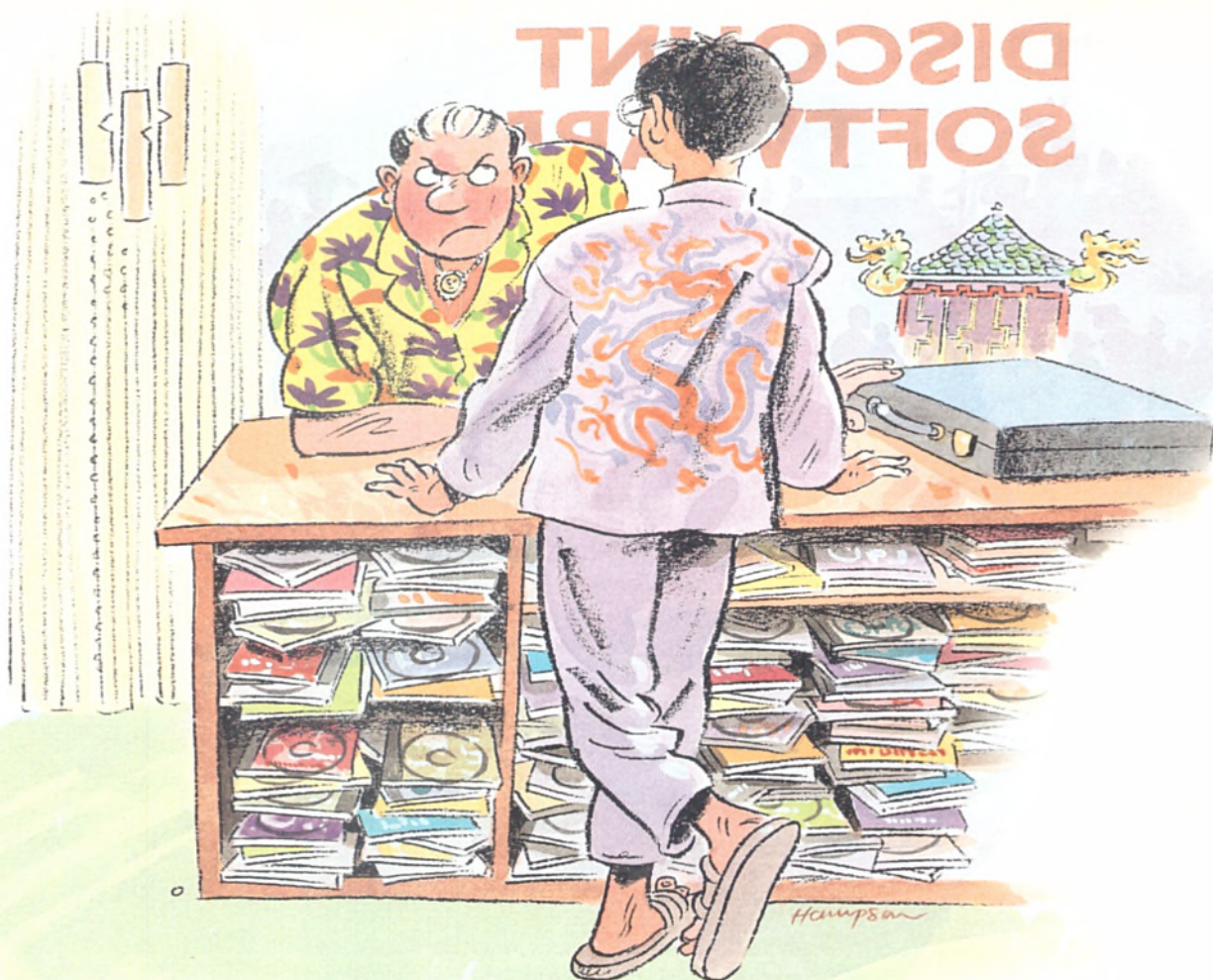
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Program transformation

New programs for old

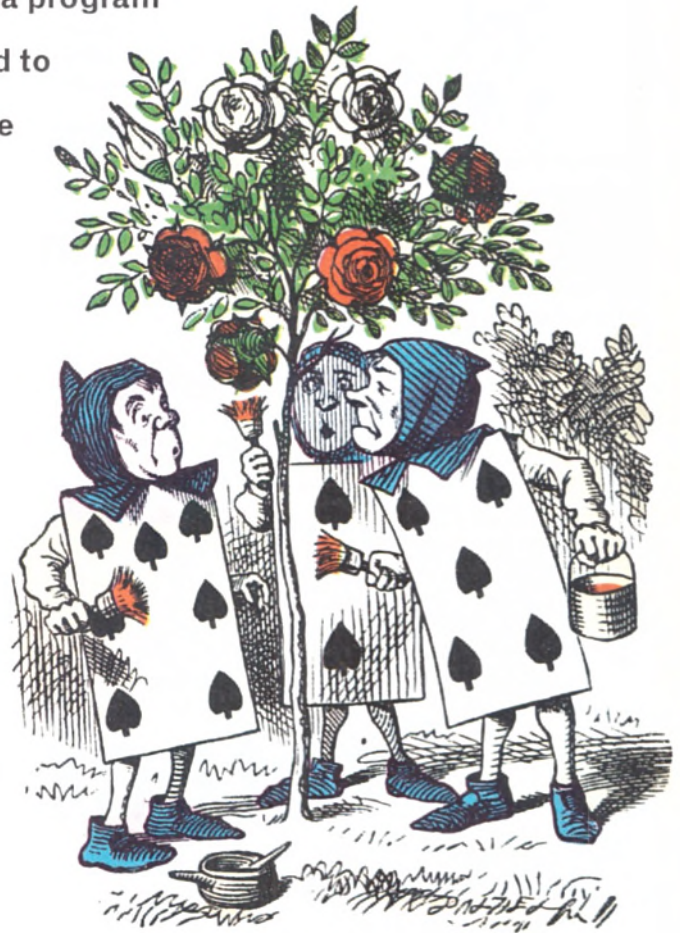
Program transformation alters the structure of a program without affecting its meaning. It can be applied to re-engineering, program understanding and the year 2000 problem. Mark Harman looks at the many ways of writing the same program.

There are many ways of writing the same program, some are easier to understand, while others are more efficient. Often there is a trade off between understandability and efficiency. We can either make the program faster, but harder to understand or expand the code in a way that makes it easier to understand at the expense of making it slower. Transformation allows us to have the best of both worlds by modifying the syntactic structure of the program to suit our taste. Because the transformation process guarantees that the original and transformed versions have the same effect, the programmer can read whichever version is easiest to understand and execute whichever is fastest.

The idea of program transformation has been around for some time, an early example is the pretty printer. A pretty printer lays out a program according to a set of predefined style rules. These rules tell it by how much to indent nested structures, how much white space to insert between syntactic components, how to handle line wrap around, and so on. A pretty printer deals with the lexical structure of the program (the very lowest syntactic level), by simply rearranging the existing text to make it more attractive on the page. An important property of a pretty printer is that it only removes and inserts white space and therefore *cannot* have any effect upon the behaviour of the program. This idea is central to all forms of transformation. Transformation changes the *syntax* of a program without changing its *semantics*.

Another example of program transformation happens inside the compiler when it *walks over* the object code that it has produced to tighten up on certain common constructions making the whole program faster. These optimisations are often called *peep-hole* transformations, because they operate on small sections of object code at any given time (that is, they operate on the program via a peep-hole, through which only these small sections of code are visible).

Source level transformations, like the pretty printer, are used to make programs easier for humans to understand and manipulate, whereas object-level transformations, like peep-hole optimisation, are performed on object code in order to make it more suitable for the machine.



A simple example of transformation

A `for` loop can be rewritten as a `while` loop. That is, given a `for` loop of the general form `for (e1, e2, e3) s`, where `e1`, `e2` and `e3` are arbitrary expressions and where `s` is some arbitrary statement, we could rewrite the loop as `e1; while (e2) { s; e3; }` without affecting the meaning of the loop. If we applied this transformation rule throughout the program, we would replace all `for` loops with equivalent `while` loops. In this way, we can use source level transformation to restructure a program, or to rewrite the program in a form that a particular programmer finds easier to read. All that we are doing, is taking the pretty printing idea a stage further. We do more than simply fiddle with the white space around the program: crucially, we retain the guarantee that the original and the transformed program have the same effect. Replacing `for` loops with `while` loops is not a

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particularly exciting transformation. However, the idea of program transformation can be applied to a surprisingly wide variety of programming problems.

Side effects can be painful

A side effect is an assignment to a variable that occurs when an expression is evaluated. For example, the expression `++i` in C has the value `i+1`, but when it is evaluated, it also has the side effect of assigning `i+1` to `i`. As all programmers know, using side effects can lead to programs which are compact and efficient though often hard to understand.

Consider, for example, the C fragment in Figure 1. Although this is a very small fragment of code, its effect on the variables `i` and `x` is not immediately clear. A more understandable version of the fragment is given in Figure 12. The code in Figure 1 is hard to understand because it combines side effects, short-circuit boolean evaluation and the representation of booleans by integers in a single compact fragment.

Figure 2 contains a rule for converting statements into a side effect free form. The rule is written as a function, `sefree`, which takes an expression and returns a side effect free version of it (an expression which has the same value, but which does not cause a side effect). Of course the side effect must still happen when we execute the transformed version of the program, so we have a second function, `side_effects`, which takes an expression and yields a sequence of assignment statements that replicate the side effects of the original. For example, `++i`, is transformed into a statement `i=i+1`; by `side_effects` and into a side effect free expression, `i+1`, by `sefree`.

Strictly speaking, since assignment is an *expression* statement in C, the transformation does not completely remove side effects. Instead, it ensures that all side effects occur only in assignment statements. This is natural, as the assignment expression statement is the archetypal side effect statement.

In order to deal with the effect of short circuit evaluation of the `&&` operator we can use the transformation `short_circuit` in Figure 3, which transforms logical operators into equivalent conditional expressions. In this transformation, and those which follow, `e1` and `e2` stand for some arbitrary expression and `s` stands for some arbitrary statement. For the expression `++i && i--`, the transformation `short_circuit` gives us the equivalent expression `++i?i--:0`. This is a correct transformation, because the conditional expression `++i && i--` means 'First, evaluate `++i`. If the result is false, then return false. Otherwise return the result of evaluating `i--`'. Using `short_circuit`, the program fragment in Figure 1 can be transformed into the fragment in Figure 4. This new version still contains all the original's side effect, but these will be removed by applying further transformations.

In order to transform the fragment in Figure 4 into a side effect free form, we shall need to extend the functions `sefree` and `side_effects` from Figure 2 to handle conditional expressions. The rules which do this are given in Figure 5. Here, we need an update function to take account of the side effects which occur when the predicate part of the conditional expression is evaluated. These side effects change the values of expression in the following *then* and *else* part of the conditional expression. For example `update(i--, ++i)` produces `i+1`, the meaning of the expression `i--` when the side effect `++i` is taken into account. Applying the function `sefree` to the conditional expression `++i?i--:0` gives us the expression `(i+1)?(i+1):0`.

Applications

The 'Year 2000' problem

Transformation can be used to isolate and re-engineer system components which are affected by, among other things, the use of two digit date fields. So the technology has a role to play in mitigating software crises which may arise from ramifications of the 'Year 2000' problem. The Centre for Software Maintenance at Durham University has set up a 'Year 2000' strategy group (<http://www.dur.ac.uk/CSM/themes/year2000/>) to provide a research-based consultancy service concerning the 'Year 2000' problem. Much of the work of the Durham group is based on transformation using the Maintainers' Assistant and its big brother, FermaT.

Bug detection

Because transformation can be used to rewrite a program, and can simplify fragments of code, it is often helpful in detecting errors. It can be particularly effective when combined with *program slicing*. Slicing is a technique for removing statements from a program which have no effect upon some chosen variable at some point within the program. Thus, slicing is really just another form of program transformation (See EXE, October 1996).

Consider, for example, the following fragment of code:

```
for(i=0, sum=a[0], biggest=sum; i<20; sum=a[++i])
  if (a[i] > biggest) biggest = a[i];
```

The variable `sum` is supposed to contain the sum of the first 20 elements of the array `a`. By focusing on the value of `sum` and applying transformation and slicing, we can produce a simplified version of the program concerned only with the variable `sum`. This will require more transformation rules than can be reasonably listed in this article, but each transformation will be defined in a similar way to the ones which we have already met. If we apply transformation to the fragment above, we could produce the simplified fragment `sum = a[20]`; which has the same effect on `sum` as the original. We can see clearly that something is not right with the value of `sum`. We would at least have expected it to be contained within some form of loop. (The error is that the original assignment expression `sum=a[++i]` should have been written `sum=sum+a[i++]`.)

The statement in Figure 1 is an *if* statement, so we need a rule for `sefree` and `side_effects` which can be applied to *if* statements. This rule is given in Figure 6. To make things simpler, I have assumed that the statements in the *then* part of the *if* statement do not affect any of the other variables in the predicate of the *if* statement. Without this assumption, the transformation would be more complicated, but still possible. Using the rule `sefree` on the program fragment in Figure 4, we obtain the equivalent fragment in Figure 7. Namely, a side effect free version of the fragment we started off with in Figure 1.

Using transformation to simplify a program

Although the fragment in Figure 7 contains no side effects, it is still hard to understand its effect, as removing side effects has made it far longer. Fortunately, transformation can help us here too. Often transformation is used as a tool for program simplification, effectively massaging the program into a simpler, but equivalent form. These transformations are easier to apply to side effect free programs than to those which contain side effects, so side effect removal is a natural first step. Having done this we can apply more general transforma-

```
if(++i && i--) x=1 ;
```

Figure 1 – A fragment with side effects.

```
sefree(i--) = i
sefree(--i) = i-1
sefree(i++) = i
sefree(++i) = i+1
side_effects(i--) = i=i-1;
side_effects(--i) = i=i-1;
side_effects(++i) = i=i+1;
side_effects(i++) = i=i+1;
```

Figure 2 – Simple side effect removal by cases.

```
short_circuit(e1&&e2) = e1?e2:0
short_circuit(e1||e2) = e1?1:e2
```

Figure 3 – Making short circuit evaluation explicit.

```
if(++i?i--:0) x=1 ;
```

Figure 4 – A version of Figure 1 with explicit short circuit evaluation.

```
side_effects(e1?e2:e3) =
  if (sefree(e1))
    {side_effects(e1); side_effects(e2); }
  else
    { side_effects(e1); side_effects(e3); }
sefree(e1?e2:e3) = sefree(e1)?
  sefree(update(e2,e1)) : sefree(update(e3,e1))
```

Figure 5 – Side effect removal for conditional expressions.

```
sefree(if (e) s) = if (sefree(e) s;
side_effects(e);
```

Figure 6 – Transforming if statements into a side effect free form.

```
if ((i+1)?(i+1):0) x=1;
if (i+1) {i=i+1; i=i-1;}
else i=i+1;
```

Figure 7 – Side effect free version of the fragment in Figure 1.

```
axiom1(e?e:0) = e
axiom2(e?1:e) = e
axiom3(e-e) = 0
axiom4(e+0) = e
axiom5(i=i;) = ;
axiom6(i=e1;i=e2;) = i = sub(e2,i,e1);
```

Figure 8 – Some transformation axioms.

```
rule(if(e) s1; if(e) s2; else s3;) =
  if(e) {s1;s2;} else s3;
  provided def(s1) ∩ ref(s2) = ∅
```

Figure 9 – A transformation rule.

```
if ((i+1)?(i+1):0) x=1;
if (i+1) ;
else i=i+1;
```

Figure 10 – Simplified version of Figure 7.

tions to our programs. Applying these transformations is rather like treating the program as a fragment of mathematics and performing algebraic simplification upon it. Luckily for the programmer, this algebraic simplification can be automated, so it will not be necessary to become a mathematician in order to use program transformation.



Some simple examples are listed in Figure 8. All of them assume that expressions are free of side effects. The transformations in Figure 8 are called axioms because they can always be applied to side effect free expressions and statements – they are axiomatic. The first four axioms apply to expressions, while the last two apply to statements. In the final axiom, the function *sub*, is used to transform an expression. The function call *sub*(*x*, *i*, *y*) yields the expression you get when all occurrences of the variable *i* in the expression *x* are replaced by the expression *y*. For example, *sub*(*i***i*+*p*, *i*, *q*+1) would yield the transformed expression (*q*+1)*(*q*+1) + *p*. That is, a version of *i***i*+*p* in which both occurrences of *i* have been replaced by the expression *q*+1.

Figure 9 contains a more complex transformation. This transformation is called a rule because it requires a test to be performed before it can be applied – it is not axiomatic. Specifically, the rule can only be performed provided *def*(*s*1) ∩ *ref*(*s*2) = ∅. The function call *def*(*s*1) yields the set of variables defined (assigned a value) in statement *s*1. The function call *ref*(*s*2) yields the variables referenced (mentioned in expressions) in the statement *s*2. The proviso *def*(*s*1) ∩ *ref*(*s*2) = ∅ requires that there are no variables which are both defined in *s*1 and also referenced in *s*2. That is, the two sets must have no intersection. If this proviso is not satisfied then the transformation cannot be performed, because it might change the meaning of the program fragment.

Transformation rules are often defined in this mathematical form, because it allows us to *prove* that the transformations are correct (that the transformed and original program fragments have the same effect). This proof is the responsibility of the provider of a transformation system and it gives us a perhaps more certain guarantee that we can rely on the transformations it produces.

Using the transformation rules in Figure 8 and 9, we can perform significant algebraic simplification on the side effect free fragment we produced in Figure 7. Let's start with the two assignments *i*=*i*+1; *i*=*i*-1;. Clearly these cancel one another out. A transformation system could realise this fact by applying a sequence of transformations. By applying axiom6, *i*=*i*+1; *i*=*i*-1; becomes *i*=*i*+1-1;, which using axiom3 becomes *i*=*i*; which by axiom5 becomes ;. Thus the fragment in Figure 7 can be transformed to the simpler version in Figure 10, which by applying the transformation rule in Figure 9 and axiom1 of Figure 8 becomes the further simplified fragment in Figure 11.

Finally, we could transform the predicate *i*+1 to *i*+1!=0, which could be transformed to *i*!=-1 (by subtracting one from both sides) which would give us the final fragment in Figure 12.

In many cases, the transformation system is simply recognising simplifications which would have been obvious to a well trained programmer. This is true of all the individual transformation steps. Each is extremely simple. However, the combined effect of applying a sequence of simple transformations can be startling. Its rather like an ant colony: each ant is very simple and has a very mundane role, but the action of the entire colony, with all ants act-

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```
if (i+1) x=1;
else i=i+1;
```

Figure 11 – Simplified version of Figure 10.

```
if(i!=-1) i=0; else x=1;
```

Figure 12 – Final transformed version of the fragment in Figure 1.

ing in concert, can be astonishingly complex and sophisticated. In program transformation, the whole is often far greater than the sum of its parts.

Automation

Using transformation, we have transformed the code fragment `if (++i && i--) x=1;` into the much more understandable fragment `if (i!=-1) i=0; else x=1;`. It has been quite an arduous task, involving many simple transformation steps. No programmer could be expected to perform these transformations by hand, it would be easier to study the original, even with its complex side effects. The whole transformation process could have been automated by a transformation tool, which a programmer could use as an assistant during development and maintenance.

Just such a program transformation tool is available (for free) on the Internet. It is called the Maintainers' Assistant and was developed by researchers at the University of Durham's Centre for Software Maintenance, with funding from the Engineering and Physical Sciences Research Council (EPSRC). From the Maintainers' Assistant, an industrial strength tool, FermaT was developed.

The Maintainers' Assistant is currently only available on Unix/Linux systems, running X Window. It works by compiling the source program into a Wide Spectrum Language (WSL), which is sufficiently general that it can represent programs in languages as diverse as C and IBM 370 assembler. Transformations are selected from a menu, using a point and click interface. Many individual transformation steps are combined into higher level transformation *tactics*, which perform a sequence of steps with the aim of restructuring a program in a particular way. Also, many of the transformations used by the Maintainers' Assistant have been proven correct, using mathematical logic, in research papers and PhD theses. The Maintainers' Assistant (both source code and executable) and research papers describing its design, implementation and application can be downloaded from <http://www.dur.ac.uk/CSM/projects/ma/>.

Even given the power of tools like the Maintainers' Assistant, it is unlikely that transformation will ever be a *completely* automated activity. Rather we can expect to see tools which work interactively, alongside the software developer/maintainer, removing much of the tedium from source code analysis, restructuring and simplification. These systems will sometimes need to be guided by the developer, who will know better (using domain knowledge, experience and that all-important programmer insight) which transformation strategy works the best in each case.



The future of program transformation

Program transformation technology continues to be developed. Systems like the Maintainers' Assistant represent the current state of the art. They are capable of automating many simple transformations as well as more sophisticated sequences of transformations, and have already been applied to several *real world* restructuring problems.

As compilers become ever more sophisticated they will employ more and more transformation technology. In the future, compilers may become much more than mere translators that convert one program notation into another. Using source-level transformation technology, the gap between compilers and CASE tools will continue to diminish to the point where programmers have sophisticated tools at their disposal, capable of integrating analysis, re-engineering, understanding, testing and measurement.

Much of the work on transformation has hitherto been concerned with conventional 3GL programming notations such as Pascal, assembler and C (as well as functional style languages like ML). Transformation technology has yet to catch up with the object-oriented paradigm, which presents formidable, though surmountable problems for automated program transformation. We can expect to see significant progress in this area. ■

Mark Harman is director of research at the School of Computing in the University of North London (<http://www.unl.ac.uk/~mark/projproj.html>). Together with researchers from the Universities of Durham and Brighton, he is currently seeking funding to apply transformation technology to Ada95 programs, in order to study concurrent transformation and slicing (See EXE, October 1996). Dr. Harman is also working with Chris Kopec to use genetic algorithms (See EXE, April 1997) to achieve improved algorithms for slicing and transformation. You can email him at m.harman@unl.ac.uk.

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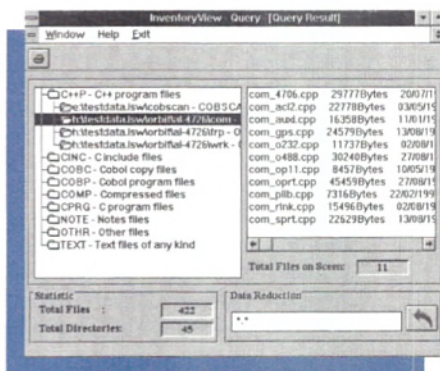
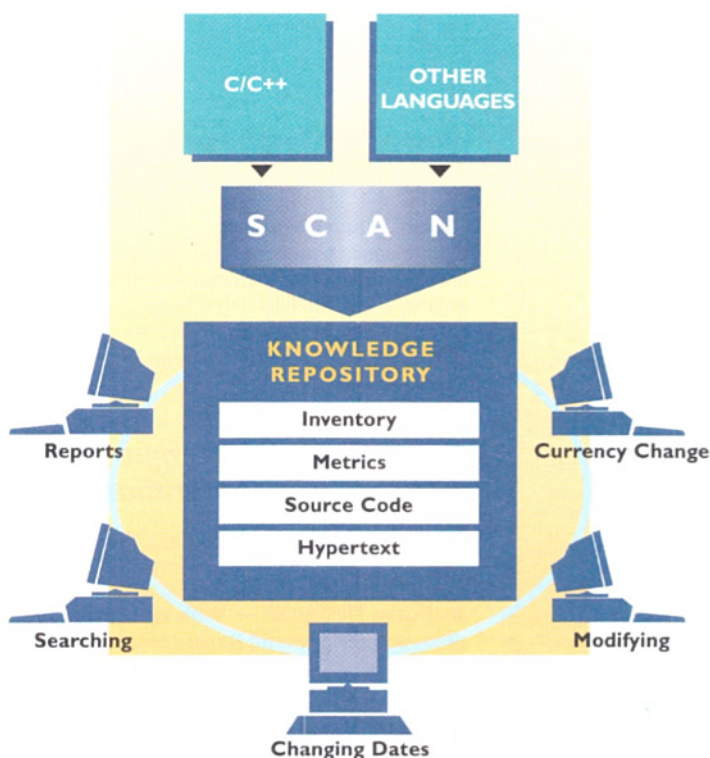
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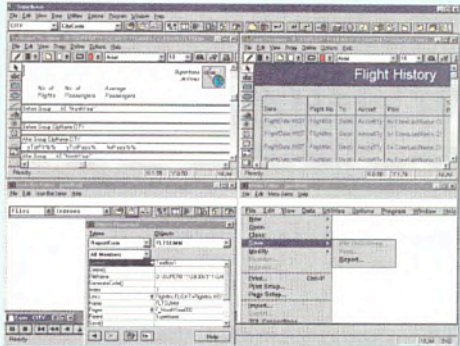


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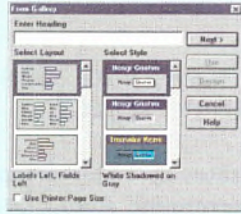
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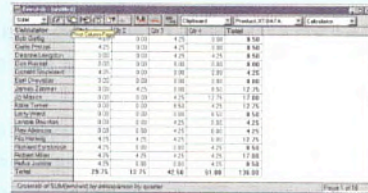
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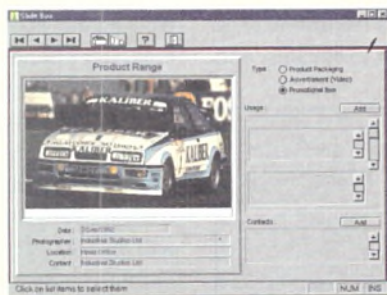
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Mouse, pen or compatible pointing device.

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And now for something completely different?

Today's software professionals need two programming languages: one to be seen doing work with, and one to work with. Python is ideal for the latter. Or is it the former?

Adrian Orlowski acts as Grand Inquisitor.

Why does Python continue to be such an obscure language? Is it the fact that only in the last year have books been published about it? Is it that the name connotes the tropical snake rather than the comedy series from which it was inspired? Maybe it's because the J-word is everywhere? Or is it just completely silly? Whatever the reason, since its unveiling in 1991 by its author Guido van Rossum, Python has attracted some very serious interest in the way of interfaces and support libraries.

Python has come a long way from its roots as a scripting language for the Amoeba operating system. Python has SQL interfaces, CGI facilities, BSD-style sockets, interfaces to different GUI toolkits and APIs, and the ability to do client/server work with shared objects (ILU and CORBA). Python is easily extendable and embeddable. Python has tools that are available to make writing library interfaces even faster. A Web browser – Grail – has been written entirely in Python (See Figure 1), and Python has become a plug-in language for writing applets for Netscape. As PythonWin for Windows (95 and NT), it exposes the Windows MFC class library to Python programs, and

allows them to act as both OLE servers and clients. With Microsoft's COM model underlying OLE and ActiveX in the ambit, Python has the keys to the Windows kingdom with its applications in reach.

Even if you already have your own favourite 'scripting' language, Python is simply too good to miss. It has a clean syntax, offers very high-level language features (classes, `apply`), and is easy to get to grips with. To demonstrate I set Python a job to do. You won't see every feature of the language described here, but you will get a flavour of Python as a general-purpose programming language, and see how you can do things quickly and effectively with it. So – anyone for tennis?

Stop that, it's silly

If you own a modern auto-focus, auto-everything SLR camera, you may sometimes find that you have a photographic problem you can't solve with it. These cameras don't have lens barrel markings which let you read the depth of field at a particular focus distance so controlling the sharp focus in an image can be problematic. Some cameras have a 'landscape' option to maximise sharp focus (smokin'), and a 'portrait' one which closes the depth of field right down to give you a sharp foreground subject and a washy *ciaroscuro* background (nice). On others you may be able to dial in maximum or minimum aperture, though that could result in an 'impossible' exposure. So it's trade-off time – and you don't have the beans to trade with. Listing 1 will give you an edge. (In the field you'll also need a PDA which runs Python, but that's just a matter of time. The queue is behind me.)

Python source is not particularly cryptic or script-ic – it looks like a 'real' programming language but has some unusual wrinkles. It is missing the explicit tokens (such as braces) that other languages have for statement grouping. Python code relies on indentation for grouping which is simple to use and reduces visual clutter.

Listing 1 constitutes a complete Python module. That is to say, you can use it and reuse it in different programs. I'll show examples as we go along. Its first few lines contain a triple-quoted string, which is Python's way of indicating a literal which stretches over many lines. Here it is not assigned to anything, but merely documents the module. Notice in the last line how character strings can be delimited by either single or double quotes – convenient for printing feet and inches signs.

The math to calculate depth of field is fairly trivial. Listing 1 spreads it across two main functions and throws in a couple of utility/conversion functions. The main functions are:

```
"""Photographic lens calculations

Compute hyperfocal distance and depth of field given:
1. focal length (mm)
2. aperture (f/stop)
3. subject distance (ft)
4. circle of confusion (mm) - default: 35mm film
"""

def mm2ft(mm):    # convert mm to feet
    return mm * 0.03937 / 12

def hyperfoc(foclen, aper, c=0.036):
    temp = foclen ** 2 / c
    return mm2ft(temp / aper)

def dofcalc(foclen, aper, dist, c=0.036):
    hy = hyperfoc(foclen, aper, c)
    near = hy * dist / (hy + dist)
    if hy > dist:
        far = hy * dist / (hy - dist)
    else:
        far = "INF"
    return far, near

def imperial(ft): # decimal to imperial formatting
    from types import *
    if type(ft) == StringType:
        return ft
    else:
        return str(int(ft)) + "'' + str(int(12 * (ft - int(ft)))) + ""
```

Listing 1 – Photographic lens calculations.



Katelyn McStavley

- `dofcalc` which does the main work. It returns the furthest/nearst points of sharp focus behind/in-front of a subject for different lens settings. This function makes use of:
- `hyperfoc` which computes the nearest subject distance which will put the far focus point at infinity (represented in these functions as the string "INF"). At this distance you have maximum depth of field (for a given lens at a given aperture).

You'll notice too straight away that Python has numbers (floating point and integers), and user-defined (and built-in) functions which take parameters and return values. You get the usual math operators, including `**` for the power function, which is put to use in calculating the hyper-focal distance. Apart from the punctuation (every language designer's prerogative to be different), and perhaps the use of the word `def` to introduce a function definition (which may or may not strike a chord), possibly the most unusual thing in the whole code is the statement:

```
return far, near
```

The `dofcalc` function computes a pair of values. Returning two or more values at the same time is no big deal in Python: you return them as a single data entity called a tuple. This is one of Python's intrinsic aggregate data types. The other aggregate types that Python has are lists and dictionaries (also elsewhere called associative arrays). Tuples are convenient since the caller can either grab it as a tuple:

```
dofdist = dofcalc(...)
or unpack it as soon as it gets it:
farpt, nearpt = dofcalc(...)
```

Using a list would take (a little) more syntax to achieve the same thing. Tuples need parentheses around them when the context requires unambiguous syntax (a function return statement is not one such place). In the following classic Python example, tuples occur on both sides of the expression and effect a swap of two values without requiring a temporary variable:

```
a, b = b, a
```

Tuples feature in other places too. They are used to implement optional arguments to functions, ie variable-length argument lists. For example:

```
def myfun(x, *rest): # body of function here
```

Within this function's body, `rest` is a tuple containing the second

and subsequent actual parameters in an invocation of the function. It would be an empty tuple if there was only one parameter in the call.

Listing 1 demonstrates default arguments in the functions `hyperfoc` and `dofcalc`. Since depth of field depends on the resolving power of the eye, which in turn relates to film format, the parameter `c` (circle of confusion) in the maths has been defaulted in the computations for 35mm film. Medium format camera users will need to include this parameter explicitly when calling the functions (0.056 is an appropriate value).

I'd like an argument, please

As Python functions go, it's possible to use keyword arguments and have Python automatically sort out the correct assignment of values to the function parameters. This makes it possible to call functions with arguments in a different order to that used in the function definition. It's also possible to mix positional, keyword, and default arguments, but beginners might prefer Watney's Red Barrel in *Torremolinos*.

Let's observe the edifying aspect of Python (compared for instance to Visual Basic) that you need not declare a variable's type to use it. You just get on and assign to it. The variable doesn't much care what you assign to it. In `dofcalc`, for instance, the `far` local variable, gets either a floating-point number or a string representing infinity. For aggregate types, though, you indicate the type of aggregate lexically. For example, the following statements create respectively an empty tuple, an empty list, and an empty dictionary:

```
tup = (); lst = []; dict = {}
```

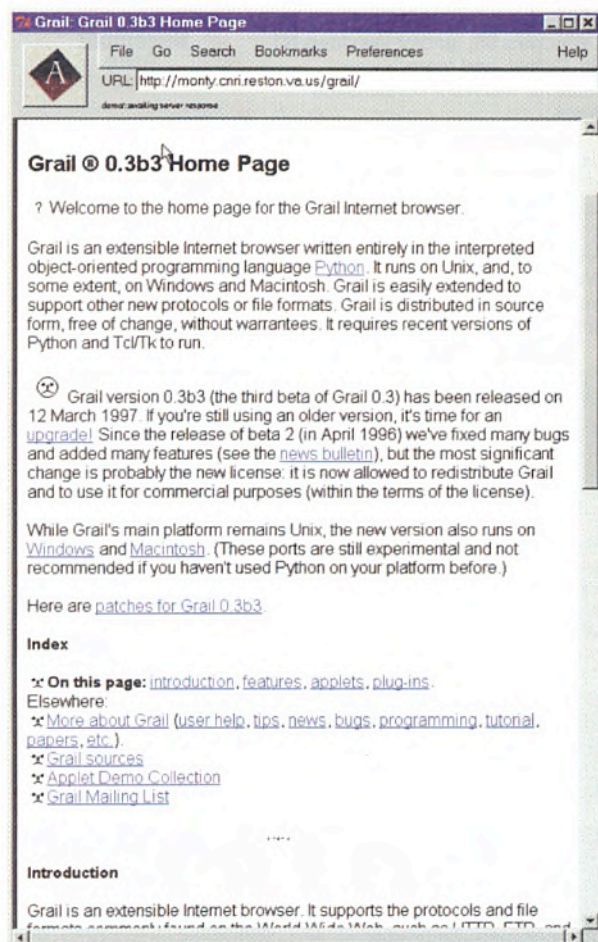


Figure 1 – The Grail Web browser written entirely in Python.

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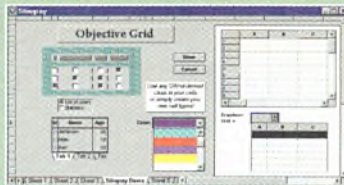
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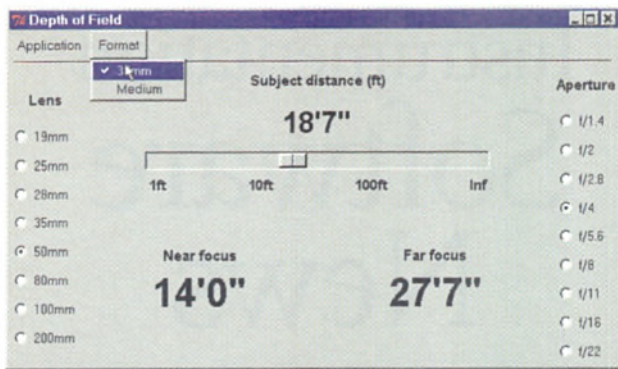


Figure 2 – A GUI interface for our photographic lens calculation program, written with Tkinter.

You can put things in them (watch closely):

```
lst = range(5)          # make list of int 0 thru 4
tup = "cir", lst, 'cus' # list now inside a tuple
dict["examp1"] = tup   # tuple now a value in dict.
```

Getting them out is as easy. Try this:

```
dict['examp1'][2][1]
```

which will produce 'u' as Python indexes start at zero. The only place you need to predeclare anything about a variable is to access from within a function a variable defined outside it. Because you can create a Python variable simply by assigning to it, an assignment in a function body will create a local variable. To access a global name from inside a function it has to be predeclared `global` before you use it.

Things aren't necessarily as they seem. Assignment does not necessarily allocate memory (although memory has to be allocated for data), it creates a reference. In the above example, after `lst` is made to contain five integers it is referring somewhere else from the empty list. Similarly, putting the `tup` tuple into the `dict` dictionary causes `dict` to have a reference to the same object as `tup`, and changing `lst` now will cause the value of `tup` and `dict` to change. As its inventor put it recently in *comp.lang.python*, Python has the syntax of an Algol-type language with the semantics of a Lisp-type language.

In practice, these semantics are mostly transparent, but one place they intrude is changing data. Python has objects which can be changed in place ('mutable' objects), and ones which can only be changed by forming completely new objects, eg by slicing and concatenation operations. Strings and tuples are immutable, lists and dic-

tionaries are mutable (even when embedded in an otherwise immutable data structure). You need to be aware of the difference between shallow and deep copies of data.



For manipulating data structures, the main problem when beginning with Python is the surfeit of ways of doing it. Python code in general tends to be structured readably because there aren't the choices of some other languages of say, writing a loop in many different ways. On the other hand, for data Python provides both operators and methods (functions), some built-in and some as libraries. You may need to dig a bit to start with, to find what you want. Both operators and methods are polymorphic to a significant degree, with strings, lists and classes being able to respond to the `+` operator for example.

Ministry of Silly Walks

Let's take Listing 1 for a walk. There are several ways Python programs can be run. It supports the well-known Unix-ism of having as the first line in a Python program something like this:

```
#!/usr/local/bin/python
```

which means Unix people can invoke scripts simply by typing the Python file name (`dof.py`) on the command line. Fortunately Python comments begin with the `#` character and continue to the end of the line, so this is compatible with other operating systems. However, it's inconvenient for larger programs split among several files, but there are alternatives. One is to fire up the Python interpreter itself, which is useful for testing.

After you've installed Python and invoked it, it should unfurl its copyright banner something like this:

```
Python 1.4 (Oct 26 1996) [MSC 32 bit (Intel)]
Copyright 1991-1995
Stichting Mathematisch Centrum, Amsterdam
>>>
```

The triple arrowhead is Python's interactive prompt. So enter this:

```
>>> import dof
```

Assuming you put `dof.py` somewhere that Python can find it, the prompt will come back almost straight away. There won't be any output of course because none of the functions in the `dof` module have been called yet – there is no code which does that. This statement causes the file `dof.py` to be read and executed, and its function definitions stored. If you now enter:

```
>>> dofcalc(50, 5.6, 12)
```

perhaps you won't get quite what you expected:

```
Traceback (innermost last):
  File "<stdin>", line 1, in ?
NameError: dofcalc
>>>
```

which is a `NameError`, I'll explain that in a moment. What you actually have to type is:

```
>>> dof.dofcalc(50, 5.6, 12)
(17.0200563156, 9.26677096459)
```

Python then returns the far and near points of sharp focus for a subject at 12 feet for a 50mm lens set at $f/5.6$. Although none of the code in `dof.py` mentions output or printing, notice that Python seems to know what to do anyway. It has wrapped the numbers in parenthesis, indicating that the function returned a tuple – but you knew that already.

Now to explain the `NameError` we got first. When you are at Python's prompt you are actually in its top-level dictionary (called `__main__`). If you `import dof` into this, Python will add a dictionary to it called `dof`. To get at `dof`'s functions you have to go through

```
from dof import *

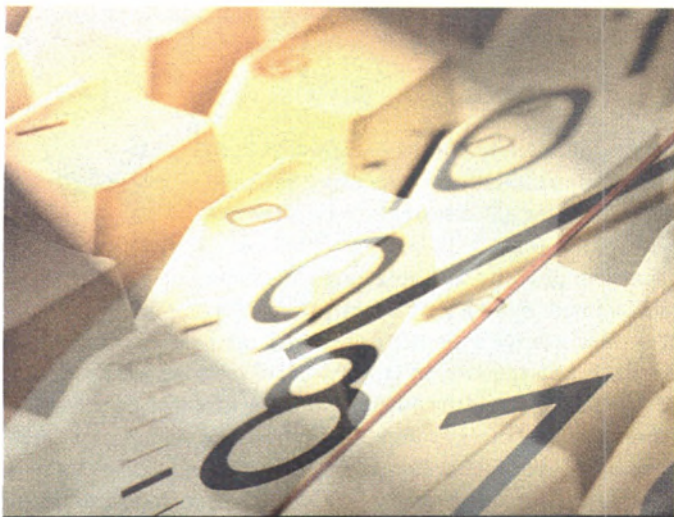
class DoF:
    def __init__(self, f=50, ap=5.6, d=12):
        self.f = f
        self.ap = ap
        self.d = d
        self.c = 0.036

    def calc(self, d):
        self.d = d
        self.far, self.near = dofcalc(self.f, self.ap, self.d, self.c)

    def __repr__(self):
        return "%s to %s" % (imperial(self.far), imperial(self.near))

if __name__ == '__main__':
    test = DoF() # make a DoF instance
    test.calc(6) # do it
    print test  # show me
    test.ap = 2.8 # change a member directly
    print test.ap # what is it now?
    test.calc(8) # do it again brain
    print test
```

Listing 2 – Printing the depth of field.



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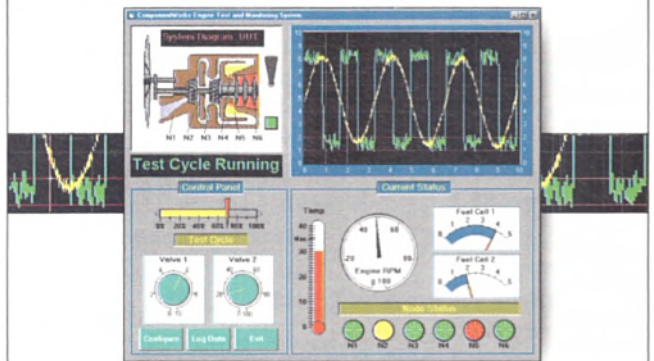


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this sub-dictionary, referencing its attributes. To avoid the qualification, you have to do as the `imperial` function in Listing 1 does with the name `types`; you have to type:

```
>>> from dof import *
```

which makes Python add `dof`'s entries to the current dictionary. This behaviour can initially be disconcerting or appetising depending on previous experience. It helps to remember that Python makes extensive use of dictionaries to track names.

The code in Listing 1 can be put to use in a number of ways. One small nuisance is that the depth of field doesn't come back as nice numbers; that's the purpose of the `imperial` conversion function. You could add some code to save what `dof.calc` returns, say into variables called `far` and `near`. Then pretty-print them like this:

```
print "%s to %s" % (dof.imperial(far),
                   dof.imperial(near))
```

which demonstrates Python's use of the C language print format specifiers, and the `%` operator for strings which takes a tuple as its right operand. No-one would even suggest these calculations should be anything other than functions, but building them into a Python class we can get the depth of field to print nicely automatically. The code for this is in Listing 2.

Fetch the Comfy Chair

If you haven't gotten into object oriented programming, Python is a good introduction. Listing 2 is about as simple as you can go. The main part of the code defines a `DoF` class. The express intent is to activate the `__repr__` special name available for classes, which Python looks up when converting an object into printable form. The code for this and for the `calc` method are self-explanatory, though the `__init__` function requires more discussion.

Python classes can inherit methods and members from other classes. They can also use multiple inheritance. Any base classes derived from are listed in parentheses, after the class name, when the class is defined. The `__init__` function is special. If defined, it is automatically run when an instance of the class is created, and used to get initialisation data into the instance; here it gives you the option of setting up member data or using some reasonable defaults. One important point is that base class constructors do not get run automatically; you have to run them explicitly. But how do you instantiate a class in the first place?

If you run the above code directly, it executes at Python's top level, and the condition

```
if __name__ == '__main__':
```

is true. This offers an elegant way to have debug code in individual modules which doesn't interfere with module reuse. Below this statement, you can see a `DoF` object being created simply by invoking the class name as a function. This is all there is to creating an instance. Once you have created an instance (in this case called `test`) you can use it to get and set members and call functions. Since a class definition does not instantiate any actual data, any reference to instance variables need to specify which instances to use – hence the qualified references to `self`, meaning 'me', 'my', 'mine'.

You don't need special member functions to access data members. To get at the value of the `f` member you simply say `DoFobject.f` from anywhere. You can assign values in just the same way. And what's more, you can create new members dynamically in individual instances, as well as in the class itself. Bare-back riding, some might call it, but as Guido van Rossum is reputed to have explained class access privileges: 'we're all consenting adults'.

There is a special `__del__` class name for instance destructors, but you don't generally need to define it since Python does automatic

garbage collection on unreferenced objects. Altogether there are about 40 such special double-underscored class names. By defining them you can implement special behaviours, such as reinterpreting the math and logical operators (operator overloading). Others let you control keying and indexing (for iteration), aggregate manipulation, function call, and assignment, deletion and creation of class attributes.



What else can we do with the lens functions? We might consider some way to store calculated depths of field in a file. While that's even less reasonable than making a class just to have a custom print function (so I won't do it), it happens to be fairly trivial to implement. You can in fact treat it as a persistent object store. The Python `pickle` module can serialise a variety of Python objects. You can store/retrieve objects with just a call to the `dump` and `load` functions. A higher level facility that can read and write using keyed access requires an environment-specific library: `dbm` or an equivalent. The options don't stop there: Python gives access to the file i/o facilities of the C libraries it's built with. You can choose to deal with the Python equivalent of C FILE objects, or with the lower level functions which use file descriptors and are especially convenient for binary data. You also get `stdio` for command line redirection. For text your only problem is deciding whether to read individual characters (with `read(1)`), lines (with `readline`), or the whole file at once (with `readlines`). You can use regular expression functions for text processing, and work is in progress to make Perl's regex facilities available.

What the lens functions really demand is a GUI interface. Here your options depend somewhat on your operating system (since you write to a Python interface onto a windowing system). Typically on Unix it's Tcl/tk using the Tkinter interface, which is a good choice as it's succinct. Tcl/tk is now ported to Windows and the Mac. It aims for a native look and feel. On Unix you can write for X. On Windows there are further choices besides Tkinter. PythonWin exposes the MFC classes (lugubrious in comparison), and WPY does something similar (albeit aiming to implement the API for Unix); wxPython is another portable library. I chose Tkinter. The code of the GUI interface module is too long to print here but you can download it from EXE OnLine (www.exe.co.uk) or directly by ftp (ftp.exe.co.uk/pub/exestuff/9707_Python).

That's no ordinary rabbit

Tkinter is a Python module which overlays a shallow hierarchic set of classes onto tk so you can use a class and function approach instead of Tcl's command-line like syntax for creating and manipulating widgets. If you've grasped the general idea of non-sequential program flow that usually pertains in GUI programming, Tkinter is not at all difficult to get going with. Although the documentation is sparse, it's possible to learn (as I did) from code examples and the tk man pages (which are available these days in Windows help format).

A user interface for the depth of field calculations needs four controls, and some way of displaying the results. I chose two sets of radio-buttons to implement lens and aperture selection (see Figure 2). I have prime lenses. If you use zooms you may want to consider re-implementing this widget as a slider type. The code subclasses a Tkinter `Frame` to create `ApertureGroup` and `LensGroup` classes. All the radiobuttons in each group share a common variable which stores the selection, so you need to look in only one place to determine the setting. The code itself is only slightly complicated by the need to label things. This is implemented throughout by having `Label` widgets form part of the custom widget classes. You will also see `print` statements in many of the widget callback functions;

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References

Check out www.pythonline.com for Monty Python's Flying Circus. The Python language home is at www.python.org and at ftp.python.org. The Grail browser has its own Web page at <http://monty.cnri.reston.va.us/grail/>. An installation survival guide is in the making at <http://www.netaxs.com/~mryan/python/>. There are currently two books in English on Python: Mark Lutz' *Programming Python*, O'Reilly (c/w cd-rom), and Watters, van Rossum, Ahlstrom *Internet Programming with Python*, M&T Books.

these print useful information to the console window running Python.

The circle of confusion parameter has been put out of the immediate way on a checkbox style menu. I won't go into this part of the code in detail: menu creation is essentially a process of creating the main menu entries, then attaching submenus to them. A point to note is that it intentionally ducks transmitting the changed setting to the master window the first time around when this menu is initialised. At this point its lord and master is not yet ready to service the notification (ie update the depth of field readouts): it's not fully built yet. This is due to the order in which the widgets are constructed. It is essentially determined by tk's need to have them in a particular order to achieve the desired spatial disposition, (doubtless there are ways of handling this problem, but this was my first ride out on tcl/tk). The `DofMenu` class also shows how message boxes are constructed.

The distance setting widget took more work; tk's supplied widget has options for a label and tick marks. Unfortunately it is strictly linear, and unusable for this application. I had to make a logarithmic slider. The `DistSlider` widget is a composite of a `Label`, a `Scale` (slider), a custom `SliderTicks` class (which simply bundles four `Labels` together to create tick marks), and an `antilog` function. The `Scale` widget is configured to act over a range of almost 0 to 3, which fits well with the three decades 1-10 feet, 10-100 feet, and 100-1000 feet. It makes sense to provide control over; the maximum value also being treated as infinity for output. While Python has a `log10` function, there's no `antilog10`. This was crudely hacked to increment a test value by fixed and then progressively smaller amounts and to check when its logarithm approached the value issued by the tk slider widget.

The main class also mixes OO techniques of inheritance and composition. The `DofGuiWin` class is derived from a `Frame`, and instantiates the widgets described above

as components. The big readouts are distinct custom components (`DistReadout` objects), consisting of a pair of `Labels`. A tk `Canvas` widget is used to put a horizontal rule under the menu. (I thought I'd need a `Canvas` and a `Line`, but it turned out the `Canvas` could do the job itself). Finally, the whole caboose is set in motion by initialising an instance of `DofGuiWin` with suitable lists of lenses and apertures.

Notice in Figure 2 that there is no 'Calculate' button. When a user selects a different lens or aperture, or sets a new format (circle of confusion), or drags the slider, the program recalculates the new depth of field automatically and redisplay it. The custom widgets are programmed to call member functions in `DofGuiWin` when they change. These simply update the member variable in `DofGuiWin` and call the `dofcalc` function we wrote earlier. Despite the crude machinations of the `antilog` function, the process is fast enough on a Pentium 100 machine not to warrant any further speed optimisations. And this from a byte-code interpreter! Which reminds me, I haven't told you Python has a profiler and a debugger. But I hope you have the general idea now.

Nudge, nudge, wink, wink

Python is available for most Unix, including Linux - it is part of the Red Hat distribution and maybe others. It is available for Windows (95, NT, and 3.x), Macintosh, DOS, OS/2, Amiga, Atari and VMS, (you can get precompiled binaries for these). The Grail browser needs Tcl/tk, (which restricts this to Unices, Windows, and Mac). Extensive documentation as well as the C sources can be obtained. It's all free, but you need to acknowledge its use if you are embedding Python in commercial products. ■

Adrian Orlowski is an SGML implementer, ex-systems programmer, and ex-ex-journalist. He can be reached at adrian@solero.force9.net.



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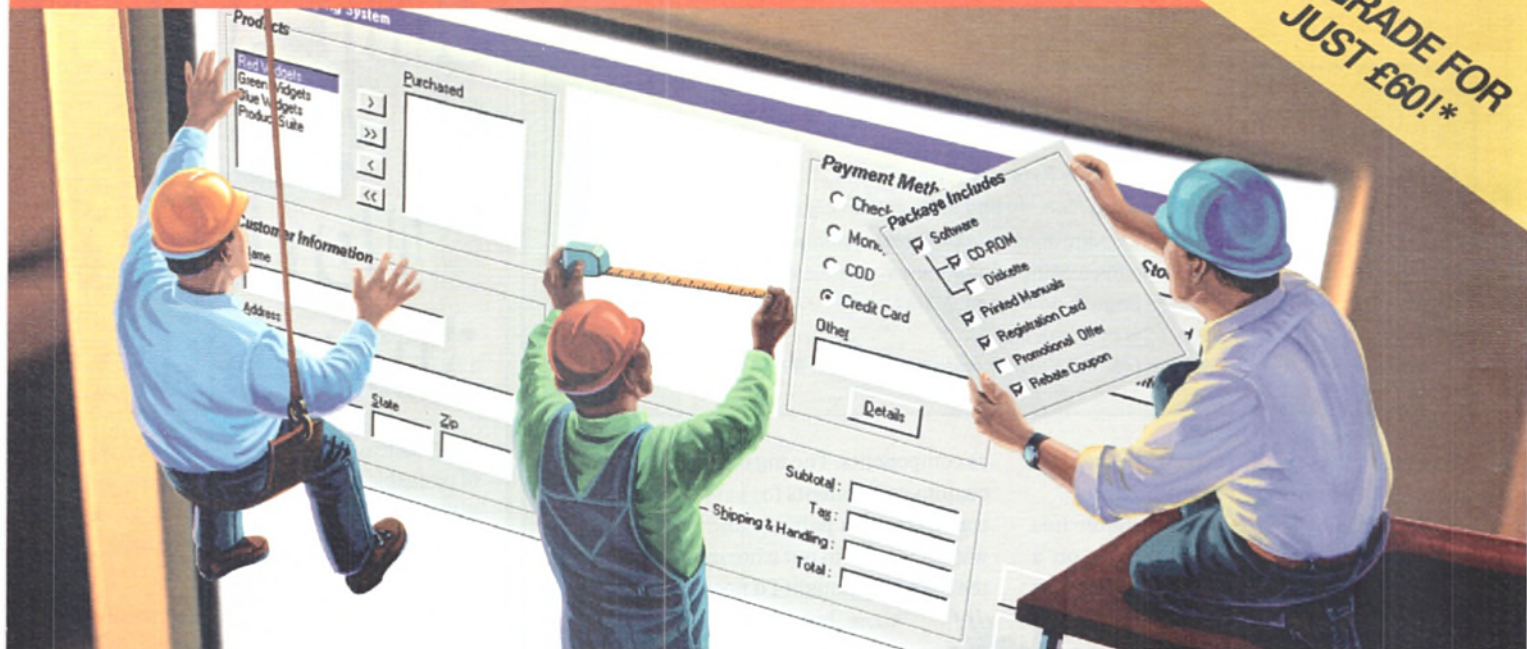
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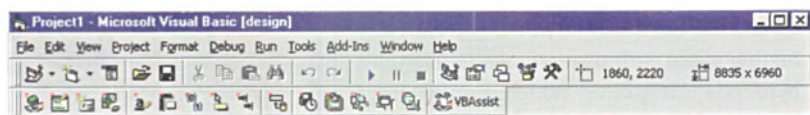
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Matt Welsh is 'Running Linux'

Mike Ingram hooked up with Linux guru, systems hacker, and computer architecture researcher Matt Welsh to have the last word on Linux, its evolution and the Bristol Zoo.

Matt Welsh has co-authored *Running Linux* published by O'Reilly and Associates (now in its second edition) as well as other Linux-related works including, *Linux Installation and Getting Started*, several *HOWTO* documents, and articles for the *Linux Journal Magazine*. Welsh is currently working as a research assistant at the University of Cambridge Computer Laboratory, the University of Glasgow Department of Computing Science and the Vrije Universiteit Amsterdam. In his spare time Welsh enjoys the works of Thomas Pynchon and Jack Kerouac and grooves to the sounds of Miles Davis and Thelonious Monk. He maintains that 'there is life beyond computing science'.

Q How did you first get involved with Linux?

Back in the Summer of '92, a friend of mine named Jon Magid got a job administrating *sunsite.unc.edu*. Sunsite was one of the first Web sites. Sun Microsystems donated the site to the University of North Carolina and said, 'do whatever you want with it'. Magid was keen on Linux which had just started to come out. One of the major Linux ftp sites was being shut down so Magid downloaded the entire Linux archive (which at that time was fairly small) and got it working. He encouraged me to download a three-disk set and install it on my machine. I downloaded a lot of documentation with it, various installation and new user guides. Most of them had been written for earlier versions of the software. At this time there was really only one version out, the MCC interim, kernel version 0.91. I eventually installed it, and thought, 'this is really easy, anyone could install this with a coherent set of notes'. I wrote up what I did, explaining it for people who weren't necessarily PC or Unix hackers. Eventually I added the material to the Linux FAQ. It was an enormous document which contained virtually all of the Linux material being written. It was impossible to maintain, much of it having gone out of date. After a few months, we decided that the FAQ had grown too large for its own good and scrapped it. Ian Jackson at Cambridge wrote a new FAQ with short questions and answers, and I started the HOWTO project. The idea was to allow individuals to write short tutorials, ten to fifteen pages at most, on what they knew. I wrote the Installation, and the Network HOWTO, which provided a means for people to write their own howtos and submit them to an archive.

Q How did that turn into the *Installation and Getting Started Guide*?

In parallel with this, a group of people: Lars Wirzenius, Michael K Johnson, myself and a few others started a small mailing list, actually the 'doc' channel on the Linux mailing list. We were interested in writing a set of manuals for Linux that one could imagine printing out and putting on the shelf next to your machine. This was long before any-



body thought about putting Linux on a CD-ROM, or publishing Linux books. It was still a very internet-based thing. We weren't thinking about publication at the time. I volunteered to start writing the installation guide. I think I called the first version *Installation, Setup and Getting Started*. I decided that was a bit verbose and got rid of the 'setup'. It's still too verbose. I was a college undergraduate, so I did it in my free time, and eventually released the first version. Later I revised it. It grew to be around 200-250 pages in the end. It was one of the first to be published in printed form. SSC (the company that publishes the *Linux Journal*) took it, made a nice cover and put it in paperback.

Q Is most of the work on Linux done by academics?

It depends, a lot of Linux enthusiasts tend to be students because it's difficult for most people to introduce Linux into a corporate environment. A lot of students are involved in Linux. Linus Torvalds himself was a student. It doesn't mean that companies are not willing to adopt Linux, it's just that most established companies already have, say, Sun equipment everywhere and there's no need. Many of the people who have done serious work on Linux in terms of the core software, such as libraries and the kernel, have been industry people. In the research setting, Don Becker develops all of the Linux ethernet drivers at the Center for Excellence in Space Data and Information Sciences, a project of NASA's Goddard Space Flight Center. They are building a cluster of Linux machines connected by a fast ethernet to use as a parallel supercomputer within that context. Several of the people who work on Linux work for companies or research groups and have managed to fit Linux into their working environment.

Q How practical is Linux for bug-patching and development when compared to a corporate environment?

Due to the availability of the source code Linux development works on a much, much faster timescale than traditional Beta testing. Back in '93 or so when the first version of the kernel (0.99 pl 10) with network support came out I spent all night trying to get my machine on the network. I had a kernel panic of some kind in the NE2000 driver so I emailed Don Becker at 2 in the morning. He sent me a patch at 2:15 saying, 'try this'. We went back and forth for a while because he happened to be awake as well. After this session and several trials I

had a working ethernet driver. It's a completely different development scenario than you would find in corporations. I'm not slighting the way in which corporations do their work; in corporate software development you have to provide real support to real customers who are paying real money. You need to go through more levels of quality control and management to get the job done. I'm not proposing that the commercial OS development community is doing everything wrong, just that as an alternative Linux has worked amazingly well.

Q How does development cope with hardware companies not publishing device specs?

To a great extent the problem has been overcome. It would take a fair amount of work to go over the number of devices or drivers supported by Linux and determine which of those were written because the information was already freely available. Someone had to do some work to obtain that information, such as convince the company to release it, or in some simple cases by reverse engineering the device. With simple devices, hiding the information does a company a disservice because people can usually figure out what's going on.

The amount of hardware that Linux now supports is pretty enormous. It used to be the case that it was hit or miss whether or not Linux would support, say, your CD-ROM drive. You had to really think about what CD-ROM to buy. Now Linux supports almost all types of CD-ROMs because there's a fairly common interface. Somebody wrote a driver that drives them all, so that's not an issue any more. It's the same with ethernet cards. It would be fairly difficult to buy a CD-ROM drive or an ethernet card or a SCSI card that Linux didn't support. There are so many hardware choices out there that people who are interested in running Linux don't have any trouble finding hardware that Linux is known to support.

Q How important has Linus Torvalds' involvement been at the kernel level?

Without Torvalds there would be a fair amount of anarchy. He has provided structure and unification to the entire project. At the kernel level, Torvalds will not admit patches that he feels go against the design of the system in some way. Obviously he doesn't have time to test every piece of code that is submitted. He doesn't accept patches from just anyone. It has worked itself into a hierarchy. Torvalds knows a certain set of people that he trusts to make good decisions about their subsystems in the kernel. He trusts Alan Cox and Don Becker to send him ethernet and network patches. He'll admit anything that they send him. Everything else he has to scrutinise carefully. He may not get around to doing that. He's probably deluged with email. There's been times when a decision has needed to be made. Torvalds has put his foot down and said 'this is the way things are going to be', but nothing about that restricts people from branching off in other directions. If you wanted to do your own development, you could take a snapshot of the kernel tree and go off and do something completely bogus and radical to it. The thing that has prevented people from fragmenting the kernel tree into many different development branches is simply that all of the new patches are going to Torvalds. Nobody else really wants the job.

Q Pertaining to source code availability, is it beneficial to have security problems, such as bugs in the OS kernel, widely distributed?

It's extremely important for several reasons. Let's say there's a gaping hole somewhere in the Linux kernel, no-one is necessarily going to find it. Just because the source code is there doesn't mean that people understand it. If the problem were so blatant that anyone just

glancing through the source could spot it, it would have been fixed a long time ago. The security problems that Linux has had tend to be fairly subtle, and aren't so easy to spot. The reason that it's important is that you cannot rely on a company most of the time to rapidly fix bugs. Just last night, someone was relating a story to me about a large commercial version of Unix that allowed anyone on the Internet to mount anyone else's file system (who was running that same version of Unix). They found this bug because they had a source license for that version of Unix. They sent the company a description, and the exact lines that needed to be changed in the kernel code to fix the bug. The next version of the OS comes out, it's not fixed. Same thing happens with the next release. Two years later the bug was fixed. Just because you're informing a company and putting red sirens all over the message, (and it should have been entered into this company's database as a very severe, stop-ship bug), doesn't guarantee that it's going to get fixed. With the Linux model if there is a security problem, it's very likely that a patch will be posted to the Internet within a few hours of it being found.

You have to be responsible about exposing security holes. If you were to post to Usenet saying 'I found a hole that will let anyone log in as root, just do this', that would be irresponsible. What you need to do is discuss the problem with people who know the subject and provide a patch. It's best not to provide any details, though by reading the patch someone may figure it out anyway. Overall Linux has the opportunity to be fixed very rapidly whereas other operating systems don't. For a large vendor, generating a patch, verifying it and putting it up on an ftp site is difficult, and in a lot of cases they won't even bother, they'll just send it out on the next patch CD-ROM.

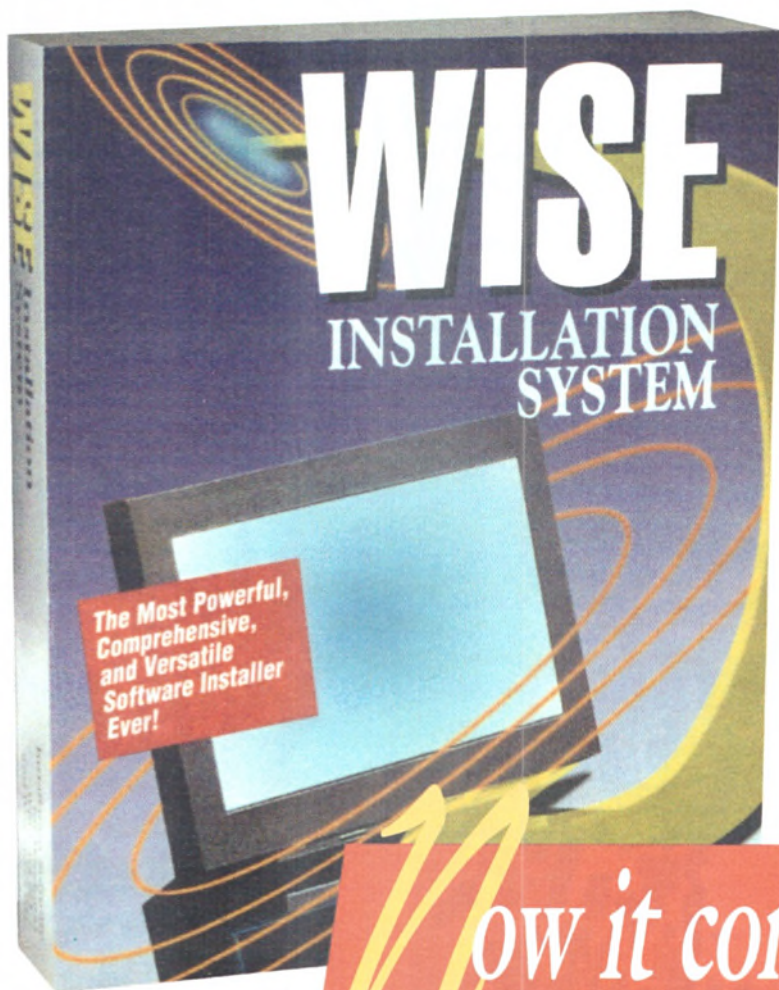
Q In the future how important will CDE (Common Desktop Environment) be in combating the knee-jerk reaction, 'I don't use Linux because it doesn't have a consistent user interface'?

Maybe CDE is a good idea if it makes certain people more comfortable but it's not what Linux is about. What's most important about Linux is that it provides people with an alternative to other OSs. There are certain people out there who really like to dump on Microsoft, and talk about how terrible their marketing practices are, but I don't think it's warranted. It's unnecessary. I used to feel that way. I have written things that were negative towards Microsoft, but it's not really the best way to go about it. It's important to be pro-Linux, and not anti-anyone else. It's not necessary to say that you don't like Microsoft in order to say that you like Linux. Linux gives people something else to run that's fully functional. Because it's free you don't have much to lose by trying it. From a technical point of view, it provides developers like myself who are interested in OS research a great amount of source code to study and use. You've essentially got a very good set of reference information. If I'm interested in figuring out how to get very fine-grained time measurements on a Pentium Pro, I can go into the Linux code that does that, and there it is in front of me, instead of having to guess from the manuals.

Q On a different point, did you hear that a local Linux users group has adopted a penguin at the Bristol Zoo and a plaque is being put up in honour of Linus Torvalds beside the penguin cage?

Fantastic! That's a fitting honour for what Torvalds has done. It would be unbecoming of the Linux project to, like, put up a monument in Time Square. ■





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QA

Introspection on Java

The Core Reflection API is one of the many added to Java in JDK 1.1, but until now it has been poorly understood. In the first instalment of a new monthly column on Java, and other technologies related to Internet and Web development, Tom Guinther stares into the abyss, and waits to see if it stares back.

Over the last two years the Java paradigm has challenged the reigning software development establishment, forcing us to rethink many of the traditional methods that we use to develop and deliver software. For me, one of the key promises that Java has made is a reduction in the complexity of developing high quality software. The Java language itself has achieved a small degree of success in reducing complexity by eliminating direct memory management and radically simplifying the type system of the language. In other areas it has added significant complexity, in part due to the 1001 re-invent-the-wheel APIs, poor documentation, lack of a broad developer experience base, and in some cases ill-conceived design. Don't get me wrong, I am a true Java fan, but as a matter of practicality everyone should be aware of Java's instability and immaturity. At this stage in its life cycle, a majority of the Java paradigm is still a moving target.

Let's start by examining a few of the core components of the Java Programming API that relate to the Java language.

Reflection, introspection, and JavaBeans

The latest Java Development Kit (JDK 1.1) release from JavaSoft contains a variety of architectural changes and includes many new and extended APIs. Among them is the Core Reflection API which provides information about, and access to, a class, its fields, and methods. The Reflection API is useful for many general programming tasks and is heavily used by other JDK 1.1 packages including the Introspection package.

Introspection is similar in concept to Reflection but is designed to provide property information about a JavaBean. JavaBeans is a model for Java component development and is in some respects similar to Microsoft's OLE Automation. I find JavaBeans to be one of the most intriguing and potentially useful aspects of the Java paradigm.

The Reflection package

The Reflection package (`java.lang.reflect`) implements the Java Core Reflection API which is a collection of classes and interfaces which expose a small, type-safe, and secure API to provide information about the classes and objects in the Java Virtual Machine. The package's implementation is relatively clean, requiring only a handful of classes and one interface. Still, due to the low-level nature of the API there were design and implementation changes needed in various JDK 1.0.2 components, especially `java.lang.Class`, which is a key user of the Reflection package.

The Reflection API is composed of three core classes that, in conjunction with class `Class`, provide core information about a class, its constructors, fields and methods. Not by coincidence these three

classes are named `Constructor`, `Field`, and `Method`. Each of these classes implement the `Member` interface which provides an abstraction of the class member's basic attributes. It defines methods for obtaining the class that declared the member, `getDeclaringClass`, to get the name of the member, `getName`, and to get the modifiers (`public`, `final`, `abstract`, etc...) for the member, `getModifiers`. Each of the three core classes provides functionality above and beyond the `Member` interface, such as `Constructor.getExceptionTypes`, `Method.getParameterTypes`, or `Field.getType`, which reflect functionality specific to the member type.

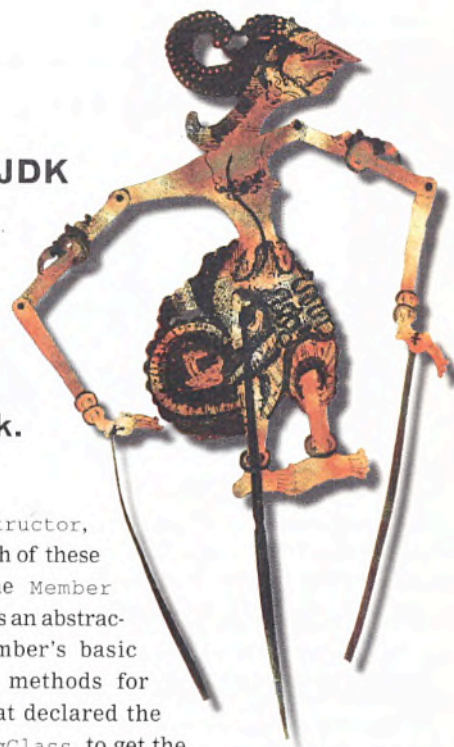
While the Reflection API provides access to the components of a class, it does not provide access to the overall class itself. To obtain any of these Core Reflection classes one must first obtain a `Class` reference. The class `Class` is implemented in `java.lang.Class` and has been significantly extended in JDK 1.1 to make heavy use of the Reflection API.

Java's class `Class`

For each class created by the Java Virtual Machine, an internal data structure that represents a run-time version of the class must be created and maintained. The class `Class` provides a high-level window into that data structure allowing applets and applications to determine almost everything there is to know about any available class. The Java Virtual Machine creates instances of class `Class` for each of the Java primitive types so that the entire type system can be represented using `Class`.

One of the first things that you will notice about `Class` is that it does not contain a public constructor and is declared `final`. This means that only the Java Virtual Machine can pass it the name of the class. The `getClass` method is a member of `java.lang.Object` and thus can be used on any object type. To use the `getClass` method with a primitive type (such as `int` or `float`) create a wrapper class of the appropriate type, or call the static method `Class.getPrimitiveClass` to create an instance of this object. There are two general methods of obtaining a `Class` instance: call the `Object.getClass` method using any object reference, or call the static method `Class.forName`, which is the name of the primitive type.

This month's example application, `ClassDump`, uses the `Class.forName` approach to obtaining a `Class` object. Using `ClassDump`, the class name is specified as the first and only command line



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parameter. In practice you should provide the fully qualified name of the class you want to access. For example, `Class.forName("java.lang.Thread")` will return a `Class` object that will describe the Java `Thread` class.

Once we have a `Class` object we can obtain one of the Reflection API class types by using an appropriate method of `Class`. For example, to return an instance of class `Method` that represents the public methods of the 'reflected' class and all its interfaces and super classes, use `{ Method method = refClass.getMethods(); }`.

Class method madness

The class `Class` contains quite a few methods, many of which you might expect such as `getName`, `getModifiers`, `getSuperClass`, `isArray`, `isInterface`, and so on. There is also an overlapping set of functions that are designed to allow access to the fields, methods and constructors of a class.

The most general, `getFields`, `getMethods`, and `getConstructors`, return the public fields, methods, and constructors of the class and all of the classes it inherits from. These methods are useful for obtaining a non-privileged, run-time view that any normal client of the class might see.

The second set of methods, `getDeclaredFields`, `getDeclaredMethods`, and `getDeclaredConstructors`, return the fields, methods, and constructors declared specifically by a class, not including any of the members of classes or interfaces it inherits from. Also, access is not restricted to public fields. These methods are heavily used by the `ClassDump` application.

Finally, there is a third set of methods geared toward finding members by name and signature. These methods can be used for dynamic binding to an object and its fields or methods. We will touch upon this aspect of the Reflection API in future columns.

The ClassDump sample application

I've written a utility application, `ClassDump`, to illustrate the static aspects of `java.lang.Class` and the Reflection API. Its purpose is to provide a complete type-definition for any Java class. That is, I want a utility that will display a Java class in the same basic format I would use to declare it in my `.java` source file. I want a quick, clean way of reviewing the class and its members without having to find the original source file (assuming I have it).

At first this might seem like a trivial task seeing how the `toString` method of most of the classes we have discussed will provide us with a formatted output describing the field, method, or constructor. It would seem that all we would need to do is enumerate each of the class members and call its `toString` method. Unfortunately, because all the type names are fully qualified (eg `java.lang.String`), this approach produces very noisy output which makes it self-defeating for my purpose. To provide clean, simple output, I need to do most of the formatting work myself.

First of all `ClassDump` expects one and only one parameter, the class name. If there are zero or more than one parameter we display a usage statement and exit, taking the user-specified class name we use the `Class.forName` method to attempt to confirm that it is a `Class` object that represents the class. If the class is not currently loaded, the Java Virtual Machine will attempt to load it. If the class cannot be found, the `Class.forName` will throw a `ClassNotFoundException`. This is a checked exception so the Java language enforces our use of a `try/catch` handler. If the exception is thrown our catch handler will display a message saying the class was not found and exit the application.

```
try {
    ...
    if (args.length != 1) {
        System.err.println
            ("Usage: ClassDump <class-name>");
        return ;
    }
    ...
} catch (ClassNotFoundException e) {
    System.err.println
        ("Class \"" + args [0] + "\" not found");
}
```

Once we have obtained our `Class` object, the next step is to display the actual class declaration with its modifiers, name, super class (`extends`), and any interfaces it *directly* implements. I emphasise *directly* because the first major snag I ran into is that `Class.getInterfaces()` returns the interfaces implemented by this class and all of its super-classes and super-interfaces. In order to determine the interfaces that are actually declared by the class, I need to eliminate all the interfaces that were declared by its super-classes and super-interfaces (see: `ClassDump.GetDirectInterfaces`, and `ClassDump.ReduceInterfaces`).

On most occasions where I need to display the name of a class I use one of the utility methods, `ClassDump.GetBaseName`, or `ClassDump.GetBaseJavaName` to reduce a fully qualified name of the form `package.class.member` to a simpler form. In some cases I only want to remove the qualifiers if it is a Java specific type.

```
// returns simple name given a qualified name
public static String GetBaseName(String qualifiedName)
{
    String baseName = qualifiedName;
    int baseIndex = qualifiedName.lastIndexOf ( '.' );

    if (baseIndex != -1)
        baseName = qualifiedName.substring(baseIndex+1);
    return baseName ;
}

// returns simple name if qualified name
// is from Java package
public static String GetBaseJavaName
    (String qualifiedName)
{
    if (qualifiedName.startsWith ("java."))
        return GetBaseName (qualifiedName);
    return qualifiedName;
}
```

I think you will find a majority of the code to be straightforward but before we conclude, I want to comment on the `ClassDump.GetTypeName` method. Because the Java type system is so wonderfully simple we only have to handle one special case type and that type is the array type. Excluding exceptions, any time we have a type, such as a parameter type or return type, I use the `GetTypeName` method to create the formal type name. This allows for arrays to be handled specially. When we have an array type we must determine its component type, which could be another array. Eventually, drilling down the type-chain, we will hit



a non-array component type and that will represent the actual type followed by the appropriate number of '[' array bracket pairs.

```
public static String GetTypeName (Class theClass)
{
    Class baseClass = null;
    int arrayDims = 0;
    String typeName = null;

    // Is it an array
    if ( theClass.isArray () ) {
        baseClass = theClass;
        // Drill down to non-array type
        do {
            // Get next type
            baseClass =
baseClass.getComponentType();
            arrayDims ++; // count the # of dimensions
        } while (baseClass.isArray());
    } else { baseClass = theClass; }

    // get the base name of the type
    typeName = baseClass.getName();

    // if it was an array add # of dimensions
    if (arrayDims != 0)
        while (arrayDims > 0) { typeName += "[" ; }
    return typeName;
}
```



Further study

Well that does it for this month but just to keep you honest I want to challenge you to extend the `ClassDump` example in a way that you feel is useful. For example you could add the ability to display members based on their attributes, or 'highlight' over-ridden methods of super classes. Send me your best extensions via email and based on form and function I will select the best of the best. The winner will receive a copy of *The Java Programming Language*, signed by the author and Java's creator - James Gosling.

About the ClassDump source code

The code for this article can be found on EXE OnLine (www.exe.co.uk) or directly by ftp (ftp.exe.co.uk/pub/exestuff/9707_Java). It was developed and tested using Microsoft Visual J++ version 1.1 and a preliminary release of Microsoft's 2.0 Java SDK which includes support for JDK 1.1. Under normal circumstances I would insure that the code works correctly under Symantec's Cafe Pro, and Borland's JBuilder. This month, due to technical difficulties and time limitations, I was not able to verify that the code works correctly under these environments.

Run the `ClassDump` application using your favourite virtual machine, passing in the name of the class that you want to see the type-definition for. If the requested class is not loaded the virtual machine will load it for you. If you receive a message indicating that the class can not be found, make sure that the location of the class is indicated in the `CLASSPATH` environment variable.

Tom Guinther is a Software Architect for NuMega Technologies in Nashua NH, USA. He can be reached via e-mail at tomg@numega.com.

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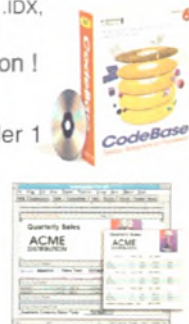
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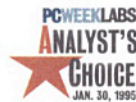
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CIRCLE NO. 370

Can NT pass as Posix?

Windows NT is masquerading as Posix compatible. The US Department of Defence may buy into it, but will the developers?

Peter Collinson unmaskes the truth.

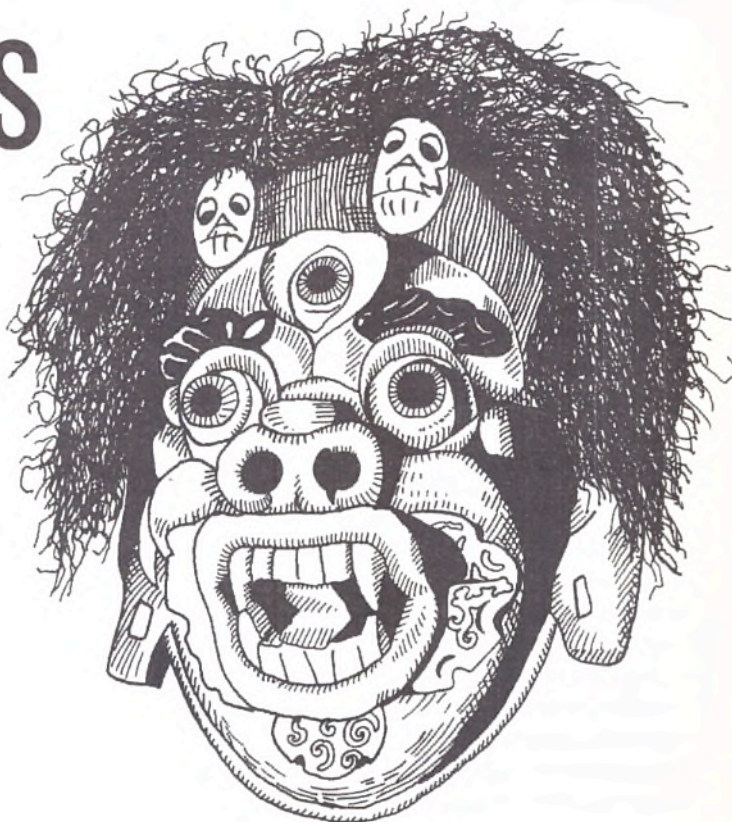
If you've seen the advertising, then you know that Windows NT is Posix compatible. Mr. Gates' organisation needs to sell into the vast market that is the US Department of Defense and the DoD insists that all operating systems it purchases are tagged with the Posix label. Well, that's my interpretation of the events. I don't know if Microsoft admits that this is why the Posix label was important to it. The advertising undoubtedly confused poor unsuspecting software houses that wondered about moving their software from a Posix base onto NT. I'm sure that they had a rude shock when they booted NT and found nothing that was remotely usable. There are some Posix shell tools, but they are part of the resource kit that you need to load after you have installed the system.

Posix compatibility is not really about a set of user tools, but is aimed at providing a standard development platform. You should be able to take a compatible program, compile it and run it with the minimum of fuss, minimum alteration and very few `#ifdef` statements. The Posix standards define a system API and also a set of tools that can be run on the machine. Well, that's the theory, of course. The actual practice in the real Unix world is somewhat different, take a look at a GNU `configure` script to get a flavour of the problems.

Nevertheless, one of the original aims for Windows NT was that it should be Posix compatible. At the time the Microsoft team started, that only meant 'compatibility at the system API level' meaning the Posix.1 standard which became ISO-IEC 9945-1.

The Windows NT operating system has a microkernel which provides a standard interface between subsystems (or processes in Unix terms) and the hardware that talks to the outside world. Many of the features of a traditional operating system kernel are supplied by subsystems running on top of the microkernel. To get things done, user application processes talk to these subsystems with messages. However, the subsystems call routines in the microkernel in the traditional way, essentially using a routine call and a context switch. I discussed the internal design of Windows NT in some detail last year (*Getting to grips with NT*, EXE, August 1996).

Helen Custer, in her book *Inside Windows NT*, goes into some detail about why Windows NT ended up with this structure. One of the main reasons was to try to provide the ability for the operating system to run clients that expect to be running in different environments.



Microsoft wanted to ensure backwards compatibility for its own products, the new system needed to run what we have come to call 'the 16-bit applications'; but also, NT was to run programs that are Posix and OS/2 applications.

A message passing microkernel operating system was seen as the way to provide a clean solution for these aims. The user application is written for a particular system API, calls for that API are translated into messages and passed through the subsystems to the kernel. If the system API demands some particular service, then that service can also be implemented as a subsystem.

The key part of Windows NT is the Win32 subsystem. It sits on top of the NT microkernel and performs system tasks for Windows applications. API calls from these applications send messages to the Win32 subsystem, which in turn calls the kernel directly. Actually, it turns out for efficiency reasons that some of the library DLLs that support the applications bypass the Win32 subsystem and make direct kernel calls.

Theoretically, the Posix and OS/2 subsystems should be placed in the system in a similar way as the Win32 subsystem. A Posix application talks to the Posix subsystem, which in turn talks to the kernel. However, something needs to manage the screen, providing a terminal window for Posix application, and Win32 has to do this. Also, something needs to be able to launch the applications, and in the absence of a Posix shell, Win32 has to do this too. So, in reality, the Posix and OS/2 subsystems talk to the Win32 subsystem.

OpenNT

The Posix subsystem distributed with Windows NT is more of a demonstration that it's possible to have such an object, than something which is actually usable. Posix utilities only have access to a small part of the operating system services, that part required to implement the Posix.1 API. A friend of mine (and I must declare an interest) Stephen Walli, who had worked on the Posix committees, saw



this as an opportunity. He had the mad idea of re-implementing the Posix subsystem and the applications that use it. The product that is emerging from this process is called OpenNT and is distributed by Softway Systems. They are just about to produce the second full release, and I have a Beta version. In fact, as I write this, the Beta will time out tomorrow, so the full version should be available to you now.

When you install OpenNT, the extant `POSIX.EXE` file is replaced with a new version and a bunch of commands are installed. Many of the commands are derived from the Berkeley 4.4BSD Lite release, and so are perhaps a little BSD-ish for some. You have the choice of shells that will start in a command window: `tcsh` and `ksh`. Many shell scripts expect to find `csh` and `sh`, these shells are present as copies of the `tcsh` and `ksh` commands.

The basic command set that is supplied with OpenNT allows you to sit and type nearly all the commands that you expect to find on a Unix system, including `ps` and `tty`. Of course, many programs need to interact with the terminal, so there's `stty` and `tset` to set it up. There's no `who` command, but you can live without that. The filesystem supports hard links to files and this is mirrored in the `ln` command, but symbolic links are harder (they are not in the Posix.1 standard). Windows shortcuts are not symbolic links but a feature of the Windows shell program, not of the underlying operating system.

Some of the commands are just so basic that you heave a great sigh of relief when you have them. Top of my list of 'programs I miss on Windows' is the `grep` command, followed by `find` and then `diff`. For the uninitiated (or seriously deprived, depending on your point of view): `grep` searches a set of files for a string; `find` allows you to search the filesystem tree looking for files and directories that fit in with some match criteria; and `diff` compares two text files. Also, I can now type shell loops which is a feature lacking in the default `COMMAND.COM` interpreter.

OpenNT comes with a couple of visual editors. Only `elvis`, a publically available `vi` look-alike, was supplied on the original release. I am told that `elvis` is not a terribly good clone of the `vi` editor. The second release contains the new `vi`, `nvi`, written and made public by one of the original Berkeley Unix team, Keith Bostic.

My old friend `ed`, the original Unix editor and progenitor of `EDLIN`, and its slightly strange offspring `sed`, the stream editor, are included. The presence of `sed` and `awk` means that you can create and use fully featured shell scripts. The Softway Web site has a binary of the latest release of `Perl` (5.003), if you are so inclined.

OpenNT is a program development environment too, there's a `cc` command. Posix wants to call this `c89`, for some reason known only to the Posix committee that decided to insist on the name change. So the `cc` command calls the `c89` command to follow the letter of the law. Softway has plans to port the GNU C compiler, but currently the `cc` command points at a copy of Visual C++ that is hopefully installed on your machine. This works fine with Version 4 of C++ but less fine with the newer Version 5. One problem is that Version 4 installs by default into `C:\MSDEV` and version 5.0 installs into the dreaded 'file name with a space' `Program Files`. File names with embedded spaces are a problem for Posix shells, actually they are a problem for `COMMAND.COM` too, if the truth be told. In an attempt to circumvent these problems, I installed my Version 5 compiler in `C:\MSDEV`, and found it doesn't place its include files in `C:\MSDEV\INCLUDE` but hides them away in a sub-directory. I copied the include files and am compiling again.

OpenNT comes with the standard set of development tools, there's `make`, `lex`, `yacc`, `ar`. A makefile taken from a standard distribution is

likely to work. I took a calculator program that I wrote in 1980 for an exercise in learning both `yacc` and `lex`, typed `make` and had a running program; no source changes, it just compiled and ran. The real problem with porting public code is trying to work out what settings you need in the `\Makefiles` so that the code compiles appropriately. Much code depends on the definition of the name of a machine type or operating system release rather than a specific feature that is used in the system.

I've tried to port a couple of bits of public code. The first, the `jove` editor, is already highly portable and there's an Win32 version that I run on my Windows systems. I decided to tell Jove that I was compiling for a `BSDPOSIX` system. The first stumbling block was to remove the definitions that assumed that `if_MSC_VER` was defined, then I was compiling for Win32. I then had to remove some include files that were unneeded. The program compiled, but wouldn't link without some further work. However, I felt fairly happy that I could port it given a little extra time.

Encouraged by this success, albeit a theoretical one, I wondered about something very large like the `emacs` editor. This is set up by a configuration script. When I ran the script, it became very confused by OpenNT. The standard `configure` mechanism poked hopefully around the filesystem and failed to find many of the libraries that are actually available. I gave up on this one.

I think that the development environment is a sound one, it's usable, and undoubtedly can be used to port programs. What's lacking is any debugging, they need to port something like `gdb` or preferably Mark Russell's `ups`.

X

OpenNT now includes Berkeley socket support, something that was missing from the original Posix subsystem. Once you have sockets, you can create services, and there's a program that can be used to install Posix programs so that they offer some service on the net. There's a version of `cron` too, so you can clean up log files and the like.

Sockets also mean that you can implement the X Window system, and Release 2 contains standard X clients running native on your NT system. You need to start the X server, and you can use various local X clients or perhaps more interestingly access a remote machine. A notable omission in the Beta is the `xterm` program and I am assured that it will be present in the final release.

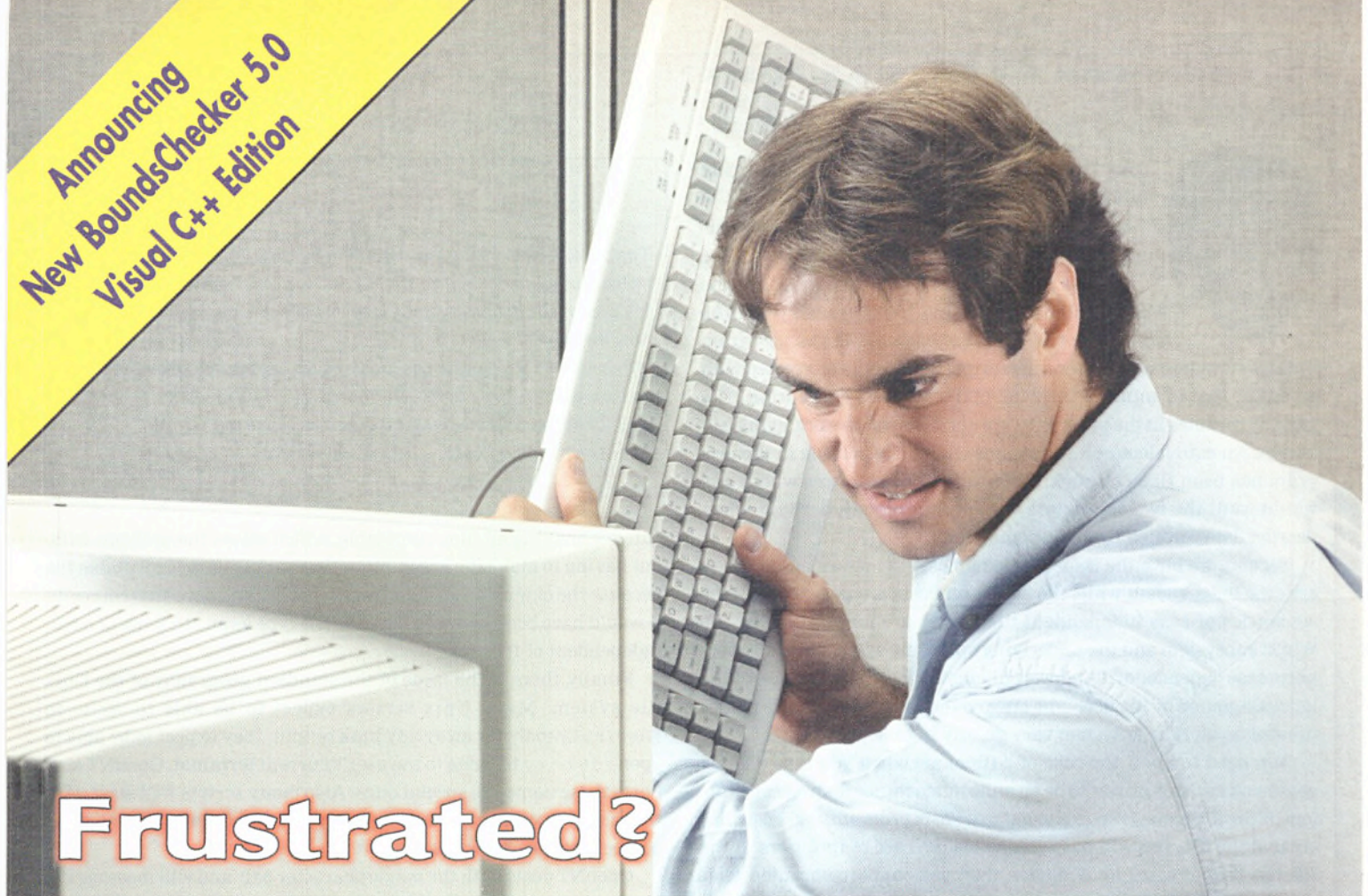
The X server runs on both Windows NT and also Windows 95, so I am guessing that it's a standard Winsock based product. Actually, the server is not bundled with OpenNT, you have to buy it separately. X can grab the whole screen or run in 'multiple window mode' giving you a mix of Windows and X applications on the same screen. I think that this feature makes OpenNT an interesting proposition if you are working in a mixed NT/Unix environment and only want one machine on your desktop.

The X development environment comes with the standard tools for compiling X programs aimed at both the default Athena widget set and the Motif widgets. I've had no time to play with these.

Compatibility

A large issue when taking Posix based programs and running them on NT is the basic compatibility or incompatibility between the Posix and NT. First, we have the issue of the character sequence used to mean 'end-of-line' in files. As you undoubtedly know, MS-DOS and Windows terminate lines in files with a carriage return, line feed pair; while Posix follows the Unix tradition of using a single end-of-line character, line feed. It turns out that the Microsoft compiler isn't too fussy about dealing with files that terminate lines with a single line

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EXE0797

CIRCLE NO. 371



feed, I've copied files from my Unix system and they compile with no problem.

However, the presence of the additional character can cause problems with Posix programs. I believe that it's a hard problem to solve. In some circumstances, you'd like the character pair to be treated as a singleton. For example, the `ksh` program is deeply unhappy about executing scripts that have been created with an editor that terminates lines using the MS-DOS convention. The parsing routines in the program were not designed to work in this situation. An equivalent `csh` script runs OK, so the parsing in the program has been fixed to work. There are circumstances where you would want the two characters to appear correctly, perhaps when passing data through the `grep` command.

Second, we have the issue of file names. File names on Windows are case independent while file names on Posix are not. Actually, the semantics of case independent file names are maintained by the Win32 subsystem and the underlying operating system actually supports case dependency. Windows will name files using the case of the letters supplied by the user who created the file, and so the file names present on an NT file system vary greatly in case.

You need to know the case of a filename when you type a Posix command and this proves to be an annoyance rather than a deep problem. If the file name is an argument to a Posix program, and Posix has created the file, you will have controlled the case of its letters. If the file has been created by Windows, then you cannot guarantee what the case of the file will be.

You can execute MS-DOS commands from the OpenNT shell (a feature of the second release) and, of course, commands are file names. You often have to guess whether the NT system has installed say its own `ping` command, `ping.exe`, with a lower or upper case name. All these commands are lower case on my system. You do have to type the full name of the command, including the extension. The trick is to alias MS-DOS commands in the shell, allowing you to type `ping` rather than `ping.exe`.

Of course, there is also the issue of the character used to separate elements in a file path name. OpenNT uses the Posix standard 'slash' character while NT uses the 'backslash' character. I guess you can tell people's computing heritage by asking them what they call the / character. If they say 'forward slash', then they are an MS-DOS and Windows user. MS-DOS has traditionally supported both forms, at one time you could force the system to change its file name separator. Several MS-DOS applications object to the use of slash in file names now.

OpenNT gets around the problem of drive names and the colons that follow them in MS-DOS by mapping them into a file address that looks like a machine path name: so `C:\users\pc\temp` on Windows becomes `//C/users/pc/temp` on OpenNT. This works OK for OpenNT applications but can confuse MS-DOS or Windows applications where the // is followed by a machine name. Actually, at the moment, OpenNT cannot deal with remote NetBIOS shares unless the remote share is mapped to a local drive name. Incidentally, there are a couple of programs that can be used to change from one filename format to another and these can help to interface OpenNT and Win32 commands.

More subtle is the effect of file permissions. Windows NT supports the MS-DOS file attributes but also uses access control lists to supply the 'real' permission on files. OpenNT pulls across the MS-DOS attributes, so its `ls` command looks right. However, the system suffers from the lack of the execute bit. MS-DOS and NT use the file extension to indicate the type of the file, whereas Unix and Posix use a bit in the file mode to indicate that a file can be executed. OpenNT fakes the exe-

Further reading

The book I mentioned at the top of the article is *Inside Windows NT* by Helen Custer published by the Microsoft Press, ISBN 1-55615-481-X. It's pretty much the only book that I have come across that tells you how the system works. Don't be fooled by the similarly named *Inside Windows NT server* and *Inside Windows NT workstation* both published by New Riders, these books tell you how to work the GUIs. You'll find the Softway Web page at where else but <http://www.softway.com>.

cute bit, making all files executable, which solves the problem without having to make the assumption that `ls.exe` is an executable file because the extension is `.exe`. I wish that NT had done this correctly, it would have been better to have the file type as an attribute of a file, independent of its name.

Finally, there is the issue of the standard geography of the Unix file system. Many Unix scripts expect to be able to write to `/dev/null` to throw away any junk output; they expect to be able to open `/dev/tty` to write to the user's current terminal. OpenNT supports these names as special ones. Also many scripts will start with the magic character sequence `#!`, expecting the system to start the correct interpreter, for example `#!/bin/sh`.

OpenNT deals with the magic character pair and will massage the interpreter string so that it starts automatically with the necessary prefix to select the correct interpreter relative to the start of the storage area for OpenNT (usually `C:\OpenNt`). This means that you can easily execute script files that start with an embedded interpreter.

An assessment

Most of the code is well tried and tested because it is derived from the BSD 4.4 Lite release. The code that OpenNT started from has been used for some considerable time and is stable. Some of the more complex Posix programs may not work in the way that you expect them to. I've found that it is easy to allow carriage returns to slip into files and this can break things. If in doubt, filter the data through the `tr` program: `tr -d '\015'` will delete the unwanted newline character.

The Bourne and Korn shells are a problem for most of the systems using Unix source that did not derive from AT&T. The freely available implementations of the shells are OK but not brilliant. They tend to have problems with some of the odd implementation details of the original Bourne shell. For example, they implement some of the strange side-effects of shell quote characters differently. The version of `ksh` that is used on OpenNT is not perfect, but it's adequate. Again, I must declare an interest, I hacked on this code quite a bit back in 1992. I now use GNU's `bash`.

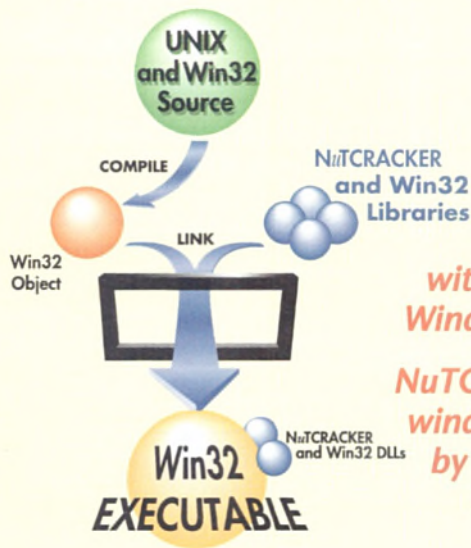
I think that OpenNT is actually a good product, and it will undoubtedly get better. In the last year, there's been a huge jump in the functionality that it offers. OpenNT provides a real development environment allowing you to port programs from Unix to NT relatively painlessly. Finally, the X environment makes it a very interesting alternative for people who are living in a mixed NT and Unix environment. ■

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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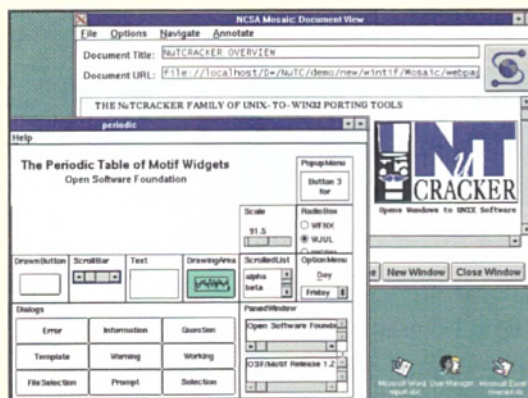
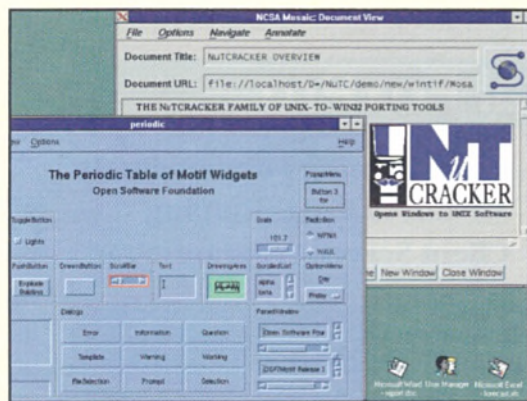
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Visual basic comes of age (or at least, reaches puberty)

Visual Basic, Version 5.0 graduates to the big leagues with its own version of callback. Dave Jewell looks at the `AddressOf` function.

One of the most interesting, and judging from what I've seen so far, most overlooked features in Visual Basic 5.0 is the new `AddressOf` function. Using this call, it's possible to pass the address of a Visual Basic procedure or function to a Windows API routine which can then 'callback' into the application code. As any seasoned Windows programmer will tell you, this sort of scenario is very common in API-level programming. For example, if you want to enumerate all the fonts available on a given device, you typically call the `EnumFonts` routine. This expects to be passed the address of a callback routine which can be called once for each encountered font, thus enabling you to (for example) progressively fill a list-box with font names during the course of the enumeration.

Other routines such as `EnumChildWindows`, `EnumCalendarInfo`, and so on, all expect to be presented with a callback procedure address. As a rule, if an API routine name begins with 'Enum', chances are that you'll need to provide an enumeration callback routine. Prior to Visual Basic 5.0, this was a major problem; traditional programming languages such as C/C++ and Borland Pascal require you to use a special keyword when declaring an exported routine. This causes the compiler to generate special prologue/epilogue code around the body of the function which allows it to be safely called from Windows itself. Unfortunately, Visual Basic has no such facility.

How then, can the `AddressOf` function be made to work? When you call `AddressOf`, you pass the name of a Visual Basic procedure or function, and you get back a 32-bit long integer rather than a callback address. Of course, those of us 'in the know' understand that this long integer value *really is* a procedure address, but it can't be treated as such within Visual Basic because the concept of pointers and addresses is quite foreign to the Visual Basic 'mindset'.

It should go without saying that the address returned by `AddressOf` is *not* the same as the callback procedure's address in memory. Instead, Visual Basic creates a machine code 'thunk' (always an imprecise term - we may as well 'overload' it within the context of this article, and give it yet another meaning!) and it's the address of this thunk which is returned by the `AddressOf` function. Within the thunk, the run-time environment of Visual Basic is established and a call is made to the routine whose address was originally passed as the argument to `AddressOf`. Establishing the run-time environment will often include switching to the p-code interpreter if native code generation isn't being used.

Although I haven't confirmed this myself, I suspect that a separate thunk is used for each different procedure address passed to `AddressOf`. This is necessary because if a single, generic thunk were used as a common callback point, there would be insufficient information for the Visual Basic run-time to establish a context each time it was called from Windows itself.



Patricia Deardorf

Getting classy

In addition to the 'Enum' family of functions mentioned above, there are many other reasons for creating callback routines. When a new window class is registered at the API level, you pass the address of the class's window procedure to the API as one of the fields of the associated data structure. In other words, you can't create custom window types directly inside Visual Basic without callback routines. Similarly, you also need callback routines to subclass existing windows using `GetWindowLong` and `SetWindowLong`.

Finally, subclassing the main form of your application enables your program to respond to more Windows messages than the predefined event types that are built into Visual Basic. For example, if you use the `Shell_NotifyIcon` routine to place a custom icon onto the 'tray' part of the Windows 95 Taskbar, you'll need some way of receiving notification messages sent from the taskbar. By subclassing your main form, you can intercept and respond to any arbitrary message number.

Strictly speaking, it's not necessary to resort to window subclassing in this particular instance. I've seen sample code which uses a windowed Visual Basic control to act as a 'proxy'. By passing the window handle of the proxy control in the initialisation call to `Shell_NotifyIcon`, any subsequent shell notification messages are passed directly to the proxy. By using standard messages such as `WM_LBUTTONDOWN`, you can then set up a standard `MouseDown` handler which will 'catch' tray notifications. This isn't a generally applicable technique since it can't be applied to arbitrary message numbers.

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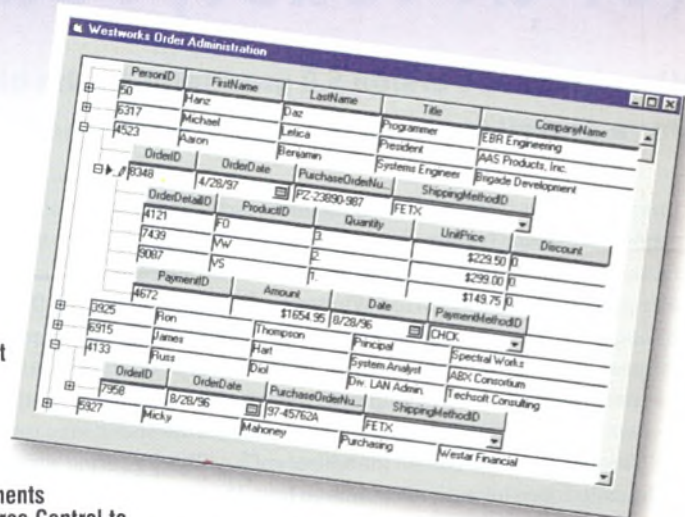
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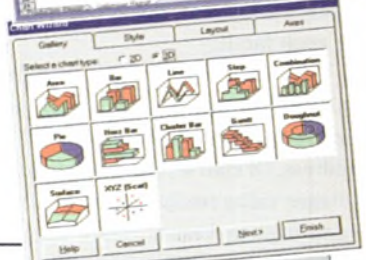
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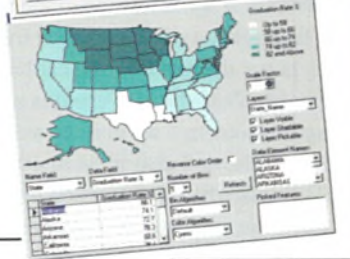
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By now, you should be getting the idea that `AddressOf` can make far more of the raw Windows API available to the Visual Basic programmer and – in so doing – it enables you to write more sophisticated applications. But there is a downside to all this, and it's as well to be aware of it before looking at some practical examples of `AddressOf` usage.

Caveat subclasser!

Visual Basic was designed to make Windows programming as easy as possible. Despite the undoubted sophistication of the Visual Basic 5.0 IDE, the high-level goodies available to VB programmers, and the continuing development of the language itself, the fact remains that BASIC still stands for *Beginner's* All-purpose Symbolic Instruction Code, with the emphasis on beginner! The Visual Basic development system goes to great lengths to insulate the programmer from the relatively hostile world of the Windows API. When you create a window (form) in Visual Basic, the Visual Basic run-time creates the form on behalf of your pro-

gram. Whenever extra memory is required by your program, it's silently created by the run-time code. System resources such as bitmaps, drawing tools, and so forth are likewise managed in the same way.



What has all this got to do with the `AddressOf` routine? The problem is that as soon as you hit the `Break` or `End` button on the Visual Basic toolbar, your application will stop dead. Because the development system has assumed responsibility for creating a program's windows, memory and other resources, the development system is responsible for destroying those resources when a program terminates. You can verify this for yourself by creating a new, do-nothing project and adding the following two event handlers to the project code.

```
Private Sub Form_Terminate()
    Beep
End Sub
Private Sub Form_Unload(Cancel As Integer)
    Beep
End Sub
```

If you close down the running program by clicking the form's Close box or selecting Close from the system menu, you'll hear two beeps (they really sound more like clicks on today's fast hardware) but if you stop the application by hitting the Break or End buttons, you won't hear a thing. A Visual Basic program never gets a chance to tidy up after itself, if it's halted while running under the IDE. Obviously, this doesn't apply to an application that's been compiled into an EXE file and is running stand-alone.

Now let's think about the situation for an application that's subclassed its form window. Via the thinking mechanism described above, such a program will have replaced the form's original window procedure with code that 'points' to a new, replacement window procedure buried inside the p-code program. Do you see the problem here? The IDE can only deallocate those system resources which it has itself allocated on behalf of the application. It doesn't know that the program has subclassed a window and it therefore stops the program stone dead as soon as the End button is clicked. It then tries to destroy the window which it created on behalf of the application, and this is where the fun starts. As soon as it sends a `WM_CLOSE` or `WM_DESTROY` message (or any message, actually!) to the form window, the IDE ends up trying to

```
-----MODULE CODE-----
Option Explicit

' Project-specific API messages
Public Const WM_NCHITTEST = &H84

' Constants for WM_NCHITTEST message
Public Const HTCLIENT = 1
Public Const HTCAPTION = 2

' Index constants for Get/SetWindowLong
Public Const GWL_WNDPROC = -4

' Original window procedure
Public OldWndProc As Long

Declare Function GetWindowLong Lib "user32" Alias "GetWindowLongA" _
    (ByVal hWnd As Long, ByVal nIndex As Long) As Long

Declare Function SetWindowLong Lib "user32" Alias "SetWindowLongA" _
    (ByVal hWnd As Long, ByVal nIndex As Long, _
    ByVal dwNewLong As Long) As Long

Declare Function CallWindowProc Lib "user32" Alias "CallWindowProcA" _
    (ByVal lpPrevWndFunc As Long, ByVal hWnd As Long, _
    ByVal Msg As Long, ByVal wParam As Long, ByVal lParam As Long) _
    As Long

Public Function FormWindowProc(ByVal hWnd As Long, _
    ByVal Message As Long, ByVal wParam As Long, _
    ByVal lParam As Long) As Long
    Dim hitCode As Integer

    If Message = WM_NCHITTEST Then
        hitCode = CallWindowProc(OldWndProc, hWnd, Message, _
            wParam, lParam)

        If hitCode = HTCLIENT Then hitCode = HTCAPTION
        FormWindowProc = hitCode
    Else
        FormWindowProc = CallWindowProc(OldWndProc, hWnd, _
            Message, wParam, lParam)
    End If
End Function

-----FORM CODE-----
Option Explicit

Private Sub Command1_Click()
    Unload Form1
End Sub

Private Sub Form_Load()
    ' Subclass the form so that we receive WM_NCHITTEST notifications
    OldWndProc = GetWindowLong(hWnd, GWL_WNDPROC)
    SetWindowLong hWnd, GWL_WNDPROC, AddressOf FormWindowProc
End Sub

Private Sub Form_Unload(Cancel As Integer)
    ' Unhook the subclassing mechanism from this form
    SetWindowLong hWnd, GWL_WNDPROC, OldWndProc
End Sub
```

Listing 1 – How to get in on the act as far as the WM_NCHITTEST Windows message is concerned.

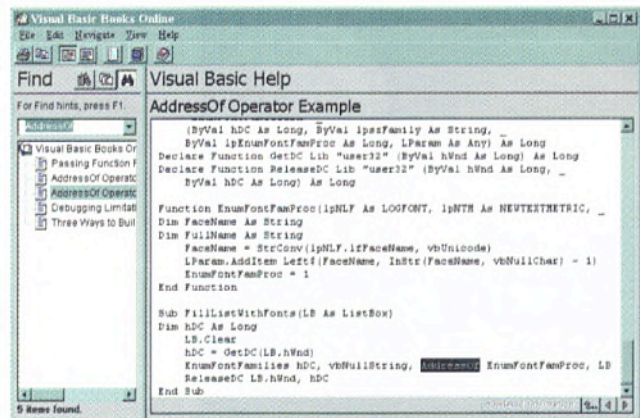


Figure 1 – Visual Basic Books Online contains one or two examples of how to use `AddressOf`, but it has very little to say about the debugging limitations discussed here.

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execute a chunk of p-code in the context of a non-running application, and ends up disappearing up it's own backside... A GPF is the inevitable – and rapid – conclusion to this scenario.

The upshot is that you can't debug a subclassing application from inside the IDE. And when you shut down such a program, take care to do it *from the application* rather than from the IDE. I imagine that it would be possible to perform debugging by building an EXE version of the program with symbolic debug information, and then debugging this from inside the new Visual C++ 5.0 debugger. However, I haven't investigated this particular avenue.

Could Microsoft have avoided this particular pitfall? Well, possibly, but not without some difficulty. When the `AddressOf` routine is called to get the address of a callback thunk, the system obviously doesn't know in advance what window is going to be subclassed. It might be possible for Microsoft to internally trap calls to the `SetWindowLong` API routine, check to see if a window is being subclassed using the address of a callback thunk and – if so – stash the old window procedure address in an internal list. The original window procedure could then be transparently restored whenever the program was halted for debugging purposes. Oh well, perhaps in Visual Basic 6.0...



Captionless drags

The first example illustrates how to *get in on the act* as far as the `WM_NCHITTEST` Windows message is concerned. This message, as you may be aware, is sent to a window as the mouse moves across it. Although most windows have a caption bar area at the top of the window, resizable borders along each side, and so forth, there's nothing to prevent you from creating a custom window which breaks all these conventions. With some cunning use of the `WM_NCHITTEST` message, it would even be possible to create windows which give the illusion of being non-rectangular, even though they actually do correspond to rectangular regions at the nuts and bolts level.

Because Windows doesn't know how a particular window is organised, it has to send the `WM_NCHITTEST` message to 'discover' how different parts of the window should be treated. For instance, as you move the mouse over the upper left corner of a window, `WM_NCHITTEST` is sent to the window. Most window procedure ignore this message which means that `DefWindowProc` gets called to process the message. Inside `DefWindowProc`, the mouse position is examined in conjunction with the window style bits and the code determines that it's appropriate to return a 'hit code' of `HTTopleft`. This is returned to the original routine which issued the `WM_NCHITTEST` code which then

```

-----MODULE CODE-----
Option Explicit

' Mouse-related API messages
Public Const wm_MouseMove = &H200
Public Const wm_LButtonDown = &H201
Public Const wm_LButtonUp = &H202
Public Const wm_LButtonDblClk = &H203
Public Const wm_RButtonDown = &H204
Public Const wm_RButtonUp = &H205
Public Const wm_RButtonDblClk = &H206
Public Const wm_MButtonDown = &H207
Public Const wm_MButtonUp = &H208
Public Const wm_MButtonDblClk = &H209

' Message constants for call to Shell_NotifyIcon
Public Const Nim_Add = &H0
Public Const Nim_Modify = &H1
Public Const Nim_Delete = &H2

' Flag constants for uFlags field of NotifyIconData
Public Const Nif_Message = &H1
Public Const Nif_Icon = &H2
Public Const Nif_Tip = &H4

' Index constants for Get/SetWindowLong
Public Const Gwl_WndProc = -4
Public Const Gwl_HInstance = -6
Public Const Gwl_HwndParent = -8
Public Const Gwl_Id = -12
Public Const Gwl_Style = -16
Public Const Gwl_ExStyle = -20
Public Const Gwl_UserData = -21

Public Const TrayCallback = 32768 ' ID for our callback message

Type NotifyIconData
    cbSize As Long
    hwnd As Long
    uid As Long
    uFlags As Long
    uCallbackMessage As Long
    hicon As Long
    szTip As String * 64
End Type

Public OldWndProc As Long ' Original window procedure

Declare Function Shell_NotifyIcon Lib "shell32.dll" _
    Alias "Shell_NotifyIconA" (ByVal dwMessage As Long, _
    lpData As NotifyIconData) As Long

Declare Function GetWindowLong Lib "user32" Alias "GetWindowLongA" _
    (ByVal hwnd As Long, ByVal nIndex As Long) As Long

Declare Function SetWindowLong Lib "user32" Alias "SetWindowLongA" _
    (ByVal hwnd As Long, ByVal nIndex As Long, _
    ByVal dwNewLong As Long) As Long

Declare Function CallWindowProc Lib "user32" Alias "CallWindowProcA" _
    (ByVal lpPrevWndFunc As Long, ByVal hwnd As Long, _
    ByVal Msg As Long, ByVal wParam As Long, _
    ByVal lParam As Long) As Long

Public Function FormWindowProc(ByVal hwnd As Long, _
    ByVal Message As Long, ByVal wParam As Long, _
    ByVal lParam As Long) As Long

    Static TrayLock As Boolean ' Exclusion lock

    If (Message = TrayCallback) And (TrayLock = False) Then
        TrayLock = True
        If lParam = wm_LButtonDown Then
            MsgBox "You clicked the left mouse button on the Tray icon!"
        End If
        TrayLock = False
    End If
    FormWindowProc = CallWindowProc(OldWndProc, hwnd, Message, _
        wParam, lParam)

End Function

-----FORM CODE-----
Option Explicit

Const TrayIconID = 9999 ' ID of our Tray Icon

' Proc to initialize common fields of the NotifyIconData structure
Private Sub InitNID(nid As NotifyIconData, ByVal TipString As String)
    nid.cbSize = Len(nid)
    nid.hwnd = Form1.hwnd
    nid.uid = TrayIconID
    nid.uFlags = Nif_Message + Nif_Icon + Nif_Tip
    nid.uCallbackMessage = TrayCallback
    nid.hIcon = Form1.Icon.Handle
    nid.szTip = TipString + Chr(0)
End Sub

Private Sub Form_Load()
    Dim nid As NotifyIconData

    InitNID nid, "My First Tray Icon" ' Initialize the nid
    Shell_NotifyIcon Nim_Add, nid ' Add icon to the Tray

    ' Now subclass the form so that we receive Tray notifications
    OldWndProc = GetWindowLong(hwnd, Gwl_WndProc)
    SetWindowLong hwnd, Gwl_WndProc, AddressOf FormWindowProc
End Sub

Private Sub Form_Unload(Cancel As Integer)
    Dim nid As NotifyIconData

    InitNID nid, "" ' Initialize the nid
    Shell_NotifyIcon Nim_Delete, nid ' Remove icon from the Tray

    ' Unhook the subclassing mechanism from this form
    SetWindowLong hwnd, Gwl_WndProc, OldWndProc
End Sub

```

Listing 2 – Adding an icon to the tray area of the Windows taskbar.

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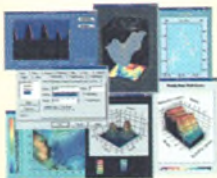
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TECHNIQUES VISUAL BASIC COMES OF AGE

displays a familiar 'north-west' sizing cursor. This might all sound a bit cumbersome but it's actually a very clever design – the important point being that the application's window procedure is free to change the default behaviour to create custom effects.

The same arguments apply to the caption bar. With the mouse over the caption bar, a hit code of `HTCAPTION` is normally returned from a call to `DefWindowProc`. Windows understands that if a click-drag action takes place while over a caption area, then it should respond by moving the window position. But it's a simple matter to get Windows to treat other parts of the window area as



if they were caption areas too. That's what the program in Listing 1 does. There are two parts to the code – a `.BAS` module, and the conventional form code. The form code subclasses the form window using the `AddressOf` function together with `GetWindowLong` and `SetWindowLong` to save the existing window procedure address and set up a new window procedure. Once this is done, all Windows messages get passed through the `FormWindowProc` code. Here, the routine checks for the `WM_NCHITTEST` message and then calls the *old* window procedure (which resolves into a call to `DefWindowProc`) to get the hit code. If the hit code is `HTCLIENT`, then it's changed to `HTCAPTION` before returning the code value to the caller.

It's important to call the old routine because we can't simply return `HTCAPTION` for every `WM_NCHITTEST` message that's received. Doing that would render the other parts of the window (such as close box, zoom box and resizable border) inaccessible.

The second example, (Listing 2) uses our old friend, the tray icon. As previously mentioned, it is possible to get the same effect by using a windowed control as a message-receiving proxy without the use of window subclassing, but it's the latter approach that I wanted to illustrate here. From the `Form_Load` routine, the `InitNID` routine is called to initialise the various fields of the `NotifyIconData` structure, and then the `Shell_NotifyIcon` routine is called to actually add the icon to the tray area of the Windows taskbar. Once this is done, the main form window is subclassed as before.

The `InitNID` routine specifies a value of 32768 for use as our tray callback notification message. This is the message number that we have to watch out for in our new custom window procedure. If this message number is detected, then the code looks to see if the left-

hand mouse button was pressed and – if so – it puts up a little message box to acknowledge that the mouse click got through. There are a couple of little wrinkles here. Firstly, you'll notice that the `WM_LBUTTONDOWN` message is 'piggy-backed' onto the tray notification message by using the `lParam` field. There are more details on this in the SDK documentation, but it should be obvious that since the message number corresponds to the application-defined notification message, the actual API-level message number 'as seen from the icon' has to go somewhere else. For similar reasons, there's no room in the notification message to store the mouse co-ordinates. This means that if you want to

respond to a right-hand mouse click by displaying a popup menu alongside your tray icon (a typical scenario) then you've got to look elsewhere to get the mouse co-ordinates. This can easily be done by making a call to `GetCursorPos` or `GetMessagePos`. The latter is preferable since, if the cursor is moving rapidly, `GetMessagePos` will still reflect the location of the mouse at the time the icon was clicked. (Even though not all messages include mouse position information, Windows always stores the mouse position internally at the time a message is posted, so that the mouse co-ordinates can always be retrieved through a call to `GetMessagePos`.)

It's also important to bear in mind that the Visual Basic application is completely asynchronous with respect to the Explorer code which is responsible for looking after tray icons, and posting messages to the appropriate application. Because messages are *posted* rather than *sent*, you can easily end up with a situation where the application window procedure is invoked to respond to a tray notification while an earlier notification message is still being processed. In the present case, this could result in multiple message boxes being displayed, but where you've got non re-entrant code in a real-world application, the consequences could be much more dire! That's what the static `TrayLock` variable is for: it ensures that only one message box at a time will be displayed. If a notification is received while a prior message box is being displayed, the later message will be politely ignored. ■

Dave Jewell is a freelance consultant, programmer and technical author specialising in low-level systems programming, development systems and compiler design. He is the author of 'Instant Delphi' published by Wrox Press. You can contact Dave as djewell@cix.co.uk.

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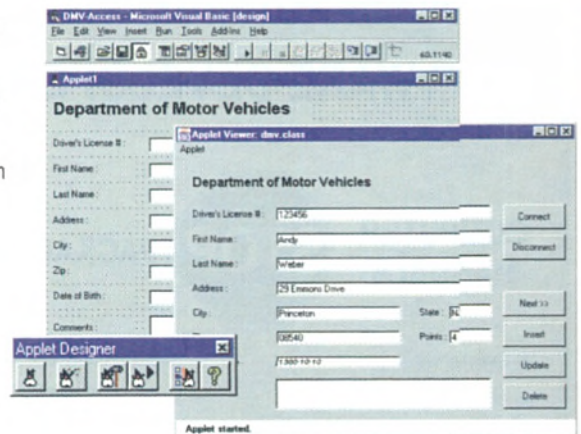
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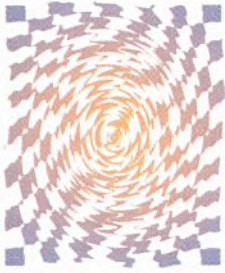
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Reference books

If a book is a dictionary you will need to browse it checking items that you already know about. If a definition does not agree with your understanding try to determine which is correct. If the book is intended as a more general reference make sure that it has an index. I am quite serious, several years ago I came across a pocket reference to C that did not have one. That made it close to useless. I think that checking reference books with reliable source is very important.

The cheapest way of getting your hands on the 1989 ISO C standard (careful because that was modified in 1994 by amendment 1) is by buying *The Annotated ANSI C Standard* (Herbert Schildt, 0-078-81952-0). You would be advised however, to ignore the right-hand pages (the annotations) as they are often wrong.

Where work is ongoing you need to check the publication date. Not only have there been many changes to C++ over the last seven years there have also been many new insights and idioms that modify the way that a competent C++ programmer works.

Reading books

The best reading books have long lifetimes. Books like Plauger's, *Programming with Purpose 1* (0-137-21374-3), *2* (0-133-28105-1) and *3* (0-133-28113-2), Bentley's *Programming Pearls* (0-201-10331-1) and *More Programming Pearls* (0-201-11889-0) etc, should be read by every serious programmer. Be careful to understand that books such as Steve Maguire's *Writing Solid Code* (1-556-15551-4) may improve your current understanding but they may also block further progress. Read reviews but be wary of the glowing ones.

Books that you buy just to read should be written in a comfortable style: Bjarne Stroustrup's *The Design and Evolution of C++* (0-201-54330-3), Andrew Koenig and Barbara Moo's, *Ruminations on C++* (0-201-42339-1) and Peter van der Linden's *Expert C Programming* (0-131-77429-8) are good examples. They are all excellent examples of technical books that are a joy to read. Do not be misled into believing that technical books need to be difficult to read and understand. If the authors know their subject the exact contrary should be the case.

Books for study

The hardest books to pick out are books for study. You need them if you are to develop your skill set and you need to trust your reading to learn something new. If you are already an expert you will often be able to recognise good books and be able to avoid damage done by technical errors in books. The novice has an almost impossible task. I get tired of the number of times I hear that novices (to learn C by reading) read Kernighan & Ritchie's *The C programming Language* (0-131-10370-9). It is a technically accurate book that makes so many assumptions about the nature of the reader that it is useless to the genuine novice. It is excellent for experienced Unix users who want to learn C – but that is all.

About the only guideline for novices is to be wary of books that claim to make it easy. Instant gratification is fine but programming takes a great deal of study coupled with lots of practice. For some reason, even competent authors become unhinged when they write books for novices. Conor Sexton has written a number of very good books but his recent *C Programming Made Simple* (0-750-63244-5) is seriously flawed. Statements that are simply untrue worry me. For example he states that too much input is truncated by `gets()`. In fact, as you know, too much input overwrites memory following the provided buffer. How does a novice realise how dangerous a book may be? The

Which book?

Last time Francis Glassborow tackled the problem of selecting potential book purchases from exterior evidence; this time he looks between the covers to help you decide which books to exchange your hard-earned cash for.

expert can already select books for quality and the novice stands no hope of doing so. That leaves the majority between these extremes.

The first thing I do when I pick up a new book on C, C++ or Java is to look at the code. I look at the comments. Are they useful? How much comment is there? Usually it's too much and irrelevant, getting between me and my understanding. I prefer to see a few succinct comments. For example I expect to see a comment in any class that lacks constructors, destructor and copy assignment, enough at least to assure me that they were not omitted by accident.

Next I look at the complexity of the code. If function definitions extend to more than a dozen lines I get curious. If the code is littered with nested structures such as loops, if-else etc, I worry. Good code minimises such things. I watch out for `break`, `continue` and `goto`. I look to see if the author declares `void main()`.

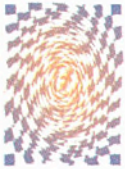
If the book claims to be using OO code I check if any data is `protected` (or even worse, `public`). If the author uses inheritance I check if there is an appropriate relationship between the derived class and its base or bases. I look to see how the author uses `friend`. If global operators are provided by using forwarding functions (wrappers) to class provided functionality, the author's credit increases.

Having looked at the code I then look at some of the text. The text and the code should be mutually supportive. Each should contribute something that the other cannot. The text should help me understand. I do not mind if I have to read the code and the text several times in order to understand it. That is what study is about. It does worry me though, when the text does not help me to understand why the code has been written that way.

To be worth the investment of time, a study book must include good, technically correct content. Any code should be of high quality. Just as good writing is based on simple sentences, good code is based on simple functions. The value of the time it takes to study a book such as Jiri Soukup's *Taming C++* (0-201-52826-6) or Jeff Alger's *Secrets of the C++ Masters* (0-12-049940-1 – much better in content than the title may suggest) far outweighs the cost of the book. A good study book is worth all you pay, a bad one has stolen your most precious resource – your time.

Choosing books

Actually choosing books for your shelves is a skill that can only be refined through practice and experience. Spend a bit of time trying to choose as well as you can. However skilled you are you will make mistakes. Do not waste time continuing to struggle with a bad book. If the book is factually wrong take it back and politely require the supplier to refund your purchase price. A technical book that contains sub-



stantial errors is unsuitable for the purpose for which you bought it. Only when readers become sophisticated enough to demand value for their investments of time and money will publishers deliver consistently high quality products.

Last month's problem

Look at the following class specification. What is wrong with it?

```
class my_string {
public:
    my_string() : len(0)
        {s= new char[1]; assert(s != 0); s[0] = 0; }
    my_string(const my_string & str);
    my_string(const char* p);
    ~my_string(){ delete [] s; }
    void assign(const my_string& str);
    void print() const {cout << s << endl; }
    void concat(const my_string& a,
                const my_string& b);
private:
    char* s;
    int len;
};
```

Let me start with the default constructor. Why use an extremely expensive allocation of dynamic memory? Even if the designer had elected to provide read access to a null terminated array of char this is still poor design. Consider:

```
my_string(): len(0), s(0) {}
```

And support it with a read access function:

```
const char * get_string {
    static char empty = '\0';
    return s ? s : &empty;
}
```

This version of the default constructor avoids unnecessary uses of `new` and so does not need to be concerned with its behaviour if the memory allocation fails. The `delete[]` in the destructor (and anywhere else it is used) will work correctly – C++ guarantees that an attempt to `delete` (or `delete[]`) the null pointer does nothing.

Much more seriously, the provided class interface does not include an operator = (const my_string &) copy assignment operator. As class instances contain a pointer to dynamic memory the accidental use of assignment will result in a serious run time failure. Good operating systems such as Windows NT and many flavours of Unix will throw the program out for such a memory violation. Poorer operating systems may allow our program to create havoc. I know that the author has provided an assign function but this is of little use because operator = () needs explicit declaration if the class designer is to overrule the compiler's (incorrectly) generated version.

Then there are a few lesser faults. Why has the `print` function been hard coded to use `cout` and to generate a new line after each output? This is very unlikely to be what the user wants.

The amazing thing is that this code is from the second edition of Ira Pohl's *Object-Oriented Programming Using C++* (0-805-35382-8). I will leave you with his and my implementations of `my_string::concat`. When you have finished laughing, ask yourself how such a reputable publisher can publish such a flawed work?

```
void my_string::concat(const my_string & a,
                      const my_string & b) {
    char temp[a.len + b.len + 1];
    len=a.len+b.len;
```

```
strcpy(temp, a.s);
strcat(temp, b.s);
delete[]s;
s = new char[len + 1];
assert(s != 0);
strcpy(s,temp);
```

```
}
```

Compared with:

```
void my_string::concat(const my_string & a,
                      const my_string & b) {
    len=a.len+b.len;
    try {
        char * temp = new char[len + 1];
        strcpy(temp, a.s);
        strcat(temp, b.s);
        delete[] s, s = temp;
    }
    catch (bad_alloc ba){
        cout << "out of memory in string::concat,
                no changes made"
            << endl;
        throw ba; // rethrow for user handler
    }
}
```

If you think I am being too harsh, you should know that the author is using the STL for the last part of his book so he should know that `new` now throws an exception if out of memory. Note also that the author's implementation places potentially large strings on the stack, much more likely to break the program.

This month's problem

What is wrong with this C code? How can C++ mitigate the problem?

```
#include <stdio.h>
int main() {
    char * strict = "OK?";
    char strange = 'ABC';
    int member = 0;
    for (member=0; strict[member]; member++){
        if (strict[member]== strange)
            strict[member]= 'Y';
        else strict[member] = 'n' ;
    }
    puts(strict);
}
```

Be careful. There are multiple layers of problem. Some are intended to be obvious, others are rather more subtle.

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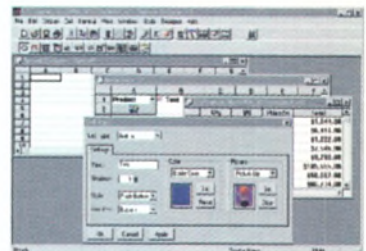


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Mastering Regular Expressions reviewed by Paul Dunne



My first thought on reading the title of this book was, why didn't I think of that? In retrospect, such a work has been needed for years though as far as I'm aware this is the first of its type.

A regular expression – or 'regex' – is a powerful, concise means of describing patterns in text. Regular expressions are a powerful tool, but writing them is something of an art. Anyone who hopes to master the art should read this book. Examples are the only way to see just how useful they can be. For instance, a regular expression which captures the header of a typical e-mail message on my system is: `/^From: .*/,/^S/`. This describes all the lines in the message from a line beginning with 'From:' to the first blank line. One of the main motifs in Friedl's book is that while the theory of regular expression engines divides them neatly into two classes ('Non-Deterministic Finite Automata' or NFAs and 'Deterministic Finite Automata' or DFAs), in practice every implementation

goes its own way, and syntax often varies, more or less. In our example, the `/.../`, `/.../` is peculiar to `sed` and friends, and would not work with, for instance, the `regex` engine in `awk`.

Friedl puts order in the confusion, explaining in great detail how the two types differ, giving the advantages and disadvantages of each. The book gives lots of practical information on the subtle differences between `regex` engines of either type. Surely we must all have spent five minutes, or ten minutes, or a quarter of an hour, struggling in vain to use a `regex` character in `sed` that was only valid in `egrep` or `awk`? I know I have! Friedl's book certainly throws light onto these niggling little differences.

The book would be worth buying for its extended treatment of Perl `regexps` alone. Over one hundred (non-padded) pages are devoted to the perl-specific chapter. Reading *Mastering Regular Expressions* has made me much more aware that one of the strengths of Perl is its comprehensive support for `regexps`, and added to my frustration with the 'all slightly different' `regex` flavours in `awk`, `sed`, `grep`, `egrep` etc.

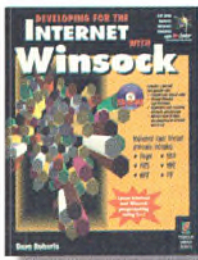
As a finale, the book presents a solution to expressing the RFC822 syntax for an email message: a problem that is tackled with increasing sophistication in several parts of the book.

So has this masterpiece any flaws at all? Well, the over-use of motor-car engine analogies quickly becomes irritating, and I found it an obstacle, not an aid, to following the argument. Other than that, well, to paraphrase the little girl in the story, I might say that this book told me more about regular expressions than I wanted to know! It's a good line, but in truth barely a line of the book is redundant; it might indeed have told me more than I *need* to know, but there is no harm in that.

✓ **Verdict:** *Recommended for almost everyone!*

Title:	<i>Mastering Regular Expressions</i>
Author:	Jeffrey E. F. Friedl
Publisher:	O'Reilly and Associates
ISBN:	1-56592-257-3
Price:	£21.95
Pages:	342

Developing for the Internet with Winsock reviewed by Philip Harris



Sometimes it seems that the world, the wife and the pet iguana are writing Windows' Internet applications. If you've got an idea for a real killer Internet application or need to interface with some legacy code, there's no escaping Winsock. The Winsock API is a collection of 44 functions which provide a consistent interface to TCP/IP protocols. Some of the functions are the equivalents to the functions of the Berkley sockets API. The rest are asynchronous versions which can be used to avoid re-entrancy problems specific to Windows.

After a brief overview of the development of the Internet and a light technical description of the TCP/IP protocol, Roberts starts on the interesting stuff: a collection of C++ classes which can be used to build Internet applications. Roberts begins by developing a set of classes which encapsulate a Windows' socket and the network address functions. The classes are specifically designed to make using

the asynchronous socket functions as easy as possible. The basic classes hide the tracking of socket identifiers (which can be tricky) from the main program using a callback system.

The basic classes are the only place any real Winsock programming takes place. The rest of the book is dedicated to the main Internet protocols, beginning with Finger but moving quickly on to more useful topics. The bulk of the book is devoted to creating a simple mail program capable of sending mail with SMTP and receiving it via POP3. Moving even further away from Winsock the book covers UU-encoding, MIME mail extensions, NNTP and FTP with the public domain `WS_FTP` source code rather than specific C++ classes). The accompanying CDROM includes all of the source from the book, most Internet RFC standards, a selection of HTML editors and other Internet tools.

Developing for the Internet is not the sort of book to buy if you're looking to learn all the intricacies of the Winsock API. Although all of the functions are covered, there is very little that isn't covered equally well by the Winsock documentation. The book does give you a good starting point for the main Inter-

net applications including a plain English description of the protocols involved. The HTTP protocol is conspicuous by its absence however, which is a real shame, as is the lack of a real FTP sample. The classes themselves are reasonably well written with the main applications based around a state machine. No doubt a C++ guru could develop an improved set of classes but the ones provided are an excellent starting point. They will save a lot of development time if you want to get an Internet application out quickly, though I would want to do some serious field testing before committing to using them in a commercial environment.

✓ **Verdict:** *Recommended if you're not interested in low-level details.*

Title:	<i>Developing for the Internet with Winsock</i>
Author:	Dave Roberts
Publisher:	Coriolis Group Books
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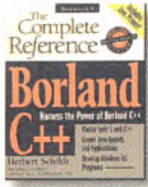
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Starting salary will be in the range £15.5k to £16.5k

Closing date for applications 31st July.

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The Company

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The Candidate

We are looking for a graduate with exceptional IT skills who enjoys the challenge of highly technical development work. As a key developer you will be involved with every aspect of software development so flexibility and an intuitive nature are essential qualities. A good knowledge of the Windows operating systems and development environments are essential along with a natural flair to discover and learn. The main development languages are C and Assembler.

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There are opportunities at all levels for ambitious technical staff to join a rapidly growing organisation bringing products to a global market.

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Software test/QA engineers c. £18-32K

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Ref: EP6/11

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Ref: EP6/13

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Ref: EP6/12

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Ref: EC6/7

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Oxford Up to £25,000 + Benefits
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Ref: EC6/8

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Ref: EC6/14

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REF SC/05/EXE

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£14-£35K + benefits

REF: SC/06/EXE

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REF: SC/07/EXE

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To £27K + benefits

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REF: SC/08/EXE

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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
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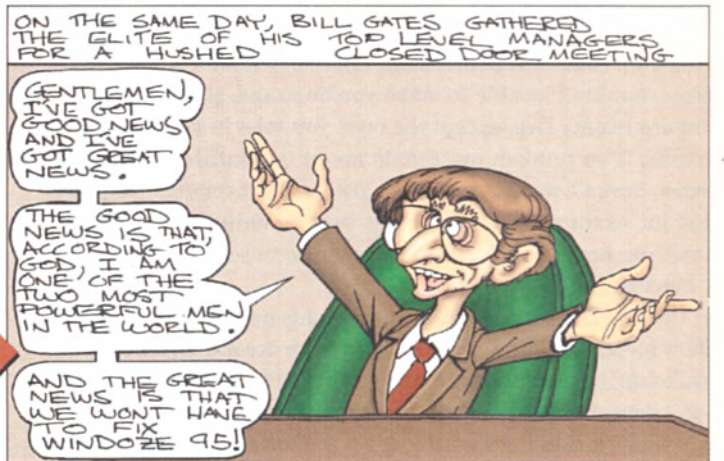
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THE FOLLOWING DAY BILL CLINTON REGAINED CONSCIOUSNESS AND WENT BEFORE A WORLD-WIDE AUDIENCE TO MAKE THE FOLLOWING ANNOUNCEMENT:



Internet meme

[To be sung *allegro*, with vigor]

Well, if you can't do it with <LINKTYPE ...>,
And features of SGML,
And if you can't hack it in HyTime,
No sweat! It's in DSSSL!

(chorus)

DSSSL!
DSSSL!
It's really cool!
A useful tool!
It's DSSSL!

'So tell me then, what does it look like?'
Afraid I can't - nobody knows!
I guarantee you're gonna love it,
Just wait and see, that's how it goes.

DSSSL!
DSSSL!
It's like a dream!
It's based on Scheme!
It's DSSSL!

The World-Wide-Web's gotta have stylesheets,
Or HTML's going to burst.
Will DSSSL come and save us
(Unless Netscape gets to it first)?

DSSSL!
DSSSL!
Never fear,
It's almost here!
It's DSSSL!

So - if - FOSI's are driving you batty,
And PDF isn't enough,
This standard will solve all your problems
(But it isn't finished yet. Tough.)

DSSSL!
DSSSL!
It's amazingly great
But you'll just have to wait
For Dee-ess-ess-ess-elllllllll!

(Note: The FOSI is an SGML tagged document. It stands for Formatting Output Specification Instance and is an instance of the DTD called the 'outspec' which appears in appendix B of MIL-STD-28001.)



You may start

Ms Stob has been imposed upon to acquire some Microsoft qualifications.

...the base qualification, the BSY ('Bill Says Yup'), may be obtained by taking and passing any single examination from the Learn Microsoft Good range of qualifications for IT professionals. However real developers, as opposed to low status tech supporters and those whose job mostly comprises installing things from floppy disk, will want to obtain the higher qualification, the BSYI ('Bill Says Yes Indeedy'). This requires that candidates attempt and pass TWO examinations from the operating system papers, ie *More Than You Ever Wanted To Know About Windows Part 1* and *More Than You Ever Wanted To Know About Windows Part 2*, plus TWO elective language papers, choose from: *Visual C++ - A Fine and Friendly Compiler*, *FoxPro The Way To Go*, *Visual Basic - not just for Stupid People*, *MS Access Your Little Database Chum*, *SQL Server - How do you spell 'Oracul' anyway?* and *Difficult OLE Stuff for Real Keanos*.

I'm in an exam. I'm in an exam! I'm thirty four. They shouldn't be able to make you do exams after you are twenty five, except the ones you take in your dreams. I've retaken my Finals about two million times, haven't we all? Somehow always discovering that the exam was to be held this very morning and here's me, not having done any revision, because I didn't know it was today.

I've had that dream the last four nights now, I suppose because I knew bloody well that it is today. No more dreaming, here I am in a real exam, just like I swore I never ever would be again; palms sweating, stomach churning, underwear mysteriously fitting in an odd way which makes it impossible to get comfortable, despite two supervised visits to the cloakroom to try to put my house in order. The supervisor is convinced I have concealed Inside OLE 2 Inside Stob's Knickers. Consequently his halitosis is condensing on my NEC Multisync as he watches my every move with an intensity that would be unnerving, if I had any nerve left to un.

Of course, things have moved on since the prime of Ms Verity Stob. The exam is computer based, in fact it's multiple choice. Oh yeah, I know what you're thinking; you're thinking Chemistry O-Level: Which of the following is NOT an element? A) Iron B) Sodium C) Neon D) Oxygen E) Banana flavour. Calculators may be used, sporty-type candidates are encouraged to copy from brighter neighbours.

But this isn't like that at all. Have a look at this one here:

Question 7: How does Windows NT detect errors?

- A) By having its API functions return an error code
- B) By having its API functions return illegal values - the programmer then calls a second function to obtain the error code
- C) By throwing an exception which the program can trap if it chooses
- D) By allowing independent third parties to write device drivers which run at ring 0 protection on Intel platforms.

Ok, so I have more or less eliminated D) from my enquiries. D) is the banana. Probably. But how the hell is one supposed to choose between A) B) and C)? What does 'How does Windows NT detect errors?' mean for God's sake?

... successful completion of the exam, the newly qualified BSY will be sent their special Learn Microsoft Good Pak. This contains 1) a mass-produced certificate with facsimile signature of Bill Gates, 2) a special BSY plastic membership card, entitling the BSY to special BSY privileges, 3) a flyer for BSY Monthly, the magazine for persons who have passed their exams and wish to gloat at those who have not, 4) a special BSY buttonhole badge, a fallback if 2) above is lost or damaged or is insufficiently special, 5) a set of six CD-ROMs representing one month's issue of the Microsoft Need-to-know Technical Knowledge Network Professional Knowledgebase Engine Roadmap, not to be confused with all the other Microsoft CDs you may have piling up around the office, to which, flushed by your success, we hope you will be persuaded to subscribe, 6) camera-ready artwork which the BSY may display on their business cards and stationery...



I wonder what that artwork looks like. Some sort of Microsoft corporate logo. An image of the terrestrial globe having the pips squeezed out of it by a gauntleted hand would do the job. Come on Verity - snap out of it. You are running out of time. Fifteen minutes left and you are staring at

Question 31) A VBX control is ported to an OLE control. How do you expect the performance of the OLE control to compare with the VBX?

- A) The VBX would be twice as fast as the OLE control
- B) The VBX would run at about the same speed as the OLE control
- C) One cannot predict whether the OLE control would run faster or slower
- D) The OLE control would run 20% to 30% faster
- E) The OLE control would run at least twice as fast.

What are you laughing at? Yes, of course the correct answer is E). Or rather, the answer required to earn the mark is E). Any hockey player can see that. It's just that in my experience of about 25 OCX (all 16-bit) ports of VBX controls, every man jack of them ran like the last creature over the line in the 7:30pm at Walthamstowe. It offends me to answer an exam question untruthfully just to pass. Mind you, I've always done it (I think 'How Green Was My Valley' is a great novel because...). I suppose it is a bit late in the day to change policy.

Congratulations Ms Verity Stob: you have passed More Than You Ever Wanted To Know About Windows Part 1 with 870 points out of 1000. Please collect your certificate from your Nympho Prometric Representative on your way out.

Is that it? Is that really all? It is? O jour frabberjeais! Calleau! Callai! J'ai tué le Jaseroque! Goodbye Mr Supervisor, and may I recommend Listerine Brown in litre bottles. Ha ha, hee hee, that wasn't so bad then. I could tackle a few more like that. I could soon mop up a BSYI. I take it all back about dear old Microsoft, bless their cotton socks. They're quite right; it is important that professionals of my calibre are recognised... Hold on, what's that? Surely it's not a fire alarm?

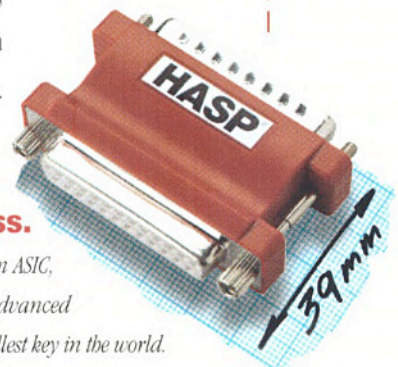
Ah. The alarm clock.



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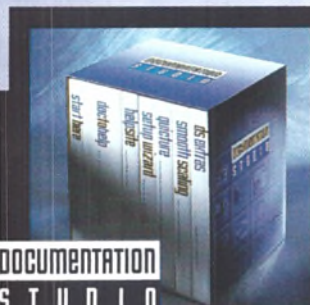
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