THE SOFTWARE DEVELOPERS MAGAZINE

EXE

OCTOBER 1997

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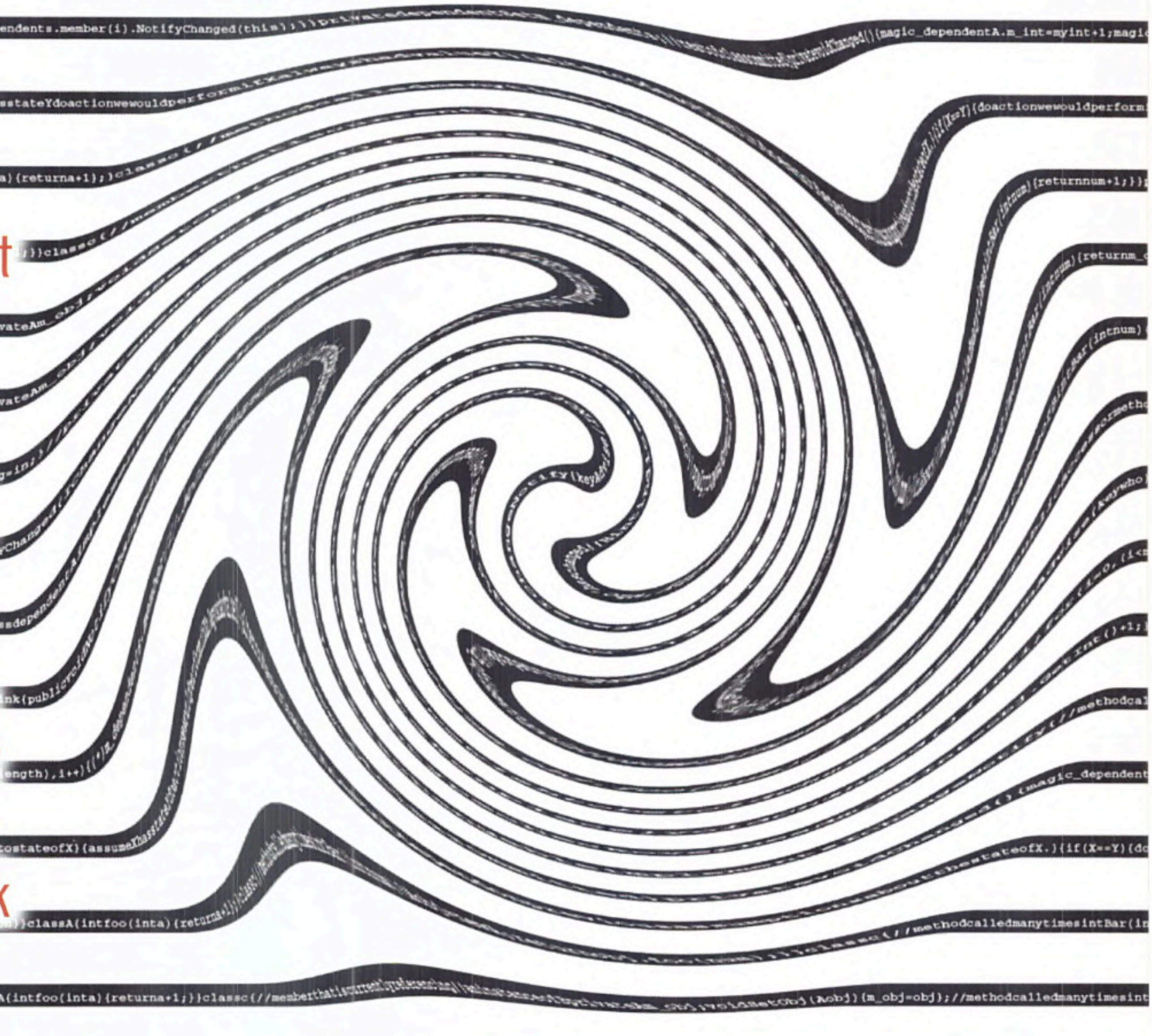
Talking low-level to Windows NT

Knuth's back

Basic Constituents for ActiveX



Self-modifying code is good for you

10

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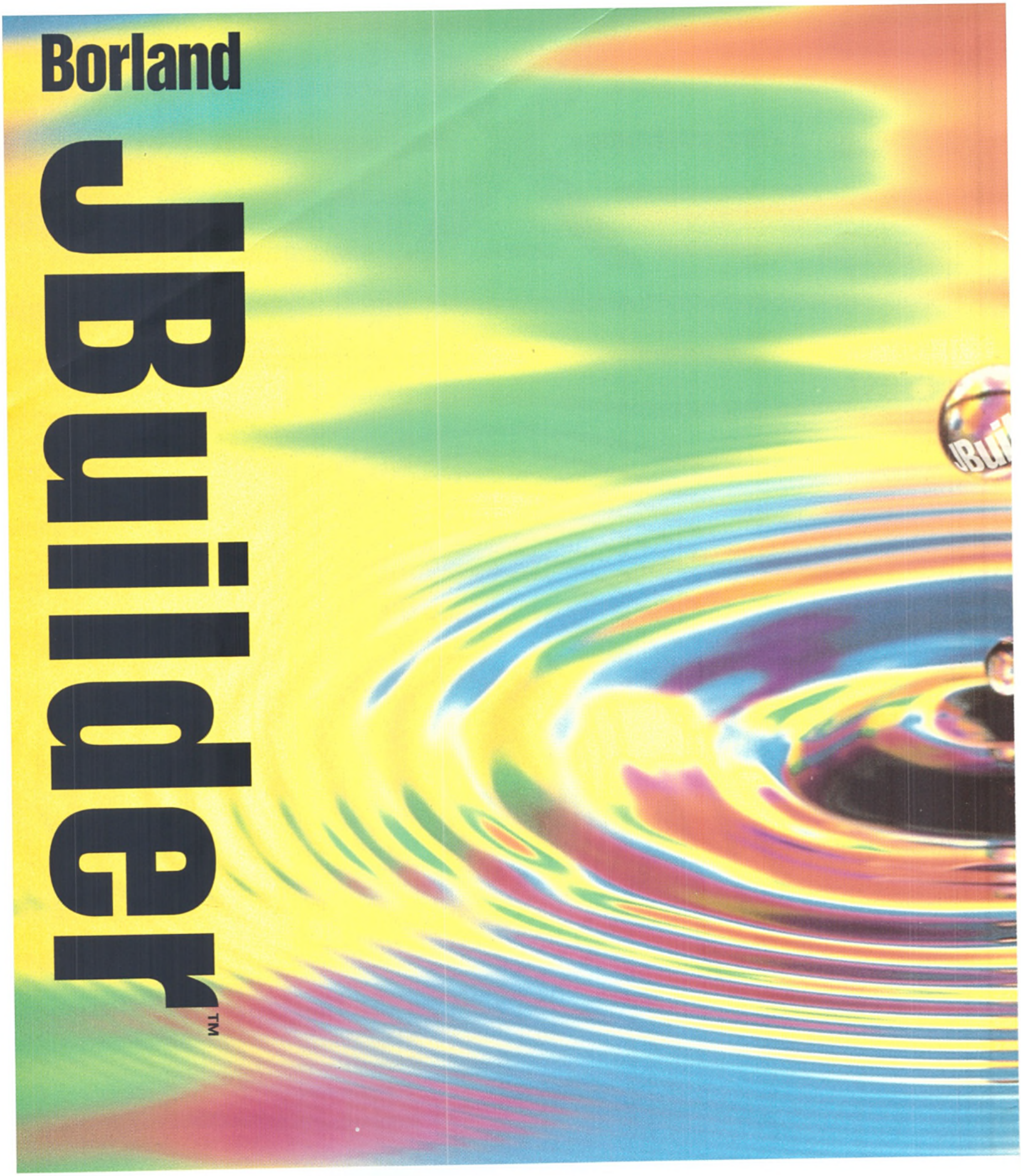

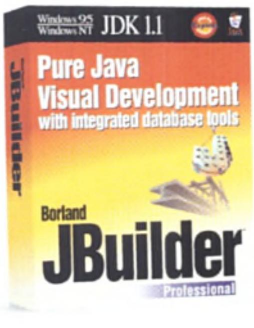

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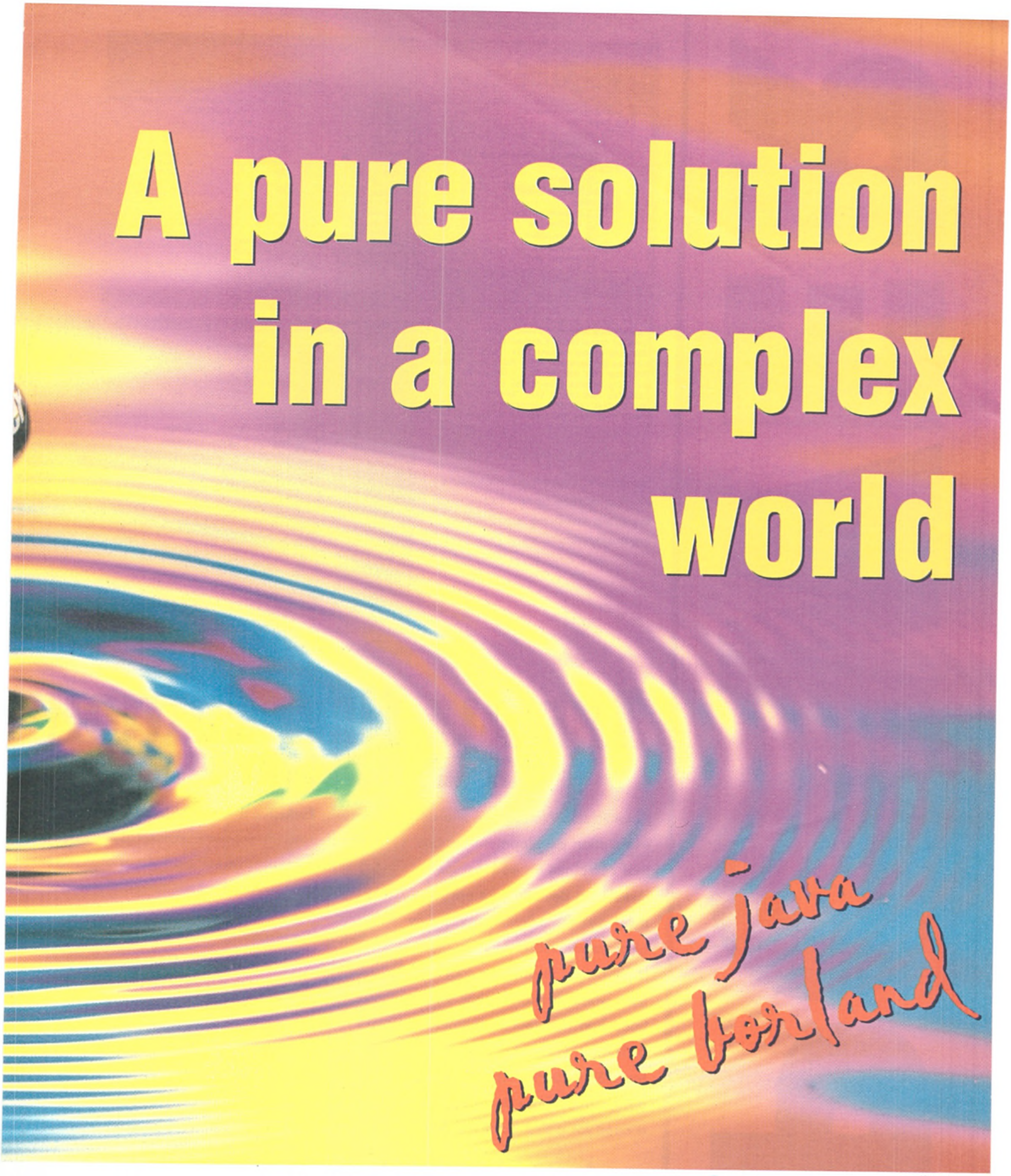
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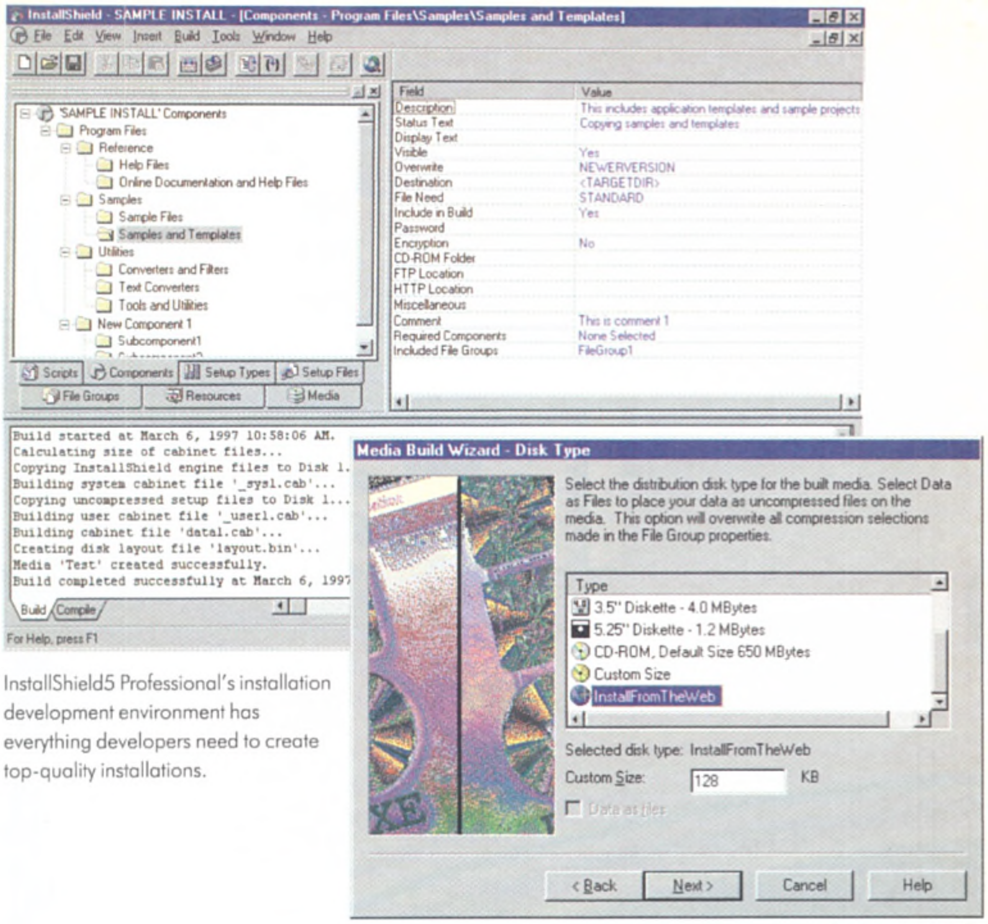

'SAMPLE INSTALL' Components
- Program Files
  - Reference
    - Help Files
    - Online Documentation and Help Files
  - Samples
    - Sample Files
    - Samples and Templates
  - Utilities
    - Converters and Filters
    - Text Converters
    - Tools and Utilities
  - New Component 1
    - Subcomponent1

Field	Value
Description	This includes application templates and sample projects
Status Text	Copying samples and templates
Display Text	
Visible	Yes
Overwrite	NEWERVERSION
Destination	<TARGETDIR>
File Need	STANDARD
Include in Build	Yes
Password	
Encryption	No
CD-ROM Folder	
FTP Location	
HTTP Location	
Miscellaneous	
Comment	This is comment 1
Required Components	None Selected
Included File Groups	FileGroup1

```
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
```

Select the distribution disk type for the built media. Select Data as Files to place your data as uncompressed files on the media. This option will overwrite all compression selections made in the File Group properties.

Type
- 3.5" Diskette - 4.0 MBytes
- 5.25" Diskette - 1.2 MBytes
- CD-ROM, Default Size 650 MBytes
- Custom Size
- InstallFromTheWeb

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Custom Size: 128 KB

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		Systemstar	01707 278300

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ENQUIRY NO. 02

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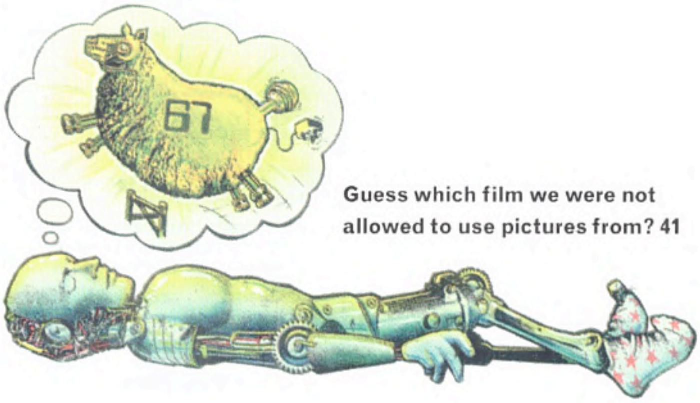
Guess which film we were not allowed to use pictures from? 41

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News & Views

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- **Project Management** - just install JDesignerPro on a single server, then run it remotely through a browser. It tracks the screen designs for any number of developers, and they can reload & modify their projects anywhere
- **Generates SQL** for inserts, updates & deletes as the fields are created. You don't even type in the field names!
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- Editor supports Win, ActiveX & custom controls, lightweight GUI objects, etc
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✉ ENQUIRY NO. 03

The Object is dead, long live the Component

Anderson Consulting confirmed it in May this year and The Butler Group has now followed suit – the future of software development architecture lies in components. Object technology has become too much of a religion, too rigid and prescriptive, dictating how every last bit of code should be written.

Today's object based software development could be compared to building piece by piece with individual bricks, while the component approach combines much larger chunks of software as the building blocks – like constructing a building from pre-fabricated blocks. The benefits of this approach can be seen from a software development angle that also makes pragmatic business sense.

Components can be viewed as groups or bundles of objects defined largely by the end application for which they are designed. In practice, components can be employed to provide a standard GUI screen interface to secure the user's password and grant entry to a defined list of other applications – a fairly routine application. Alternatively, components can be employed within a database to undertake a series of SQL queries and distribute the analysis across a range of platforms throughout the organisation. In essence, organisations can select from a combination of ready made 'off-the-shelf' components, for routine tasks such as GUI user entry and verification, and bespoke components for the more complex, distributed tasks such as SQL data mining or Web deployment.

Object-based programming has not enjoyed widespread success because it is too fine-grained and because, in many respects the tools are too technical. The evolution of second-generation client/server tools and development of 3 and 4GLs brought the complex nature of the object-oriented approach into focus.

Organisation-wide software development becomes an issue of component integration.

Client/server tools such as NatStar, SuperNova's Application Developer, Forte and Dynasty, complete with application partitioning may have addressed some of the software integration issues brought up by their predecessors. But what they gained in power and flexibility they certainly sacrificed in terms of ease of use. In reality, to a generation of programmers brought up on Cobol and C, second-generation client/server tools were a bridge too far.

Faced with the prospect of having to retrain teams of programmers in an increasingly diverse set of tools and languages ranging from legacy Cobol to the latest Java, component-based architecture provides a solution to placate both the IS and financial departments.

In an ideal world, programmers would select a combination of off-the-shelf and bespoke components generated from a variety of tools determined only by the application and the programming skills at their disposal. Visual Basic for Windows-based applications and Java for Web deployment, for example. Rather than being driven entirely by the nature of the legacy system or toolset, programmers could select 'best of breed' tools to build components for deployment. Organisation-wide software development becomes an issue of component integration. The shift away from the rather granular concept of individual objects towards components certainly represents one step towards addressing the issue of global integration, that is, the universal ability to combine components generated by any and all tools.

Talk of development tool 'standards', however, is likely to remain just that. The ActiveX/JavaBeans debate highlights the ambiguity regarding unified standards. The ActiveX marketplace for components has been valued at over £180 million, so market forces combined with Microsoft's well-documented muscle should ensure its proliferation – but where does this leave JavaBeans, also supported by Microsoft?

In common with Anderson Consulting, The Butler Group supports a third solution besides purchasing off-the-shelf applications or developing systems from scratch – the use of re-useable, modifiable software components. Future software applications will be assembled from existing components held in a repository, providing access for developers to as wide a range of components as possible. The future lies in *component glue* software. According to the Butler Group, such glue would have essential properties: the ability to create applications without writing code; the ability to combine components developed with various tools into one application; strong support for industry standards; technology independence; and integration of legacy systems.

Faced with the necessity for an increasing variety of applications to be distributed across a growing array of platforms, the concept of object-based development is no longer valid. In today's environment, the OO approach is too fine-grained and, in many cases, the tools are too technical. Today's programmers are looking to select best of breed client/server tools for the job in hand. Provided that components can be easily integrated, programmers can then effectively select tools simply on the basis of the application itself and the programming skills at their disposal.

Component glue, therefore, remains the key technology enabling applications to be built by mixing and matching software built with different tools. Only then will developers be able to concentrate on the business requirements without being constrained by the technology.

David Barkaway
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Can the Web run on DESL?

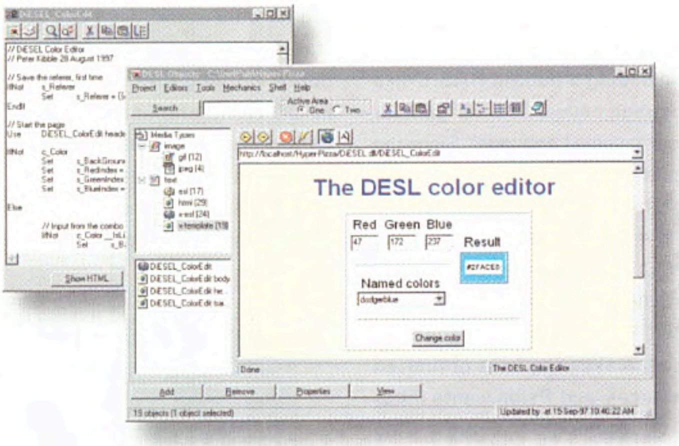
At the moment there are two methodologies in Web development; the visual and the programmatic. The visual method, exemplified by tools such as FrontPage and HotMeTaL Pro, takes a WYSIWYG approach. The programmatic method developed out of 'Visual Notepad' – the joke name given to the tendency of many Webmasters to write all the HTML code by hand. The nearest thing to a traditional code-based development tool for Web applications has been Microsoft's Visual InterDev, which in its current release still leaves a great deal to be desired – especially as it has no direct support for server-side scripting or debugging.

DESL (pronounced Diesel) from UK Internet consultants Q4, is designed to be the first Web development tool aimed directly at traditional codeheads. The product consists of an interpreted language – itself called DESL – together with a full IDE comprising HTML and code editors, debugger, object manager, and change management facilities. The server-side environment is built with ActiveX components running on Internet Information Server on Windows NT. Web applications are built in the DESL language, which Q4 claims is easy to learn and was designed specifically for the job rather than cobbled together from existing languages, and as you would expect can interface with ODBC data sources and incorporate server-side Java applets or ActiveX controls.

DESL also maintains strict session criteria, so any attempt to spoof or change IP address during a session will be rejected. EXE recently saw a demonstration of the product in beta, and we were impressed.

The following licences will be available: DESL engine only (for runtime purposes) priced at £500 for unlimited useage, Standard Edition priced at £750 including 3 developer licences, Professional Edition priced at £1250 which adds ODBC/RDO capabilities and includes 5 developer licences, and the Enterprise Edition which adds support for Unix Web servers and includes 10 developer licences. DESL is scheduled to ship in November.

t 0181 317 3733 w www.q4.com



```
// DiESEL Color Editor
// Peter Kibble 28 August 1997

// Save the referer, first time
IfNot   s_Referer
        Set     s_Referer = (I
EndIf

// Start the page
Use     DiESEL_ColorEdit heade

IfNot   c_Color
        Set     s_BackGroun
        Set     s_RedIndex =
        Set     s_GreenIndex
        Set     s_BlueIndex =

Else

        // Input from the combo
        IfNot   c_Color__IsLi
                Set     s_B
```

http://localhost/HyperPizza/DiESEL.dll/DiESEL_ColorEdit

The DESL color editor

Red 47 Green 172 Blue 237 Result #2FACED

Named colors: dodgeblue

Done — The DESL Color Editor

15 objects (1 object selected) — Updated by at 15-Sep-97 10:40:22 AM

ORBs for free

The Oracle and Olivetti Research Lab (ORL) has announced the availability of a 'free' CORBA ORB. In this case, it is also free in the Stallman sense as the ORB is being released under the GNU General Public Licence. ORL claims the ORB is significantly faster than the competition because of its native platform thread support.

Offering the product free may pull the rug from under competitors like Visigenic which has been making a lucrative business licensing its technology to development tool vendors.

The ORB – called OmniORB2 – is a native IIOP implementation which will be compatible with offerings from Visigenic and Iona. Versions are available for Windows 95/NT, Linux and flavours of Unix.

w www.orl.co.uk

Cold Fusion happened

Not to be confused with the unproved 'fusion in a glass' experiments of Professor Martin Fleischmann (or the rather more promising supercold fusion experiments of a Japanese team based here in the UK), Cold Fusion is a Web development tool from Allaire Software.

Like DESL (see above), Cold Fusion specialises in Web application development on the server side where client HTML pages are generated from a database rather than held as flat files. However, Cold Fusion is not aimed at codewrights – all the server-side logic is stored in templates which are incorporated into raw HTML within the visual design environment. Cold Fusion is available from UK distributors Grey Matter priced from £446.

t 01364 654100

w www.greymatter.co.uk

JBuilder is go at last

Borland's long-awaited JBuilder has finally shipped, fulfilling the promise made by CEO Del Yocam that it would do so this quarter. All versions including the client/server edition should be available from resellers as you read this.

w www.borland.com

OpenGL developers will be pleased to hear that **Silicon Graphics** has released a revised version of the OpenGL libraries (and development kit) for **Windows 95** and **NT**. MMX support is included, as is support for **DirectDraw 5.0** in 2D applications.

www.sgi.com/technology/opengl

Need to add **FTP** functions to your application? Then look no further than **Conduit**, a Windows DLL which provides high-level functions for achieving FTP transfers. **16-bit only** for now, with a **32-bit** version coming soon.

www.modmed.com/conduit

More 2D graphics with **Carnac**, a **C++** and **Java** graphics toolkit for fast 2D object-based drawing. Version 1.1 includes a full **SDK** and support for **24-bit** images and textures. One suggested application is real-time data visualisation.

www.int.com

Protect your software with **SoftSentry** from **20/20 Software**. SoftSentry is a software-only protection system for licensed or **demo** software. Claimed features include the ability to **imprint** an executable at installation so it will only run on **one** particular machine.

www.componentsource.com

Following on from the launch of **Web Integrity** (see EXE, September 1997), **MKS** has announced availability of **Mac** and **Unix** clients for the software, although the server is still NT and Unix only. See the MKS Web site for more information on **upgrades**

www.mks.com

Launch of an EPOC-making event

For years, the Psion Organiser series was unique in the PDA world in including a built-in BASIC-like language called OPL (Organiser Programming Language). Since the inception of the Series 3 it has been possible to write directly to the APIs of the Psion operating system, EPOC. The 32-bit version of EPOC on which the Series 5 is built, EPOC32, is a multi-threaded OS which makes the best of limited resources, and Psion wants third-party developers to start writing EPOC32 applications for the Series 5 and other EPOC devices which will include mobile phones and smaller task-specific PDAs.

To this end, the company has launched a Web site, EPOC World, which aims to act as a central resource for all Psion developers working on the platform. EPOC World promises the latest SDK revisions, online discussion groups, an EPOC knowledge base, downloadable code samples and tools, and training programs.

Individual developers can get access to most of the site by joining the EPOC World program; prices start at £200 per year for C++ based EPOC32 developers, and £75 for those using OPL. An extensive 'licensee-only' area will also be available for companies licensing the EPOC technology for their own products. In the meantime, you can try out the public areas of EPOCWorld for free.

Given the unprecedented demand for the Series 5 (they sold out completely within the first week and at the time of writing are on long-term back-order!) now may well be the time to get into EPOC development.

w www.software.psion.com/EPOCWorld

Embedded environment from SDS

Yet more embedded development news with the announcement by specialists Software Development Systems (SDS) of a customised version of their SingleStep development environment tailored to the Motorola's latest embedded PowerPC processors, the 750 and 740.

As well as in-circuit debugging and tracing tools, SingleStep for PowerPC includes a PowerPC 750/740 emulator for Unix and Windows 3.x/95/NT – the SingleStep Advanced PowerPC Emulator – which allows developers to test their software in a simulated environment before the first track on the PCB is etched.

SingleStep targets a variety of industry-standard realtime operating systems including Nucleus, OSE, RTEK, RTXC, and VxWorks. SingleStep for PowerPC should be available immediately.

w www.sds.com

The incredible shrinking Eiffel

The latest Eiffel release from Interactive Software Engineering (ISE) is Embedded Eiffel, a version of the language targeted at embedded systems development. Featuring the same EiffelBench development environment found on its cousins, Embedded Eiffel has been equipped with a number of features designed for the particular needs of the embedded development environment.

First of these is a tailored version of the Eiffel runtime scaled down to fit in less than 110 KB of ROM and 70 KB of RAM. The necessary libraries and tools to perform host-target debugging and development have been ported to the VxWorks embedded OS, and ISE claims that this version can be easily ported to other embedded operating systems. A scaled-down version of the Eiffel garbage collector allows for automatic collection even at the embedded level.

A special version of CECIL – the C to Eiffel Call-In Library – is supplied which allows for the inclusion of existing C/C++ source code into the Embedded Eiffel project. Tuning tools to aid per-implementation optimisation are also included.

Traditionally, the civilian embedded development market has been the province of the C, C++, or assembler programmer (things are different in military development where specialised languages are often used). However, Eiffel has made a name for itself by being both more fundamentally object-oriented than C++, and producing faster and more compact code than many C compilers. ISE clearly hope to win over this potentially lucrative slice of the development pie to its side of the argument.

Embedded Eiffel is just the latest in a series of releases from ISE aimed at popularising the Eiffel language including the low-priced Personal Eiffel and the Eiffel 4.1 point release. Information about all Eiffel versions, as well as downloadable trial and retail versions of the software, can be found on ISE's Web site. Embedded Eiffel should be shipping as you read this; no pricing information was available.

w www.eiffel.com

InstallShield has launched a **Java** version of its eponymous **installer** aimed at closing the loophole whereby Java applications which run cross-platform still need a plethora of **platform-specific** install programs. More information from *www.ptsdirect.co.uk*

Version 3.2 of **SoftICE**, the kernel-mode debugging package for Windows 95/NT from **NuMega Technologies**, features support for the current beta version of **Windows 98** and **multiprocessor** NT boxes. It finally allows SoftICE to reside in a **window** on the desktop rather than as a character mode application. *www.numega.com*

Continuing its programme to port leading embedded RTOSes to the **ARM** platform, Advanced Risc Machines has announced the availability of the **CMX-RTX** RTOS for ARM processors including the ARM 'Thumb' multimedia chip. *www.arm.com*

Oracle's Designer/2000 application development platform has entered **beta** for version 2.0. Oracle claims the **IDE** has been made more intuitive with the use of **wizards** and **drag-and-drop** functions. The beta is **not** available for download, so contact Oracle to participate in the programme. *0118 924 0000*

The latest version of **Symantec's Visual Café Pro** is available to download at the company's Web site; version **1.0e** features native support for **Informix**. A preview version of an as-yet-unnumbered **JDK 1.1-compliant** release is also available. *www.symantec.com*

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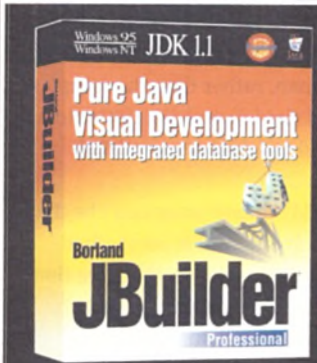

Borland JBuilder

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"JBuilder looks set to deliver a knockout blow to existing Java tools as well as prove once and for all the viability of writing large applications in the language."
- EXE Magazine, August 1997

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Low bandwidth

Back from holiday, Jules gets a new toy. It's not very big, it's perfectly safe, and it annoys nobody – why would anybody want such a useless item?

It's funny, isn't it, how nobody is neutral about mobile phones. They've been around for so long now, and they're sufficiently cheap that everyone who wants one has got one, that you'd think we'd have learned to live with them by now. But, it doesn't seem to be so; what's the polite thing to do if your phone rings during a meal, for example? The tones on mobile phones are hard to localise, such that whenever a phone rings in a crowd fifty people reach for their pockets, yet why have so few phones got vibrators inside them? And finally, should one take a phone to the pub at night – most publicans would say definitely not.

The real problem, though, is the telephone-like nature of a mobile phone. When the phone rings, you've got to stop what you're doing, even stop in the middle of a conversation, to answer it. Now, you have to be polite to the person who is interrupting your life without any consideration for what you happen to be doing – politeness meaning you have to spend five minutes or so greeting the caller and closing the conversation, before you can even begin receiving the message and negotiating its contents. That's expensive, and can ruin an already-running conversation. What's more, while using a phone in a bus is frowned upon, and using a phone in the underground or inside steel-framed buildings is chancy or downright impossible, using a mobile on a motorbike is a silly idea, and even using one in a car is increasingly being legislated against. Finally, the ability to call someone anytime, anywhere, and say 'Hello, hello ... can you hear me?' seems of dubious value at best.

I've noticed that I use my phone in two ways. One is simply to receive messages; 'I'm going to be late for our meeting', for example, or (more commonly) 'You're late!'. The other is to hold a conversation which involves some degree of discussion or negotiation. The messages are by far the lion's share of my use, and when I do need to negotiate, I much prefer to devote my full attention to it, organise my thoughts beforehand, and so on, so I use the phone only to make an appointment to have the discussion later.

Most large organisations have made the same distinction between these two kinds of communication for years, so they provide their employees with telephones, and with email facilities or (in the old days) with memo pads. The point is, of course, that a memo is not just a poorer, narrower-bandwidth form of communications; it's frequently better because it allows the recipient to prioritise his work, and to place the messages into filing cases or give them physically to someone else, and it forces the sender to be clear about what it is he's trying to say – memos rarely extend beyond fifty words.

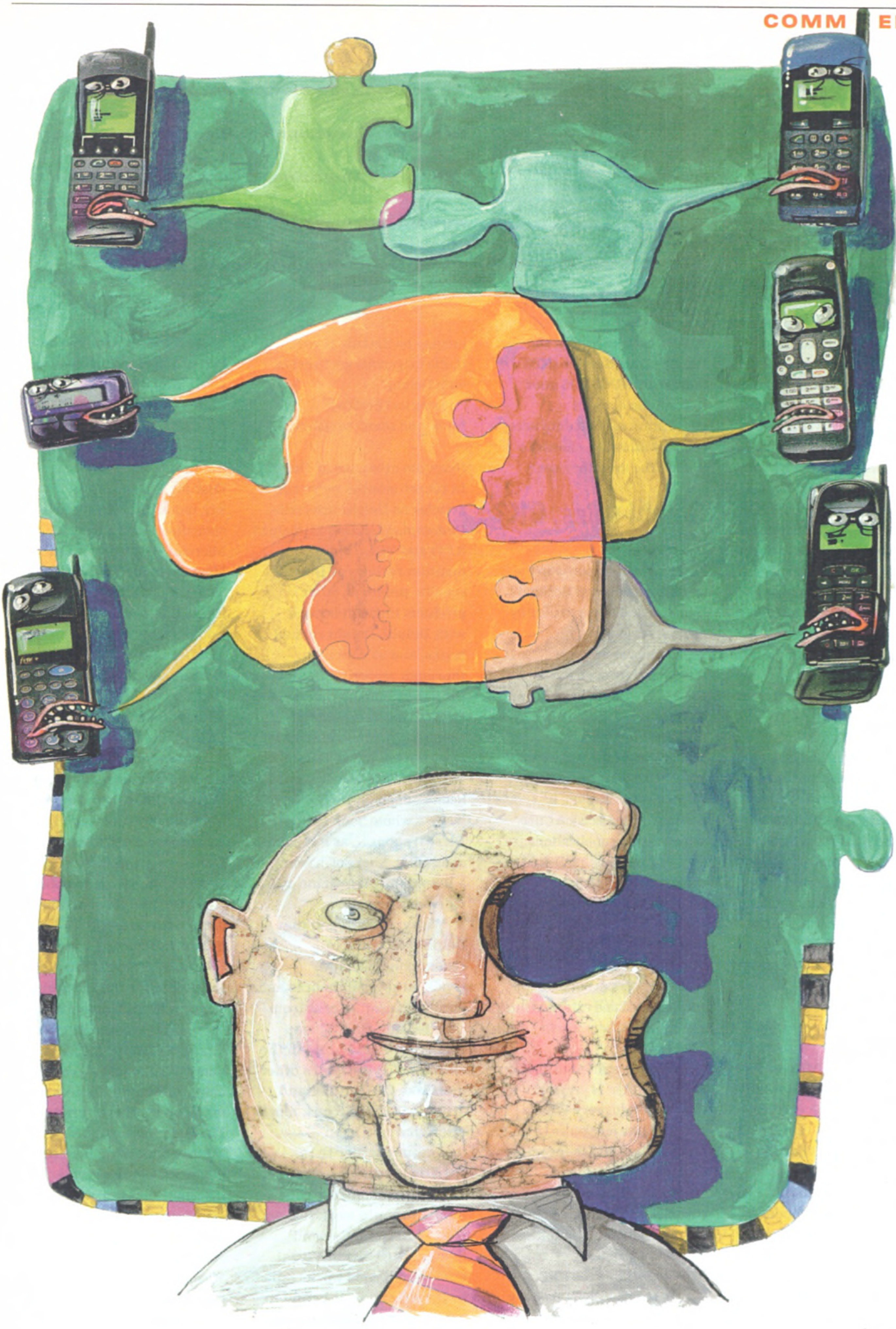
Though silly legislation around email is beginning to limit its use in certain litigious companies, memos and email are increasingly under-used because they are being provided to people who are uncomfortable with the written word. That's a shame, because some kind of mobile memo (other than Interflora, of course) is well worth having.

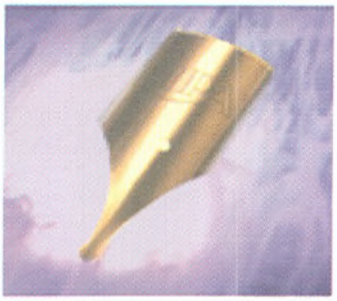
Well, I've discovered what I think is a remarkably well kept secret. I've just bought a pager. I diverted both my landline and my mobile to it for when I don't answer them.I'm finding more and more that I'm relying on it, to the extent that my mobile rarely gets switched on. I can clip the pager to my bike (or to the dashboard when I'm in a car), and when a message comes in I can read it right away – the screen is sufficiently big that most messages will fit in one page, yet there isn't so much information that I can't read it at a glance. (I know my phone has a message facility, but it's rendered useless because the display can only show a dozen characters). I can program my pager to vibrate silently (which was a somewhat unnerving experience until I got used to it), I don't need to keep worrying about charging it up, and I can selectively delete and shuffle messages around, entirely unlike an answering machine. It's so small that nobody can tell when I'm wearing it, and it has no value to a thief (an important consideration, considering my last mobile phone was cloned). I don't even have to worry about bad reception, because the system will keep sending the message until the pager gets it. This, quite simply, is what I'd needed all along.

I'm using a bureau service to collect the messages. At first I was disturbed by the typos on the messages which arrived; names would be spelled wrong, funny contractions would appear. After a while I realised that none of these things made the messages any less comprehensible, and most made them better able to fit into a page. The errors and inaccuracies are actually part of what makes this system work as well as it does. Where most digital systems are very intolerant of errors (dropout on a digital phone is a truly horrible noise, for example, and in July I wrote about dropout on a hard disk), here's a system which tolerates errors very well, because it's designed to be low-bandwidth, lo-fi, and interpreted by the immensely flexible mind of man, rather than the complex and rigid digital discriminators used by telephones and disk drives.

My phone usage can't be that much different to most other people's, and it seems to me that messaging systems are a far more efficient use not just of users' time, but also of the radio bandwidth. How come nobody makes mobile memo pads, like the mobile phones? You could build stuff into laptops and palmtops, you could have Microwriter-type keypads on the back of cigarette packet sized pagers, and you could build voice recognition or handwriting recognition or even gestural interpreters into the same cases we use now – 100% accuracy is not, after all important for what would otherwise take the form of a handwritten note. ■

Jules can now be paged on 01459 110967. You can still email him as jules@cix.co.uk, or call him on 01707 662698, but neither of those will be any good when he's out on his motorbike, or if he's not answering his phone.





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MSFT's TLAsz

Dear Sir,
Has anyone else noticed that Bill's camp has gone decidedly schizoid recently? Do they not understand that VBX, OCX, OLE, and ActiveX are all the same thing? And so are ODBC, ADO, RDO, and ODBC-direct. And more recently DAO, OLE DB, ADC, JET and… RDS? Do they think that we can't figure it out?

Time was when a new design or a new release was just that. Mostly the same as the old, with a new twist. There was a little honesty and integrity involved: 'Sure we messed up, but we've thought of a better way. Try this.' Everyone understood the rules.

Now Microsoft heralds each new release of a few dull drivers as an exciting new technology. Either they know what they're doing and they think we're too dumb to figure it out, or marketing truly believes the tech boys are inventing gold every minute, and they're too stupid to figure it out themselves

I've always been a staunch supporter of Microsoft because I've always seen Bill as the underdog. Trying to fight the multiprocessor, multithreaded, distributed processing Unix crowd with DOS and Windows 3 took some balls. Now Bill has read the Unix manuals, are his conjugal responsibilities taxing his sanity?

Is this a case of 'The Emperor Has No Brain'?
Alan Ambrose
alan@alan-ambrose.com

Straight from the Microsoft Web site: 'New Name for ADC--Remote Data Service (RDS) – ADC has now been integrated with ActiveX Data Ojects (ADO) to provide date remoting [sic] within the same programming model as ADO. This makes it easier to design, code, and deploy both Web-based and LAN-based applications. To clarify the relationship of ADC to ADO, ADC is now known as the Remote Data Service (RDS), a feature of ADO. RDS goes beyond the current generation of Web data access tools by allowing clients to update the data they see.'

Delphi rules, OK?

Dear Sir,
Just a note in response to the criticism levelled at Borland's Delphi 3, and in particular its pricing structure.

The enormous price differential between the Professional and Client/Server editions is justified not just by the database connection capabilities of the latter but the extra VCLs that ship with the Client/Server version, in particular the Decision Cube. When creating applications derived from existing Delphi components it's well worth spending some time exploring the possibilities of subclassing the Decision Cube. This component is difficult to master in its native form but once encapsulated and extended into a user-defined component… well, what can I say!

I recently started to develop in Delphi after 14 years of C/C++ skulduggery. What a relief! If like me you're tired of bit-twiddling and re-inventing the wheel then switch to Delphi. Its object model is far superior to C++, and of course, it's not another Microsoft bloatware product.

When will we see EXE (which seems to deny the very existence of the said product, judging by the lack of coverage in the magazine) get to grips with Delphi?

Long live Borland!
Name and email supplied.

Deny the existence of Delphi? In recent months we've run articles on Delphi internals, Undocumented Delphi, Delphi RTTI and VCLs, not to mention reviews of Delphi-specific products, other products that can be used with Delphi, Delphi-related books, and of course a thorough review of Delphi 3 itself. Remember Anders Hejlsberg (the creator of Delphi)? We interviewed him after the launch of Delphi 2. We have Dave Jewell, who is keen enough on Delphi to write a whole book (*Instant Delphi*) about it, as a regular columnist. Short of becoming a Delphi-only magazine, what more could we do?

We agree with you that Delphi has much to recommend it. As we reported several months ago, even Microsoft uses it from time to time. Should we concentrate on Delphi to the exclusion of Borland's other tools like C++ Builder and JBuilder? EXE's focus, more often that not, is on techniques rather than specific products; unless otherwise stated, the code we publish should work just as well in Borland C++ and Symantec C++ as in Visual C++. Delphi code works only in Delphi and so is bound to have a more limited appeal.

As for Delphi having a better object model than C++… well, we'll leave that for others to comment on.

Tangy processor

Dear Sir,
Err, unless they produced two computers, the Tangerine Microtan 65 (mentioned in Mayhem in the last issue) was a 6502-based machine, not Z80-based. But to point that out would be picky, wouldn't it. 8-)
Matthew Jones
mattjones@cix.co.uk

Well, what can I say? You are picky… and mostly correct!

After much research – isn't the Web wonderful? – I found that the CPU of the Tangerine Microtan 65, released in 1979, was indeed a 6502 and not a Z80 as we printed. This 6502 was running at a whopping 0.75 MHz and the machine came with no less than 1 KB of RAM. However, Tangerine Computer Systems Ltd did all the design for the Tangerine Tiger, a desktop machine with three processors: a Z80 for CP/M, a 6809 for I/O, disk and printing, and a graphics chip. Unfortunately, this machine was never produced. The Oric was designed by the same company, then an R&D house for Oric Products International Ltd. – Ed

More information can be found at www.tardis.ed.ac.uk/~alexios/MACHINE-ROOM/Tangerine_Microtan-65.html and at www.ensica.fr/~frances/oric/BOOK/chapter1/html.

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Taking advantage of

Although generally thought of as bad practice, self-modifying code can be extremely useful. When used for dynamic optimisation, it allows for layers of logical abstraction, without the accompanying overhead. Robert Ennals looks at how to inline virtual function and dynamically unroll loops.

We generally associate self-modifying code with hackers writing programs which are hard to prove and hard to maintain. It is also condemned by Intel: the Architecture Optimisations Manual lists 'Avoid self-modifying code' as number 12 in a list of ways to produce faster executables. This is due to the overhead from pipeline and cache flushes when code is modified. However, there is a good side to self-modifying code. When applied by a carefully proven dynamic optimiser it can lead to incredible performance increases. If the creation and management of self-modifying code is left to a dynamic optimiser then one can have the speed benefits without the problems.

The never ending optimiser

A dynamic optimiser is different to a static optimiser in one important way. While a static optimiser creates optimised machine code and then leaves it alone, a dynamic optimiser never stops optimising the code and may change the resultant code as conditions change. Listings 1.1, 1.2, and 1.3 illustrate the basic operation of dynamic optimisers.

The most common type of dynamic optimisations, the *timid optimisations,* are those which produce optimised code that will function correctly, whatever state the machine is in. Although a timid optimisation will correctly function for any state, we can optimise it so that it is faster when certain assumptions about the state of the machine are true. It will however often be slower when the assumptions are false.

There is a more complex type of dynamic optimisation – *fierce optimisations* – where we produce code that will not always function correctly. This code will only function correctly when certain assumptions about the state of the machine are true. This code will often be significantly faster when these assumptions are true, at the cost of not working at all when they are false. In order for the code to always work and the optimisation to be invisible, the optimiser must catch any attempts to perform actions that would change the state of the machine such as to break the assumption that the generated code relies on. When it catches such an event, it must change the optimised code that relies on the assumption so that it behaves correctly with the new machine state. This can be done by attaching notification code to any code that could break the assumption. With some languages, such notifications are very hard to attach, but in other languages, such as Java, where there is no address space, attaching them is relatively easy.

Most fierce dynamic optimisations provide a speed benefit by moving an overhead from the code that depends on the assumption, to the code that causes the assumption to be broken. If the code that changes it is executed rarely and the code that depends on it is executed often, then a major performance benefit can result from moving the check.

Inlining the uninlinable

One of the simplest, but also most useful fierce dynamic optimisations is dynamic inlining of code. Static inlining is a very common optimisation on conventional static optimisers. It consists of moving code from a called function that is known never to change, into the function that called it. For small functions, the overhead of the call can be significant compared to the time spent in the function and so the resultant speed up can be significant. An optimiser supporting static inlining might

```
Code that depends on state of X:
{
     inspect X
     do action relevant to state of X
}
```

Listing 1.1 – Basic structure of code before fierce dynamic optimisation.

```
Code that depends on state of X:
{
     assume X has state Y
     do action we would perform if X always had value Y
}

On Changing X:
{
     alter code so that it does not depend on
     previous assumptions about the state of X.
}
```

Listing 1.2 – Basic structure of code that is being fiercely dynamically optimised.

```
Y is a very common state of X.
Code that depends on state of X:
{
     if(X == Y)
     {
          do action we would perform if X had value Y
     }else{
          work out what we should do
          do relevant action
     }
}
```

Listing 1.3 – Basic structure of code that is being timidly dynamically optimised.

self-modifying code

optimise Listing 2.1 into Listing 2.2. This static inlining optimisation relies on the fact that the called code is always the same.

Dynamic inlining lets one inline called code, even if the called code is not always the same. We can for example inline virtual functions and dynamically linked functions. A dynamic optimiser might optimise Listing 3.1 into Listing 3.2. When the code being called is not inlined, an overhead is incurred every time the code is called, so that the code can run when the code being called changes. Dynamic inlining allows us to remove this overhead in exchange for an overhead when there is a change to which function will be called.

Let's look at the code in Listing 3.1 in more details. If I regularly invoke a virtual method of object pointer m_obj, every time I am suffering an overhead in order for my code to be able to call the correct method code whatever object pointer m_obj points to. If the object m_obj changes rarely and the method is called frequently, then one may gain a speed improvement by dynamically inlining the code in the called method. The speed improvement is gained by removing the requirement for the code to work when m_obj references a different object. However our program needs to continue to work when m_obj is set to reference a different object, so the code for Bar() must be regenerated if m_obj is changed such as to invalidate the existing code.

```
class A
{
     int foo(int a) {return a + 1);
}

class c
{
     // method called many times
     int Bar( int num )
     {
          A obj = new A;
          return obj.foo(num);
     }
}
```

Note that the optimiser can easily prove that obj will always be an instance of A and so can rely on the fact that obj.foo always calls the same code.

Listing 2.1 – Code suitable for static inlining.

```
class c
{
     // method called many times
     int Bar( int num )
     {
          return num + 1;
     }
}
```

The implementation of obj.foo has been inlined into Bar and obj has been optimised away as it is an unused object with no construction side effects.

Listing 2.2 – Code after static inlining.

The optimiser does this by inserting extra code into the method that changes m_obj so that it tells the optimiser that the code for Bar() needs to be regenerated. The optimiser will respond to this notification by either generating code that depends on the new contents of m_obj, or producing code that can work for any value of m_obj and removing the notification code from SetObj(). By inserting extra code into the SetObj() method we are adding an extra overhead to changing the reference. This overhead is likely to be significant, especially as many processors require a complete flush of the instruction cache if code is modified. In order for this optimisation to be beneficial, the gain in speed from removing the virtual method call overhead in Bar() must be greater than the loss in speed from adding a significant overhead to SetObj().

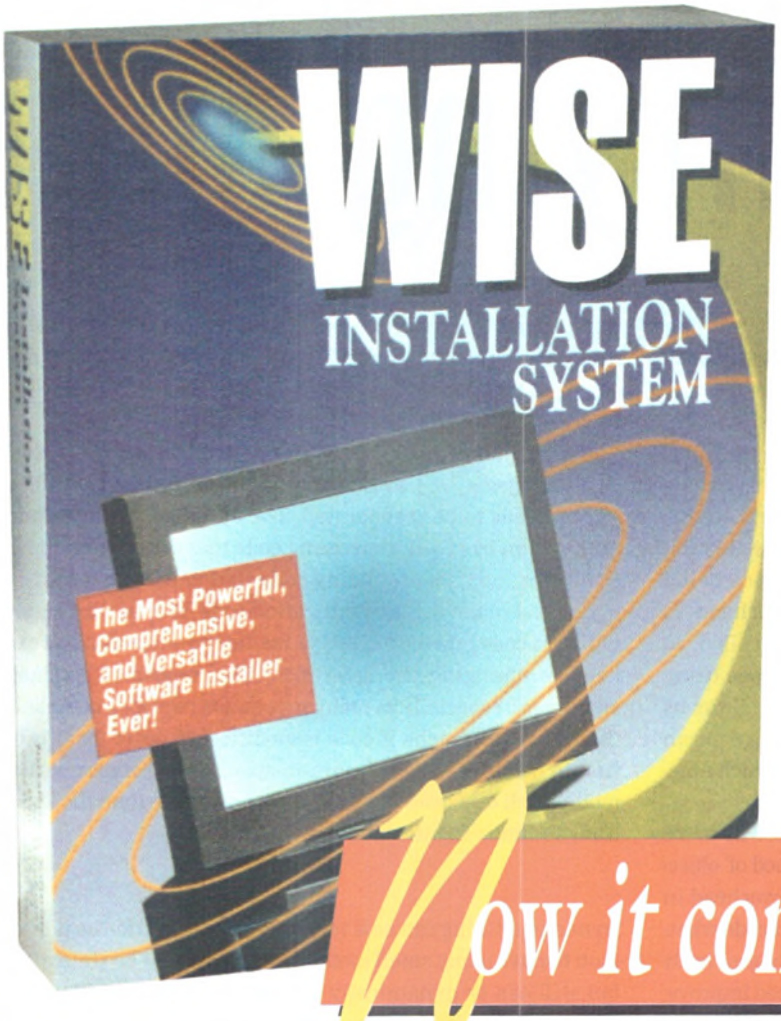
Get Set go

Dynamic inlining can be a very useful optimisation as it is very common to have many small methods which cannot be statically inlined, but still can be dynamically inlined. For example often well structured code has lots of very small Get and Set methods that do very little (Listing 4 gives an example). When they are implemented as statically linked non-virtual methods they can be statically inlined and there will be no overhead. However if one wants to dynamically link to an object, or call such methods on an object via a pointer which may point to an instance of any of several derived classes, static inlining will not be possible.

These Set and Get methods are a very useful alternative to public member objects as they allow the object to react to changes in its members and so keep itself consistent. These methods tend to be very small, often simply setting and returning the value of an object held internally. As these methods are so small, the overhead of the call will often be very significant compared to the overhead of the actual action. When Get and Set methods are used in inner loops, the time spent in them can end up being a significant proportion of the time a program takes to do something. I have come across people who insist on using public data members instead of public accessor methods just because of this overhead.

Fortunately, this overhead can be avoided with dynamic inlining. Often the pointer will point to the same object most of the time and the methods will be invoked extremely frequently. Even when the object being pointed to changes, it will often still refer to an object that does exactly the same thing in its Get and Set methods, thus allowing the inlined code to be updated relatively rarely.

Get and Set methods are not the only example of small dynamically linked methods that benefit from dynamic inlining. Graphics routines are another good example. In order to achieve device independence, routines for doing things like writing pixels to the screen tend to be dynamically linked. They also tend to be executed very often and almost always call the same code. On top of this, they also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```
public interface A
{
     public int foo(int a);
}

class B implements A
{
     int foo(int a) {return a + 1;}
}

class c
{
     // member that is currently referencing
     // an instance of B
     private A m_obj;

     void SetObj(A obj) {m_obj = obj};

     // method called many times
     int Bar( int num )
     {
          return m_obj.foo(num);
     }
}
```

Note that a static optimiser cannot prove what code will be called by `m_obj.foo(num)` and so would not be able to inline `foo`.

Listing 3.1 – Code suitable for dynamic inlining.

```
class C
{
     // member that is currently referencing
     // an instance of B
     private A m_obj;

     void SetObj(A obj) { alert_optimiser; }
          // optimiser needs to change inlined code
          // if m_obj is set to point to something
          // which isn't an instance of B

     int Bar(int num)
     {
          return num + 1;
     }
}
```

The dynamic optimiser has produced code that relies on `A` always being an instance of `B`, even though it cannot prove that this is always the case. If this assumption is broken, the code will change. We might also inline the calls to `Bar`, removing yet another layer of overhead.

Listing 3.2 – Code after fierce dynamic inlining.

```
class C
{
     // member that is currently referencing
     // an instance of B
     private A m_obj;

     void SetObj(A obj) { m_obj = obj };

     int Bar(int num)
     {
          if(m_obj = magic_common_obj)
          {
               return num + 1;
          }else{
               return m_obj.foo(num);
          }
     }
}
```

Note that `magic_common_obj` is set by the dynamic optimiser to an object that `m_obj` often points to. This code always checks before calling the inlined code and so will always behave correctly. Thus the optimiser does not have to re-optimise `Bar()` every time `m_obj` is changed.

Listing 3.3 – Code after timid dynamic inlining.

tend to be very small. All this makes them a good place to apply dynamic inlining.

Speeding up patterns

Another very common and very useful programming pattern that can be sped up a lot through dynamic optimisation is multicasted notification. This pattern works as follows:

Objects which other objects can depend on hold a list of objects that depend on them. When another object needs to depend on the first object, it calls a method of the first object, adding itself to this list. When the first object is changed, it iterates through this list notifying the objects that depend on it that it has changed.

Listing 5 gives an example of possible Java interfaces for change notification multitasking. They are based on the interfaces used by Microsoft in OLE. Listing 6 gives an example of a very common way of implementing the function that multicasts the change notifications to dependent objects.

When objects are notified by a notification multicast, they usually do one of two things, depending on whether they are lazy or eager. Lazy objects will invalidate their current contents and leave regeneration until the object is needed. Eager objects will regenerate their contents to be consistent with the change in the object they depend on. Usually large, rarely used objects will be lazy, and small, frequently used objects will be eager. Leaving generation for later saves generating data that will not be used, and regenerating the object at notification-time saves the overhead of checking if the object exists when it is requested.

Let us take as an example a file browser similar to the windows explorer. One might have an object representing the selected item in the tree on the left. Several other objects, such as the tree display, the contents display, the status display, and any other related items, would depend on which item was selected. The object that represented the selected item would not know which other objects depended on it at compile-time. The dependent objects would register themselves with the object representing the selected item at runtime and would update their contents when this object notified them that it had changed. This model is very useful as it does not require objects to know what other objects depend on them at compile-time. This allows other objects to bind to the object they depend on without requiring it to be recompiled.

Another useful example is graphics output. A program might have a bitmap that it regularly writes pixels to. It could provide a notification system whereby bitmaps that depended on this bitmap were told when a new pixel was added to the main bitmap so that they could add relevant pixels to themselves. In this case, the change notification method on the dependent objects would be given a 'hint' saying which pixel had changed.

This notification model is very widely used. It is the standard way for objects to depend on each other in OLE and in many other systems. It is becoming increasingly common to make class hierarchies which contain only `const` methods and notifications. Thus preventing any object from ever being allowed to write to any other object directly or to know when other objects would need to be written to. Instead of writing to other objects, one changes the value of one of one's sub-objects. If other objects need to be changed to reflect this, they will have asked for notifications from this sub-object.

The only problem with change notification multicasting is that when one uses static compilation it can carry quite a large overhead

```
class A
{
// --- public accessor methods ---
     public thing getThing() {return m_thing;}
     public void setThing(thing in) {m_thing = in;}

// --- private member data ---
     private thing m_thing;
}
```

Note that very little is actually done in the `Get` and `Set` methods

Listing 4 – Common use of Get and `Set` methods.

```
public interface IchangeNotify
{
     key Advise(INotifySink adviseme);
          // we wish to be told when you change

     UnAdvise(key who);
          // we no longer wish to know when you change
}

public interface INotifySink
{
     void NotifyChanged(IChangeNotify who, CHint hint);
          // The object referenced by 'who' has changed
          // Hint indicates what kind of change has
          // taken place

}
```

Listing 5 – A possible interface for objects supporting change notification. Based on the interfaces used by OLE.

```
void Changed()
{
     int i;

     for(i = 0, (i < m_dependents.length), i++)
     {
          m_dependents.member(i).NotifyChanged(this);
     }
}
```

Note how all dependent objects are notified from the same line.

Listing 6 – A typical change notification routine.

Instances of `dependentA` and `dependentB` have registered with the `advise` method (not shown) of `changable`.

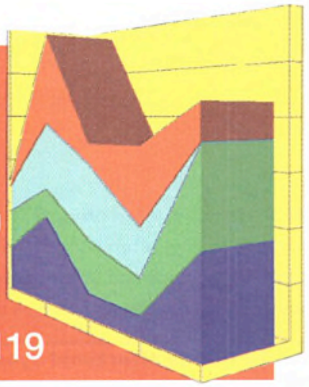
```
class dependentA implements INotifySink
{
     public void NotifyChanged(IChangeNotify who)
     {
          changable obj = who;
               // dynamic cast with type check overhead
          m_myInt = obj.GetInt() + 1;
     }

     private int m_myInt;

     // rest of class omitted
}

class dependentB implements INotifySink
{
     public void NotifyChanged(IChangeNotify who)
     {
          m_valid = FALSE;
     }

     private bool m_valid;

     // rest of class omitted
}

class changable implements IChangeNotify
{
     // method called when object has changed
     private void Changed()
     {
          int i;

          for(i = 0, (i < m_dependents.length), i++)
          {
(*)            m_dependents.member(i).NotifyChanged(this);
          }
     }

     private dependentSet m_dependents;

     // rest of class omitted
}
```

If instances of both `dependentA` and `dependentB` have registered for notifications from an instance of `changable`, then every time the asterisked line is executed, the virtual function called will be different, causing a mispredicted jump on many processors.

Listing 7.1 – A possible dependency arrangement.

with it. As objects do not know what other objects need to be notified at static compile-time, a static compiler can apply very little optimisation to change notification routines. In order to be ready for the needs of future objects it is considered good style to support notification of changes on as many objects as possible, including those that no objects currently depend on. Consequently, whenever one changes anything there is likely to be an overhead for notification. Even if no objects depend on the change one is making there is the overhead of checking to confirm that no objects depend on the change, the memory overhead of having to have code in memory to do this checking, and the memory overhead of storing the list.

When objects do depend on others, the overhead of changing the object that is depended on is much larger. Multicasting a change notification involves iterating through a list



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ENQUIRY NO. O12

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```
private void Changed()
{
      magic_dependentA.m_int = myint + 1;
      magic_dependentB.m_valid = FALSE;
}
```

The dynamically created code can access private members of the client classes as although the code is physically in the `Changed()` method of the object depended on, it is logically in the `NotifyChanged()` method in the dependent objects and access restrictions only apply to the logical code position.

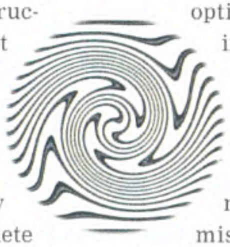
The references `magic_dependentA` and `magic_dependentB` have been dynamically created by the optimiser and reference items from the `m_dependents` object. The original loop has been unrolled.

Listing 7.2 – Dynamically optimised version of changable::NotifyChanged().

of pointers to objects and invoking a virtual method on each of them. We have the overhead of a virtual method call, and one that will often involve a mispredicted jump.

Unrolling the ununrollable

If more than one object is being notified (as is frequently the case) then every time we invoke a virtual method, we will be jumping to a different place to where we did last time from the same instruction. Many processors predict that any jump will always go to the same place it went to last time and so will always mispredict the jump. The overhead of a mispredicted jump can be very large as it often requires a complete pipeline flush. As the method being called usually does something very simple, such as setting a bit to say an object is now invalid or generating a small object, the overhead of the mispredicted jump will often be larger that that of the actual work being done.



Static loop unrolling can relieve this a little by providing more than one place where virtual functions are called from. Unless there are less dependent objects than there are unrolled stages the benefit will be minimal, and static unrolling increases code bloat as the static optimiser is unlikely to know where unrolling is sensible. It will either unroll too little everywhere and get no speed benefit at all when there are too many dependants, or unroll too much everywhere and bloat even those objects which do not have any dependent objects.

As a result of the aforementioned overhead, change notification multicasting is not used as much as it should be and systems that make intensive use of it are often criticised as being slow. Fortunately, dynamic optimisation can remove the overhead.

A dynamic optimiser can unroll the notification multicast loop and inline the code from the methods that would have been called. It can also optimise away notification functions for objects with no dependants. In order to maintain correctness in all conditions, it will insert code in the `Advise` and `UnAdvise` methods to cause the code to be regenerated when the set of dependants changes. A dynamic optimiser could optimise Listing 7.1 into Listing 7.2.

Generally the list of objects needing to be notified changes rarely and the notification code is called frequently, thus allowing major benefits. With dynamic optimisation, programs using notification for changing programs can be made to run as fast as objects which allow objects to call `mutor` functions on each other.

Dynamic unrolling of notification loops can make code feasible that would otherwise be unreasonably slow. Without dynamic optimisation, the graphics notification example given earlier would be far too slow to be of any practical use, despite its being a logically good model. Dynamic optimisation could make this graphics example as fast as writing the pixels to the bitmaps directly and allows many other good programming patterns to be used.

Next month: optimisation of dynamic binding. This series will be concluded by the dynamic optimisation of an interpreter into a compiler. ■

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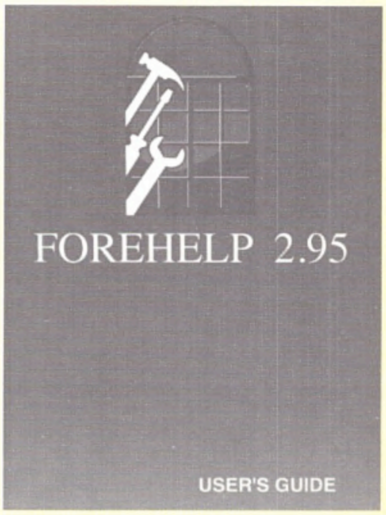

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Taking on Goliath

NT device drivers are small. NT itself is huge. Yet, a badly-written device driver can bring the OS crashing to its knees. With an eye to avoiding the Blue Screen of Death, Chris Cant shows us how to do it right first time.

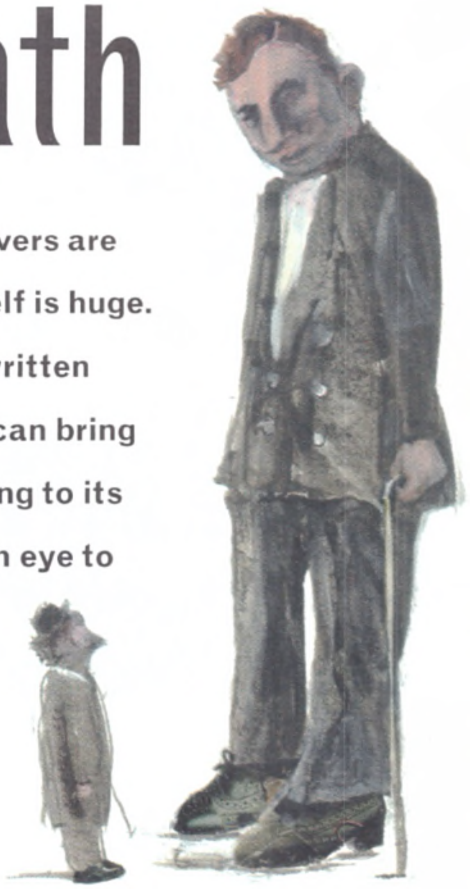


Illustration: David Humphries @ Monster

Of all the kinds of software, a developer can be called upon to write, device drivers are generally regarded as the worst. Since drivers often run at a high CPU privilege level, they are able to crash even the most stable systems with ease. In some cases device drivers need to be written in assembler rather than a higher level language, with all the development baggage that entails. In any case, writing a driver is a serious business.

The first question to ask when faced with the task of writing an NT device driver has to be whether a new driver is actually needed. There may be other tools or techniques which achieve the same end with less effort. For instance, generic device drivers available can be customised with a script. Talking to a proprietary dongle or graphics card will usually need a device driver. Before we can really tackle the issue of device driver development, we should look at an overview of Windows NT's internal architecture.

- A device driver is a trusted part of the NT kernel.
- In between the kernel and user programs is the Win32 subsystem which implements the Win32 API and manages the screen, etc.
- A Virtual DOS subsystem allows 16-bit DOS programs to run and a Windows on Windows subsystem handles all 16-bit Windows applications.
- Drivers are controlled by the I/O Manager and talk to the electronics using NT's Hardware Abstraction Layer (HAL).
- Device drivers are therefore *not* Win32 programs so the Win32 API and standard C routines such as `printf()` must not be used. Instead, drivers can call various NT kernel routine types as described in Table 1. Note that not all kernel routines have these prefixes.

See the box *Understanding hardware* overleaf for a more detailed explanation of the basic issues involved in driver design.

DDK kernel support

Both non-paged and paged memory can be allocated in various guises, depending on how crucial it is that it's available. There are in fact only minor differences between NT 3.51 and NT 4.0 device drivers specifications; NT 4.0 provides just a few extra data structures, API routines and call options.

Simple drivers will talk straight to the hardware. However more sophisticated drivers fit into a hierarchy. For example, the `parport` low-level driver exists simply to arbitrate between access requests for the parallel ports. The `parallel` printer class driver sits on top; it uses `parport` to get exclusive use of parallel port but then talks to the hardware directly. If your driver talks to the parallel port then it should use the same technique. The documentation recommends that the parallel port is just grabbed for each read and write. However, this does not seem appropriate for some applications, so you might want to allocate a port when a device is opened and release it when the handle is closed.

Other I/O areas are arranged in layers. NT's generic SCSI port driver does its job using SCSI mini-port drivers. So to write a driver for a new SCSI card, just the documented interface defined for a mini-port driver is needed. A similar approach applies to video card drivers. File system drivers, however, seem to be undocumented.

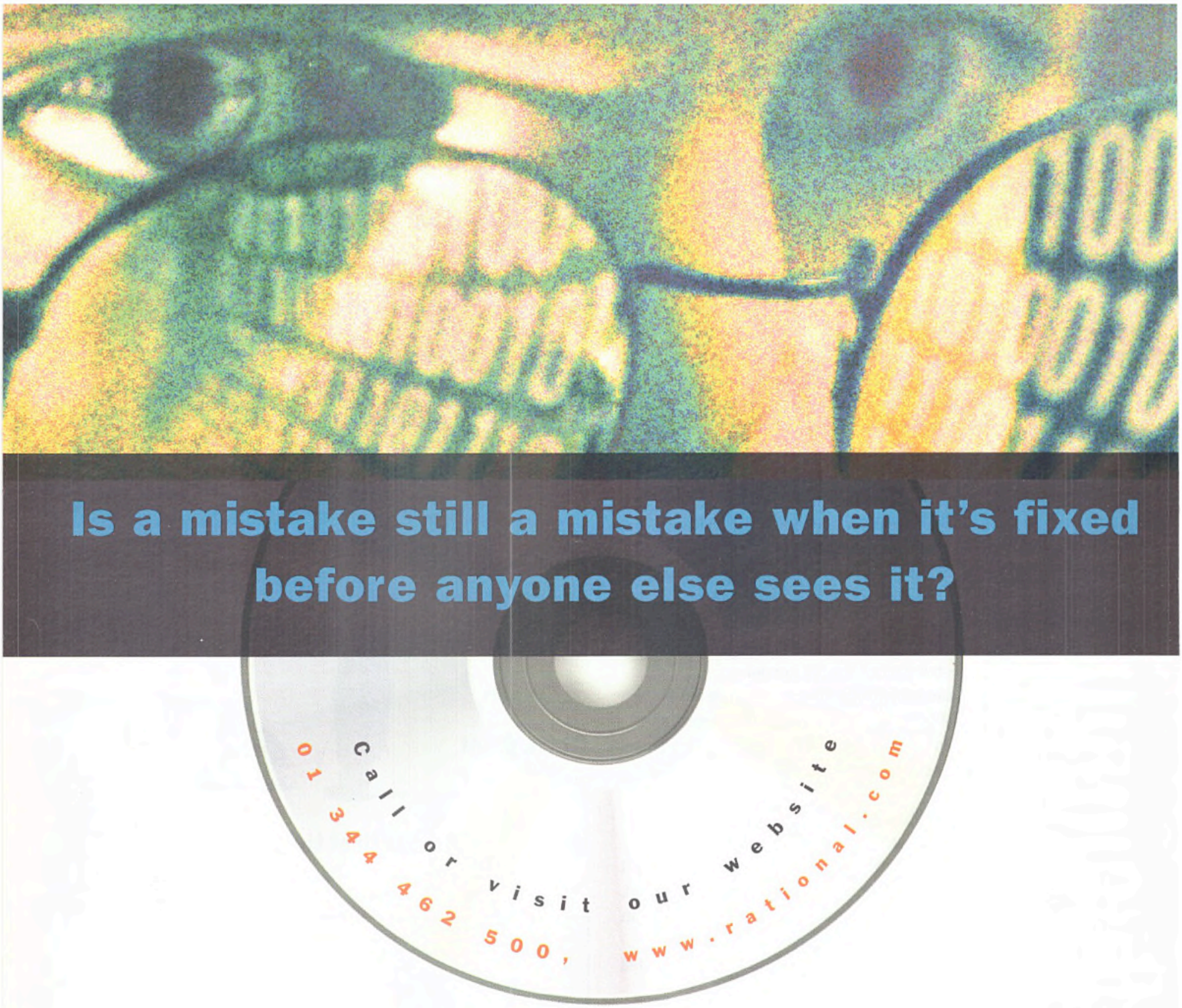
Filter drivers can sit unseen above a driver, intercepting all I/O requests. A filter driver could, for example, transparently add com-

`Ex...()`	Executive Support
`Hal...()`	Hardware Abstraction Layer
`Io...()`	I/O Manager
`Ke...()`	Kernel
`Mm...()`	Memory Manager
`Ob...()`	Object Manager
`Ps...()`	Process Structure
`Rtl...()`	Runtime Library
`Se...()`	Security Reference Monitor
`Zw...()`	Other Routines

Table 1 – Common driver call types.

IRP	Function	Win32 Call
`IRP_MJ_CREATE`	Request for a handle	`CreateFile()`
`IRP_MJ_CLEANUP`	Cancel any pending IRPs	`CloseHandle()`
`IRP_MJ_CLOSE`	Close the handle	`CloseHandle()`
`IRP_MJ_READ`	Read data from device	`ReadFile()`
`IRP_MJ_WRITE`	Write data to device	`WriteFile()`
`IRP_MJ_DEVICE_CONTROL`	Control operation	`DeviceIoControl()`
`IRP_MJ_INTERNAL_DEVICE_CONTROL`	Control operation from other drivers	
`IRP_MJ_SHUTDOWN`	System shutting down	`InitiateSystemShutdown()`

Table 2 – Some common IRP types.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pression or encryption to a file system or device handler without altering the underlying driver design.

To Win32, a driver appears as one or more file devices. So an application can open a device file, read and write to it, and then close the handle. A driver can also handle DeviceIoControl() requests to do any sort of I/O. Microsoft's NT drivers have various I/O control requests defined. A DongLpt driver for a dongle on the parallel port might provide devices \\.\DongLpt1 for the first parallel port, \\.\DongLpt2 for the second, etc. \\.\DongLpt1 is just a Win32 symbolic link to the real hidden NT kernel device name \Device\DongLpt0. Note that kernel device numbers are zero-based by convention. (See the panel '*DOS device support*' for information on supporting DOS and Win16 applications with your NT drivers.)

Be prepared

Arm yourself with a suitable compiler such as Visual C++ and get a Microsoft Developer Network Level 2 (or above) subscription. Install both the Platform SDK and NT DDK. The DDK examples are particularly useful as they are the source code of many of Microsoft's actual NT device drivers. They show how real device drivers are put together and can yield some undocumented features. For example, there is documentation for the parport driver interface. However only by looking at its source code will you find an extra internal device I/O control request.

Brace yourself for a development style that went out with the ark: the command line. You may also need several NT machines available for deep debugging.

Most people will just write their driver in plain C and use Microsoft's command line utility build. *Free* (retail) and *checked* (debug) versions of drivers can be built. The rebase utility will strip out all remaining symbols from a final release retail version. A Microsoft technical note says that you can write in C++ and debug from the Visual C++ IDE. I have not tested this approach.

There is a lot to learn before starting coding. Drivers need to be well designed from the start. Remember that data areas can be accessed by several different parts of your driver, which may be running at more or less the same time (or even at the same time if in a multi-processor machine). Several Win32 programs could slew off lots of overlapped I/O requests. So think re-entrant and avoid global variables. And remember that all strings must be Unicode.

A driver design might not take the expected course. The NT parallel port printer driver does not use interrupts, for example. The parallel port interrupts often conflict with other devices, so it uses a system thread to poll the printer.

Before getting started, it is worthwhile tuning your NT start-up. Cut out anything that is unnecessary as your computer will probably need quite a lot of reboots. It is easy to get device names left behind when a test driver unloads. There are quite a few alterations needed in the registry; some changes are only recognised at boot time. However, once past the initial stages, new versions of a driver can be installed using the Control Panel Drivers window. Hopefully you will not see NT's bugcheck Blue Screen of Death too often.

Do not be afraid to copy techniques from existing code: that's what all the DDK source is there for.

Driver structure

An NT driver has one standard entry point, DriverEntry(). This discovers any hardware, creates any devices and loads up a table of other entry points. Apart from the DriverUnload() routine, all the other main calls will be the result of I/O Request Packets (IRPs), discussed below. Various callback routines can be set up; as well as interrupt handlers, there are deferred procedure calls, and completion and cancel routines. A useful convention is for all a driver's routines to have a common name prefix, eg DongDispatchOpen(), DongDispatchWrite().

Understanding hardware

If you are new to device drivers then your first job will be to fully understand how the hardware works. If talking to another device at the far end of a link, try to get its source code as well. If they have not done it yet, get your hardware engineers to finalise their spec!

Standard parallel and serial ports have a well-defined interface. However, some devices at the other end of the wire may not. There are several flavours of parallel port configurable in the BIOS set up, for example unidirectional or bidirectional. Unidirectional parallel ports can be made readable by reading data 4 bits at a time via the status port.

I/O devices may be on the motherboard or on one of the various types of bus. A device may need to be serviced by the processor, or DMA transfers can be set up. Perhaps the card can even act as a bus master itself.

Hardware may or may not produce interrupts, and signals may be level sensitive or edge triggered. Allow time for data values to become stable on output lines before toggling a signal wire. Very slow inputs may need to be de-bounced. Devices have a habit of timing out, running out of paper, not being turned on, causing framing errors, CRC errors, overrunning their buffers, etc.

Plug and Play allows hardware devices to be configured automatically by the operating system. Plug and Play is not a part of NT yet so extra effort is needed to set up such devices at the moment.

For each routine, note carefully which interrupt level it runs at. All the IRP dispatch routines run at PASSIVE_LEVEL while interrupt routines run at one of the processor-specific DIRQLs. In between, deferred procedure calls run at DISPATCH_LEVEL.

There are different things you can and cannot do at each interrupt level. If running at DISPATCH_LEVEL or higher, you must not touch paged memory. And note that these routines are usually not running in the context of a user's thread. Interrupt routines need to run very quickly and so usually ask a deferred procedure call to do any post-transfer processing.

There is a data structure for each device, however most working variables will be in the associated device extension defined by the driver. Besides IRPs and devices, there are many kernel data structures. Low down, there is UNICODE_STRING and LARGE_INTEGER. Controller, adapter (DMA) and interrupt objects can only be used by one device at a time. Zone buffers, look-aside lists and linked lists are different ways of organising memory.

Use spin locks to guard access to data areas. The Cancel spin lock is used to protect access to the cancel fields of an IRP. It is a useful cheat to use this Cancel spin lock to guard data areas in all the dispatch points. A minor point to note is that the status values returned to the I/O Manager are not identical to the values Win32 programmers see, ie a non-obvious mapping occurs.

Common IRPs

As described above, a separate handler is required for each IRP. Not all IRP function codes need be implemented, but create, cleanup, close and read or write are a useful minimum (see Table 2 for a list of the common IRPs). An IRP has a header area followed by several stack locations. Each

stack location holds a function code and various parameters, eg for the read, write and device I/O control functions.

When the first driver processes an IRP, there will be only one stack location. If it passes the IRP to a lower level driver to process, then the next stack location is allocated. Note that the new stack location can have a different function code. As an example, a transport network layer driver could accept data transfers of any length. The lower level driver might have a maximum transfer size, so the transport driver will keep calling the lower level driver until all the data is sent.

Alternatively, a higher level driver can allocate whole new IRPs. The transport driver could therefore allocate all the necessary IRPs and send them all off to the lower level driver at once. Obviously, it would need to check carefully that all the IRPs completed successfully.

With buffered I/O, the I/O manager copies any user write data into non-paged memory automatically (and vice-versa). With direct I/O, the I/O manager locks the user buffer into physical memory for the duration. Direct I/O is slightly more complicated to use but has less overhead.

Installation

The driver executable should be put in the appropriate Drivers directory, eg `\WINNT\System32\Drivers\DongLpt.sys`. Various entries are needed in the registry to make NT realise a driver is there. Use REGEDT32 instead of RegEdit as it can handle all the necessary registry types.

DongLpt's main driver registry key is `HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\DongLpt`. In here are several standard values, eg if `Start` has a value of 2 then the driver is loaded automatically on re-boot. A driver's `Group` and which groups and drivers must be loaded before it does can be specified. A driver may well have a `Parameters` sub-key. This could have an `ErrorLogLevel` value which indicates the level of event log messages required.

For the final cut, you can write a script file or write an installation program by hand. The Win32 Service Control Manager functions can be used to install, start and stop drivers, so a reboot will usually not be necessary.

It is best to write a driver in stages, checking that each part works before moving onto the next. First, get it to load and unload. Then find the hardware, allocate it on load and release it on unload. Make the devices and symbolic links on load and release them on unload.

Now start handling IRPs. Initially just dispatch these to be run straight away in your Start I/O routine. Then they could be put in a driver's own internal queue for processing later. Now catch interrupts. Time-outs can be caught with the basic one second I/O timer or custom timers can be set for any time interval. In NT 4.0, these can fire repeatedly, while earlier versions were one-shot.

Microsoft recommends not tying up the processor for more than 50 microseconds at a time. For lengthier interactions, consider using a design based on system threads. Event, mutex, semaphore and timer objects may be used to coordinate thread activities. Ensure that the thread is told to exit when it is not needed, as the kernel will not stop it if you forget.

For debugging, I found that writing messages to NT's event log was the easiest way to find out what the driver was up to, a bit like putting `printf` statements in. Write the event logging with the first bit of code. Messages for the event log are stored in an `.mc` file and compiled into a resource using the `mc` utility. Source code level debugging is possible between two NT machines. The development machine runs retail NT and the `windbg` utility. Debug info is passed along a serial line to the other computer running the NT checked kernel build and the test driver. Have a proper network connection available for transferring files.

DOS device support

An NT device driver can be accessed from legacy DOS or Win16 programs, provided certain rules are followed.

Only standard DOS device names can be used, eg `LPT1`, `COM1`, etc. Note that `LPT1`, etc. is output only, while `COM1`, etc. is bidirectional.

A symbolic link must be set up from a DOS device name to an NT kernel device name. NT's own parallel and serial drivers will try to allocate any appropriate device names. One simple approach is to make `COM9` link to the desired driver. This corresponding device could talk to the parallel port.

If you really need your `DongLpt` driver to allocate `LPT1` for example, then you need to stop NT allocating it. In fact, what you need to do is allocate `LPT1` before NT does, by setting up the driver group load order correctly.

The NT parallel port arbitrator `parport` driver is in the group `Parallel Arbitrator`. The parallel class driver `parallel` is one of several drivers in group `Extended Base`. If `DongLpt` loads after `parport` and `Parallel Arbitrator` but before `Extended Base` then it can reserve the name `LPT1` before `parallel` does. Note that this technique implies that the driver must start at boot time and so will reserve `LPT1` for the entire NT session. In contrast, making a link from `COM9` allows a driver to be started only when needed.

So far I have not found out how to allocate `AUX` before NT does.

Non-paged memory is a precious resource. The `alloc_text` pragma can be used to mark appropriate routines as pageable, and initialisation routines as discardable. The DDK has a test suite to check drivers in stressful situations. Once you're happy with its performance, a driver can be submitted to Microsoft's compatibility labs for certification testing.

Example – the DongLpt driver

As an example I have written some initialisation code for a `DongLpt` driver which talks to a dongle on the parallel port. This code is available on EXE OnLine or directly by ftp at *ftp.exe.co.uk/pub/exestuff/9710_NTdriver.* After initialising its event log, `DriverEntry()` sets the other entry points for the driver. For each of the parallel ports that NT has found, `DongCreateDevice()` first creates an NT kernel device. This driver uses buffered I/O. Then the device extension is initialised.

`DongCreateDevice()` then links to the corresponding NT `parport` device to retrieve information about the port. Finally, the appropriate Win32 symbolic link name is created. `DongGetPortInfoFromPortDevice()` builds a new Internal Device I/O Control IRP for `parport` to retrieve the port information. The routine uses a notification event to wait for `parport` to complete processing of the IRP. Various hardware details are stored on return, then `parport`'s routine `TryAllocatePort()` is called directly by `DongLpt` when it wants to do some I/O. `FreePort()` makes the port available again.

As intimidating a task as it might seem on first inspection, once you have prepared the ground and learned the necessary techniques, writing NT device drivers is a relatively straightforward process. Certainly a useful skill to have in your repertoire. ■

Chris Cant runs PHD Computer Consultants Ltd. You can reach him at chris@phdcc.com, or go to his Web site at http://www.phdcc.com/.

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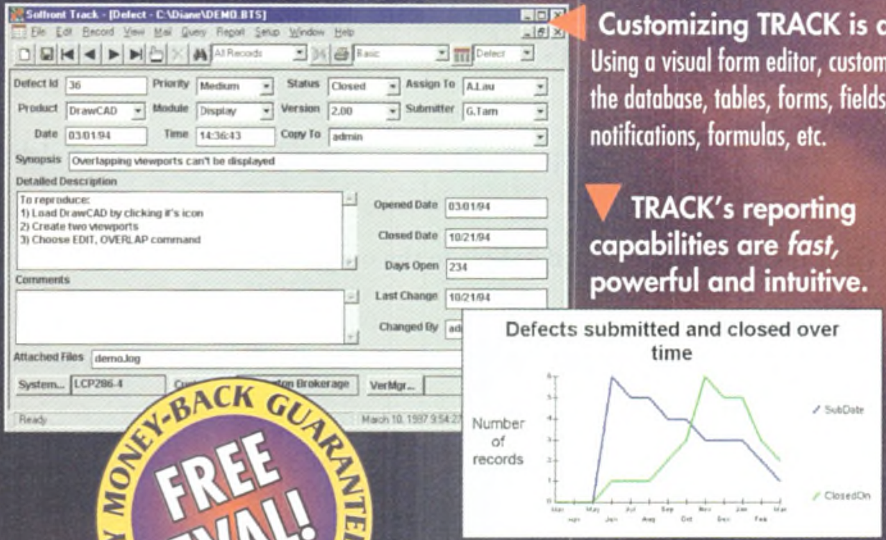

Soffront Track - [Defect - C:\Diane\DEMO.BTS]

Defect Id: 36 | Priority: Medium | Status: Closed | Assign To: A.Lau

Product: DrawCAD | Module: Display | Version: 2.00 | Submitter: G.Tam

Date: 03/01/94 | Time: 14:36:43 | Copy To: admin

Synopsis: Overlapping viewports can't be displayed

Detailed Description:

To reproduce:
1) Load DrawCAD by clicking it's icon
2) Create two viewports
3) Choose EDIT, OVERLAP command

Opened Date: 03/01/94
Closed Date: 10/21/94
Days Open: 234
Last Change: 10/21/94
Changed By: ad

Comments:

Attached Files: demo.log

System...: LCP286-4

Ready | March 10, 1997 9:54:27

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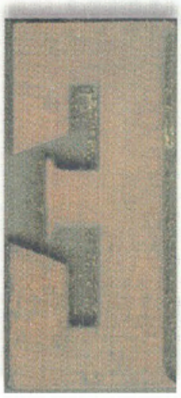
LATX typesetting as a programming language

LaTeX is a system for typesetting documents that replaces the notion of What-You-See-Is-What-You-Get with standard ideas from conventional programming languages. Mark Harman demonstrates the power of this inheritance.

Anyone who has used a What-You-See-Is-What-You-Get (WYSIWYG) editor, wordprocessor or DTP package will have probably had two frustrations:

WYSIWYG always seems to be a lie – What you see is rather *similar* to what you get, or what you see is *almost always* what you get, or what you see *would* be what you got had your printer had the right fonts, but what you see is seldom *exactly* what you get.

WYSIWYG is restrictive – Suppose you can't get to see what you want? What you see is what you get has the additional, and tacit implication that what you cannot manage to see you also cannot get. How often have you wanted something to look slightly different (or perhaps very different) but your editor will not allow it?

LaTeX (pronounced Lateck) is a typesetting system which does not follow the WYSIWYG approach. Instead, it is inspired by programming languages. It inherits all the advantages of programming languages and some of their disadvantages. Instead of composing a document 'at the screen' (the WYSIWYG approach), a LaTeX document is a *program* which tells the LaTeX system how to create the document. The program is compiled using a LaTeX compiler to produce a document which can be printed or viewed.

This may sound a little odd to someone familiar with the WYSIWYG approach, but anyone who enjoys (or appreciates) the power and flexibility of a high-level programming language, will soon find that LaTeX is simply a better way of designing documents.

In this article, I will explain a little of the LaTeX language, enough to allow you to download a free LaTeX system and to write some normal documents. There will not be time to cover all of the features of LaTeX (this would take a whole book), but I hope to leave you with a strong feeling for ways in which writing a document could, using LaTeX, be a similar activity to writing a program.

A simple LaTeX source file

Figure 1 contains a simple LaTeX source file. The first line is a predefined LaTeX command. All commands start with a backslash character. The command in the first line establishes the global properties of the document to be typeset. The document style 'article' is the style used for a short article. Other styles include book, report, thesis and so on. Each document style changes global parameters which describe the layout of your document. For example, in the book environment, running headers are produced giving the chapter title and author on alternate pages.

Like all good programming languages, all this is, of course, entirely configurable. However, like most programming languages, the more flexibility you want, the more you will find you need to know of the underlying programming language. Fortunately the default settings for all of the LaTeX environments give very pleasing results, so it is possible to get a long way without having to know too much of the underlying language. What you get is *likely* to be what you want, and if it is not, then at least you will be able to change it.

The text of the document itself is contained within the commands `\begin{document} ... \end{document}`, `\begin{}` and `\end{}`

```
\documentstyle{article}
\begin{document}
hello world
\end{document}
```

Figure 1 – A Simple LaTeX document.

```
\documentstyle{article}
\begin{document}
\section{Introduction}
This is a fairly short document and this is its
introduction.

\section{Rationale}
The document is so short because it is simply an
example.
```

Figure 2 – Sections.

```
\documentstyle{article}
\begin{document}
\section{Introduction}
\label{intro}
This is a fairly short document and this is its
introduction.

\section{Rationale}
A brief introduction to this document can be found in
section \ref{intro}.
\end{document}
```

Figure 3 – Symbolic references.

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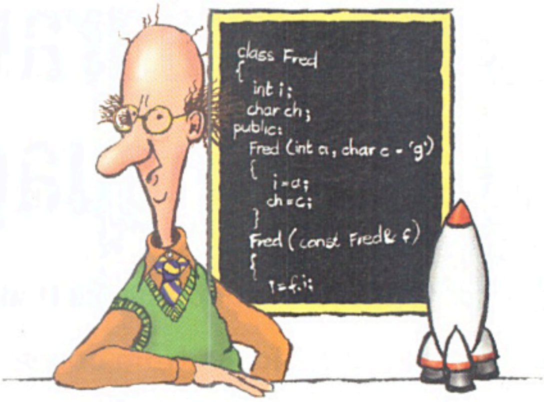

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are commands which open and close an environment. All documents (and fragments of documents are typeset within an environment. We can also nest environments, as we shall see later.

Space characters are unimportant to LaTeX; one space is a good as one hundred. New lines can also be inserted anywhere, but two or more new lines are used to denote the point at which one paragraph finishes and another starts. When you print out the final document, LaTeX will left and right justify the text (inserting hyphens, where pure justification would lead to unattractive output).

A large document usually consists of a number of sections, which may contain subsections. A new section is introduced into LaTeX using the `\section` command, and a new subsection with the \subsection command. The LaTeX source code in Figure 2 describes a document with two sections, the titles of which will be 'Introduction' and 'Rationale'. Notice that, in the source code we do not need to give the sections a section number. LaTeX will do this for us when it compiles the document. Thus, 'Introduction' will be section number 1 and 'Rationale' will be section number 2. If we were to swap the order in which the two sections occur (by cutting and pasting the source code), then 'Rationale' will become section 1, while 'Introduction' will become section 2 – automatically.

An important question now arises: How would I cross-reference from one section to another? For example, suppose I want to refer to the section 'introduction' in the section 'rationale'. The way that this is achieved illustrates the first advantage we gain from the LaTeX way of doing things.

Symbolic references

Because a LaTeX source file is a program, you can use symbolic names to refer to parts of the document. This makes cross-referencing a pleasure, as the cross-reference is a logical entity, referring to some named part of the document. If this named part of the document should be moved, then all we have to do is recompile.

To introduce a symbolic reference, we use the `\label{}` command, and to refer to it we use the `\ref{}` command. Figure 3 illustrates this. `\label{intro}` introduces a symbolic name, label, whose value depends upon the context in which the `\label` command appears. In this case, since the `\label` command is used in the first section of the document, the value assigned to 'intro' will be 1. The `\ref{}` command simply produces the value of the label. Now if I move the introduction to a new position, for instance, after the 'Rationale' section, the value of intro will change to 2, and the cross reference in 'Rationale' will thus point to the new location of the section 'Introduction'.

This style of writing forces us to think of the document at a logical level rather than at the physical level. It would be foolish to write 'as we saw earlier in section \ref{intro}' for example, because we may move the label 'intro' to a point after the reference. Instead of thinking of our document as a monolith of text occurring in a particular order, we think of it at a higher level of abstraction, as a collection of sections which we are free to move around. We can even reuse sections from one document in another, and providing our symbolic names are unique, we will find that all the cross references work out correctly.

Some more environments

LaTeX has lots of useful predefined environments. Suppose we want to produce a sequence of points using bullets. We can do this with the 'itemize' environment, the source code in Figure 4 will produce a document which lists the three principal states of matter, one per line and each preceded by a bullet point mark. In many respects the LaTeX way of designing a document is similar to the HTML way of doing things. For example, the itemize environment is rather like the unsorted list environment in HTML.

Sometimes we want to put items into a sorted, numbered list. This is achieved with the enumerate environment. Figure 5, shows a nested sequence of enumerated items, describing the four eras of geological time and the periods within them. LaTeX uses different numbering systems for each level of nesting (Arabic numerals for level one, alphabetic characters for level two, roman numerals for level three). This, as with everything else, can be changed if we so wish.

To emphasise a portion of text, it is enclosed in the 'em' (emphasise) environment, so we simply write '\begin{em} help! \end{em} she cried.' to emphasise the word 'help' (and the exclamation mark which follows it).

Procedures

In a conventional programming language, the ability to define procedures gives the programmer considerable flexibility. In LaTeX too, we can define procedures for laying out text. The simplest form of procedure is a parameterless one. It allows us to name some portion of source code and then call it up. Suppose I am writing a document in which I want to refer to an item of fruit, but I haven't yet decided whether it is to be an apple, orange or pear. I could introduce a procedure called 'fruit', and put an arbitrary fruit name in its body. When I've finally decided which fruit I want to refer to, then I will *only* have to change the body of the procedure; all the points at which the procedure is called will then automatically take account of the change to its body.

```
\begin{itemize}
\item Solid
\item Liquid
\item Gas
\end{itemize}
```

Figure 4 – The Itemize environment.

```
\begin{enumerate}
\item Cenozoic
   \begin{enumerate}
   \item Quaternary
   \item Tertiary
   \end{enumerate}
\item Mesozoic
   \begin{enumerate}
   \item Cretaceous
   \item Jurassic
   \item Triassic
   \end{enumerate}
\item Paleozoic
   \begin{enumerate}
   \item Permian
   \item Carboniferous
   \item Devonian
   \item Silurian
   \item Ordovician
   \item Cambrian
   \end{enumerate}
\item Precambrian
\end{enumerate}
```

Figure 5 – The enumerate environment.

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In LaTeX, a procedure is called a command, and a new one is created with the command `\newcommand`. Commands are often called macros because LaTeX expands calls to these when it meets them in the body of the document. Figure 6 illustrates the use of a simple parameterless macro. When compiled, the LaTeX source in this figure produces the text 'The first apple to appear will be the first apple I shall eat.'

To be entirely fair, this *could* be achieved, perhaps more simply, with a WYSIWYG wordprocessor, simply by performing a search and replace. (Of course, this would *not* have worked had the sentence been 'the first \fruit to appear is the apple of my eye'!) This is, however, only a simple example of what we can do with LaTeX macros. They really come into their own when we provide them with parameters.

Parameters

Suppose I am writing a document about array handling. I might want to describe an algorithm for finding the largest element of an array. To make the document more generic and to save retyping large sections of it, I could produce two versions, each specific to a particular programming language, for example, Basic and C. Using commands, I can avoid using the particular syntax of arrays, or at least I can capture the syntactic differences in a single command, making it far easier to adapt my document to different programming languages.

Figure 7 illustrates this. In the command definition for `\lookup`, the `[2]` tells the LaTeX compiler that the command takes two parameters, the first is referred to as `#1` and the second as `#2`. In a call to a command, the parameters are supplied one after the other in curly brackets. So the call `\lookup{S}{2}`, will produce the text 'S(2)'. This is the Basic version of the `\lookup` command. If we replace it with the version in Figure 8, then we obtain the same document, but with array references in square brackets. This is the C version of the document. Notice that the difference between the two LaTeX source documents is precisely *two characters*, namely, the two characters which make up the difference between array referencing in Basic and C.

As with programming language procedures, it is possible to call one procedure from the body of another and to use the result of a procedure call as the actual parameter to another. So, for example, we can write `\lookup{A}{\lookup{B}{1}}` which produces either the text 'A(B(1))' or 'A[B[1]]' depending upon whether we are using the Basic or the C version of the `\lookup` command.

Variables

LaTeX has its own variables, on which we can perform simple arithmetic (more advanced forms of arithmetic are possible, but addition is usually all that is required for typesetting). I will look at two simple examples of the way in which we might use variables, both of which will be familiar to programmers; the counter variable and the flag variable.

Suppose we want to include a sequence of numbered points in a document. We can use a counter variable to number each point, and write a few simple commands to control the numbering. Figure 9 illustrates this. The counter is declared using the command `\newcounter`. It is set to a specific value using the command `\setcounter`. The command `\point` is used to printout the current point number and to step the counter (to add one to its value). The command `\the<name>`, for some counter `<name>`, causes the value of the variable to be printed. This command can be used with any variable, not just those that the user has introduced, so for example `\thesection` prints out the current value of the section variable. In Figure 9 we use the `\point` command to print out three points. A nice feature of this approach is that we can vary the order in which the points occur and the numbering will change accordingly.

Now let's see how we can use variables as flags to choose what text is produced in a document. As we shall see, the combination of flags and macros allows us to write very generic documents, which can be instantiated simply by choosing a suitable value for the flag. Consider again the problem of writing a document about arrays, where we wanted two forms of the command `\lookup`, one for Basic and one for C. It would be better if we could use a flag in our LaTeX source to indicate whether the language was to be C or Basic. All that we would then have to do is to give the flag the correct value before compiling the document. Figure 10 illustrates this.

The first thing to do is to include the option '`ifthen`' in the document style declaration. This allows us to use the command `\ifthenelse` later on. Next we declare a counter variable, '`language`', which is set to 1 if the language is to be Basic and to 0 if it is to be C. The `%` symbol is used by LaTeX for comments; any text which appears after a `%` symbol (and before the end of the line) is ignored by the LaTeX compiler. Next we set the counter to 1, using the command `\setcounter{language}{1}`, so the text we shall produce will, in this case, be specialised for Basic. This specialisation is achieved using the modified version of the `\lookup` command. The new version of `\lookup` uses the built in command `\ifthenelse` to test the value of the 'language' variable. The format of an `\ifthenelse` command is

```
\documentstyle{article}
\newcommand{\fruit} { apple }

\begin{document}
The first \fruit to appear will be the first \fruit I
shall eat.
\end{document}
```

Figure 6 – Parameterless commands.

```
\documentstyle{article}
\newcommand{\lookup} [2] { #1(#2) }

\begin{document}
To find the biggest element of the array A, store the
first element, \lookup{A}{0}, in the variable b. Next
enter a loop, controlled by the variable i, starting 1
and proceeding to the end of the array. At each point in
the loop, compare element i, \lookup{A}{i}, with the
value in b. If \lookup{A}{i} is larger than b, then
assign \lookup{A}{i} to b.
\end{document}
```

Figure 7 – Parameters: Basic version.

```
\documentstyle{article}
\newcommand{\lookup} [2] { #1[#2] }

\begin{document}
To find the biggest element of the array A, store the
first element, \lookup{A}{0}, in the variable b. Next
enter a loop, controlled by the variable i, starting 1
and proceeding to the end of the array. At each point in
the loop, compare element i, \lookup{A}{i}, with the
value in b. If \lookup{A}{i} is larger than b, then
assign \lookup{A}{i} to b.
\end{document}
```

Figure 8 – Parameters: C version.

```
\newcounter{pointnumber}
\setcounter{pointnumber}{1}

\newcommand{\point} { Point \thepointnumber
\stepcounter{pointnumber} }

\point
Some text associated with one of the points

\point
Some text associated with another point

\point
```

Figure 9 – Counter variables.

`\ifthenelse{<test>}{<then_branch>}{<else_branch>}`. It behaves just like an `if` statement in a conventional programming language. If `<test>` evaluates to true, the text in the `<then_branch>` is produced, if false, the text in the `<else_branch>` is produced.

Using this flag we might write lots of commands, each of which produces the text for a particular kind of statement, the language depending upon the value of the flag counter variable. In this way we could write a *generic* document about programming and simply set the flag appropriately to produce the specialised version of the document we want.

Figure 10 shows how we might do this. We define commands which produce Basic or C syntax for array lookup (using the `\lookup` macro, as described above), array updating and, more elaborately, a command which produces the appropriate syntax for a 'for' loop. The last of these requires some further explanation.

The difference between a for loop in C and in Basic is largely syntactic, and we can use the flexibility of LaTeX to escape from these syntactic details. The command `\forloop` uses the flag counter 'language' to decide whether to lay out the four elements of the loop in Basic or C style. This allows us to write some text about array initialisation and loops, *without* having to decide which language the target document will refer to.

Notice that in the C version of the for loop syntax the curly brackets that enclose the statements of the body of the loop are written as `\{ ... \}`, rather than as `{ ... }`. This is because the curly bracket symbols already have a meaning to LaTeX, so to get it to print curly brackets we prefix them by a backslash.

In Figure 10, we set the counter language to 1, so the output produced will be for Basic. From the source code in Figure 10, LaTeX will produce the output in Figure 11. If we want to produce a document which says the same thing about C arrays, we simply have to change the line `\setcounter{language}{1}` to `\setcounter{language}{0}`. It's that easy.

Mathematics

LaTeX is often (and rightly) praised for the way in which it allows for the typesetting of complex mathematics. Many modern mathematics, computing and other science and engineering texts are typeset using LaTeX.

Mathematical text can either be laid out 'in-line', in which case it appears in the sentence in which it is typed, or in 'display mode', in which case it appears centred on a line of its own – 'displayed' as it were. All the standard mathematical symbols and forms of text are provided for using commands. As LaTeX has been around for so long and has been used developed and enhanced by so many mathematicians around the world, it is extremely unlikely that there exists any form of mathematical output that has not been catered for by someone. A quick trawl through your bookshelf will probably reveal acknowledgements to LaTeX in several computing and mathematics textbooks, as it is often used to prepare technical books, allowing the author(s) to provide camera-ready copy for their publishers.

There is also a thriving LaTeX user community which ensures that all of this valuable information is collected, maintained and updated. All LaTeX developments are entirely backwards compatible, so there's no need to worry that your documents will somehow 'go out of date'.

Reuse

I estimate that it takes between two days and one week to become productive using LaTeX. Many readers may consider this unacceptable when compared to the lead-in time for WYSIWYG editors. Certainly, if

```
\documentstyle[ifthen]{article}
\newcounter{language} % set to 1 for Basic and 0 for C
\setcounter{language}{1}

\newcommand{\lookup}[2]
{
\ifthenelse{\value{language} = 1}  {#1(#2)}  {#1[#2]}
}

\newcommand{\update}[3]
{
\ifthenelse{\value{language} = 1}
        {LET #1(#2) = #3}  {#1[#2] = #3}
}

% The forloop command takes four parameters
% 1. The lower bound of the loop
%    - an integer or integral expression.
% 2. The upper bound of the loop
%    - an integer or integral expression.
% 3. The loop control variable - an integral variable.
% 4. The body of the loop - a sequence of statements.
% The flag counter language, is used to determine the
% language in which the syntax of the loop is written.
\newcommand{\forloop}[4]
{
\ifthenelse{\value{language} = 1}
{
FOR #3 = #1 TO #2

#4

NEXT #3
}
{
for(#3=#1;#3 != #2;#3++)

\{

#4

\}
}

\begin{document}
To store the value 10 in element number 3 in the array
A, we write \update{A}{3}{10}.

To initialise the elements 0 through to 10 in the array
A with the initial value 0, we can use a for loop,
starting at 0 and going up to 10. This would be written
like this

\forloop{0}{10}{i}{\update{A}{i}{0}}

\end{document}
```

Figure 10 – Flag variables.

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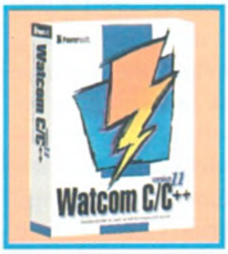

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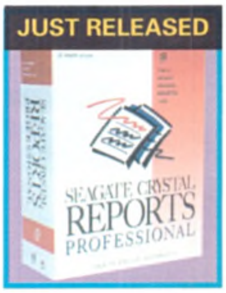

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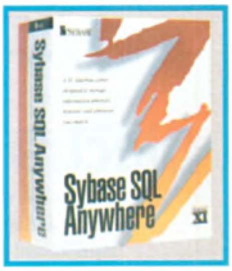

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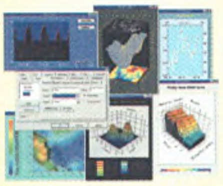
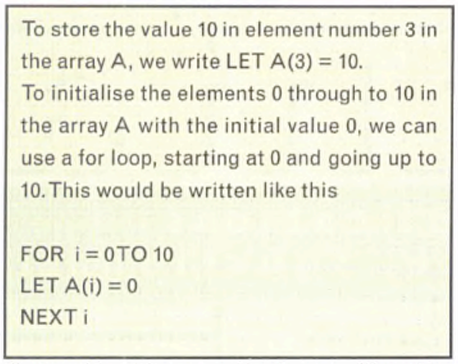


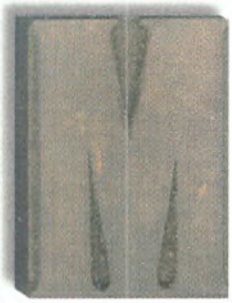


To store the value 10 in element number 3 in the array A, we write LET A(3) = 10.

To initialise the elements 0 through to 10 in the array A with the initial value 0, we can use a for loop, starting at 0 and going up to 10. This would be written like this

```
FOR i = 0TO 10
LET A(i) = 0
NEXT i
```

Figure 11 – The result of compiling the LaTeX source in Figure 10.



you only have to prepare documents such as letters and memos then LaTeX is probably not worth considering. However, if you are concerned with the production of a large amount of text and are prepared to invest in a system that could ultimately save you months of work, then LaTeX may be the answer.

One of the most intangible, yet most attractive advantages experienced by LaTeX users comes from the way in which, like a good programming language, LaTeX supports reuse. Very quickly you will find yourself building up a set of your own personal macros, which will allow you to tailor your documents to your own taste. Reusing parts of a document in another is achieved effortlessly and seamlessly. The seamlessness derives from two aspects of the LaTeX approach. The symbolic naming of parts of a document allows cross-references to be updated automatically as the document is edited. The concept of an environment means that the same piece of source text may look different when included in different contexts. Of course, this directly contradicts the WYSIWYG principle, but this is the essential strength of LaTeX. Many computing journals *[but not EXE, still battling with WYSIWYG – Ed]*, conferences and publishers provide their own LaTeX 'style files', which, when included in a LaTeX source file, automatically lay the document in the form required for publication.

Where to go next

If you are interested in trying out LaTeX for yourself, versions for Windows 3.x and Windows 95/NT can be obtained (for free) from *http://www.eece.ksu.edu/~khc/tex.html.* LaTeX comes as standard on most Unix platforms, and with most Linux distributions, so if you're using one of these try typing 'man latex'. There is an FTP site containing many useful LaTeX tools, macros and related documents at *ftp.tex.ac.uk*.

There are two indispensable books on the subject of LaTeX document writing. Both are highly readable and informative. *LaTeX A Document Preparation System* by Leslie Lamport (ISBN 0-201-15790-X), describes the basic system and is a very good book to get started with. It contains enough information to write immediately most normal documents. *The LaTeX Companion* by Mike Goossens, Frank Mittelbach and Alexander Samarin (ISBN 0-201-54199-8), is more detailed, and covers all the new features added to LaTeX by the LaTeX2e project. This book is useful if you want to write a great many documents using LaTeX and to customise the language to your own tastes. It explains how to achieve all sorts of exotic effects, such as laying text out in a heart shape (perhaps useful for certain documents written just before the 14th of February). Both these books are published by Addison-Wesley.

Logical is better

The LaTeX document preparation system has evolved and improved over the years. It is extremely robust and provides features for writing documents to publishable standards containing text and mathematics. A LaTeX document is described using a programming language, which gives the LaTeX user all the power and flexibility of a conventional programming language. The style of writing forces the user to view documents at the level of their logical organisation, rather than their physical appearance. This is initially a little frustrating, but ultimately it has many advantages such as supporting reuse and creating generic documents which may have several physical instantiations. ■

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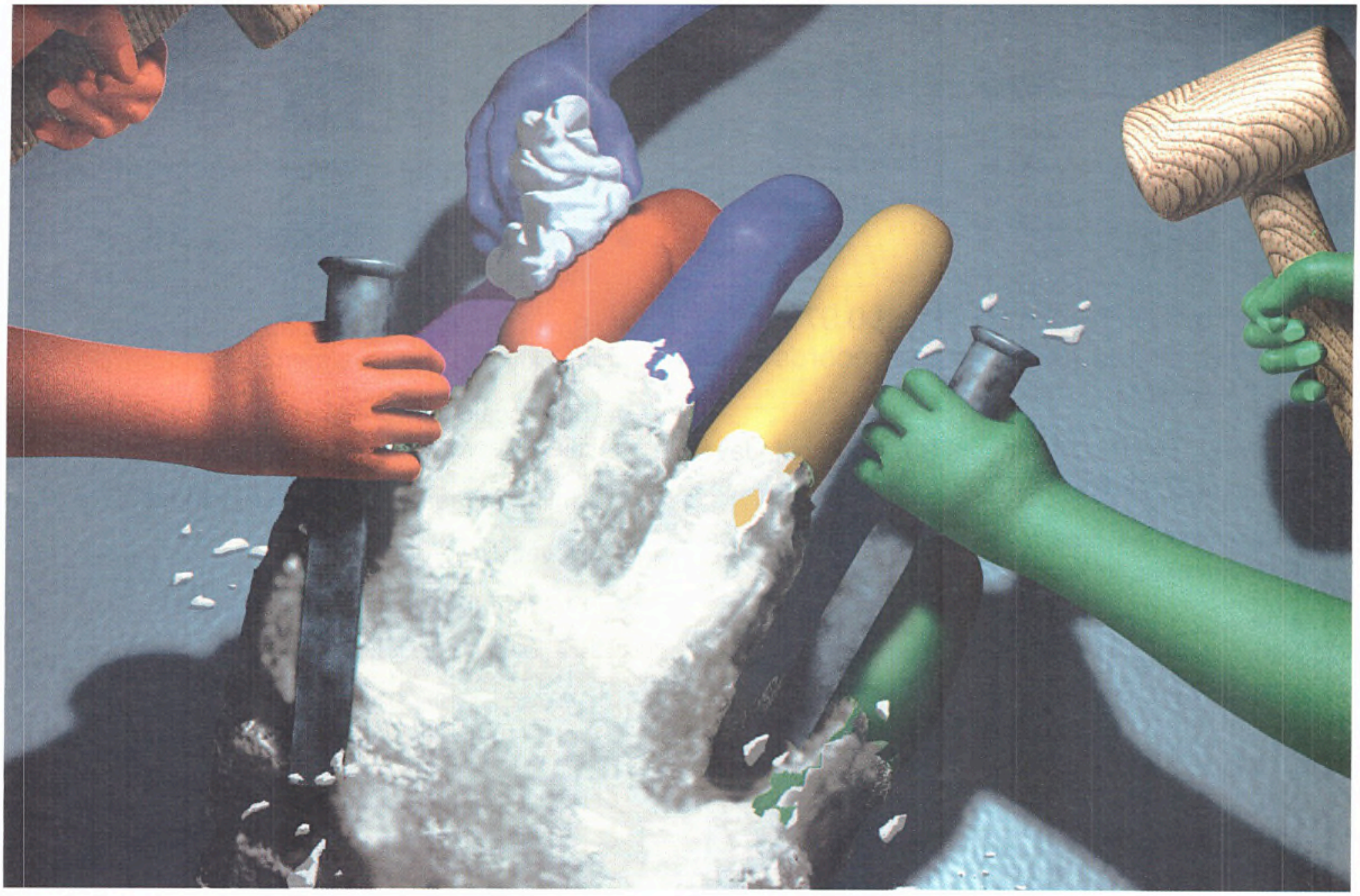

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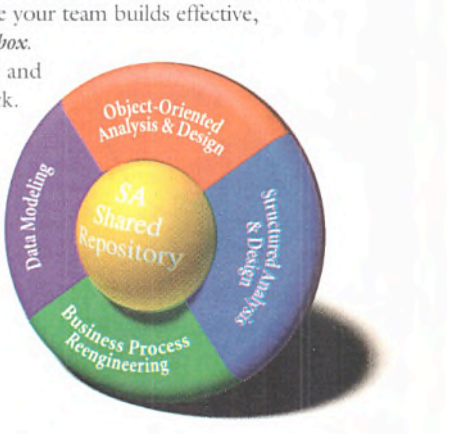
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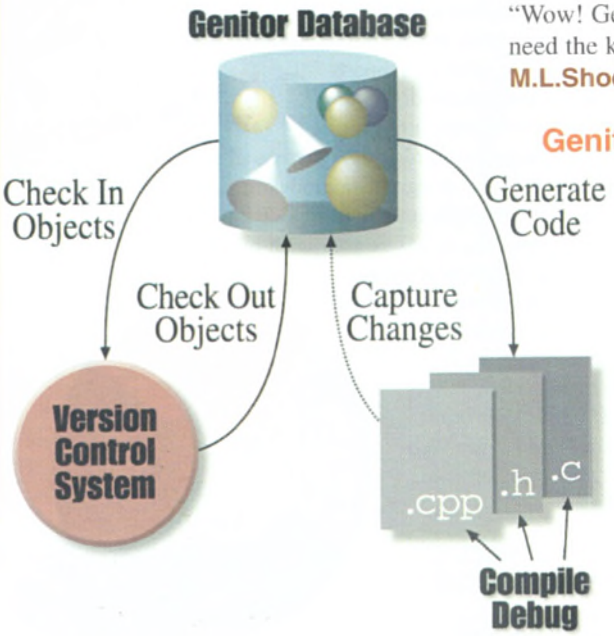

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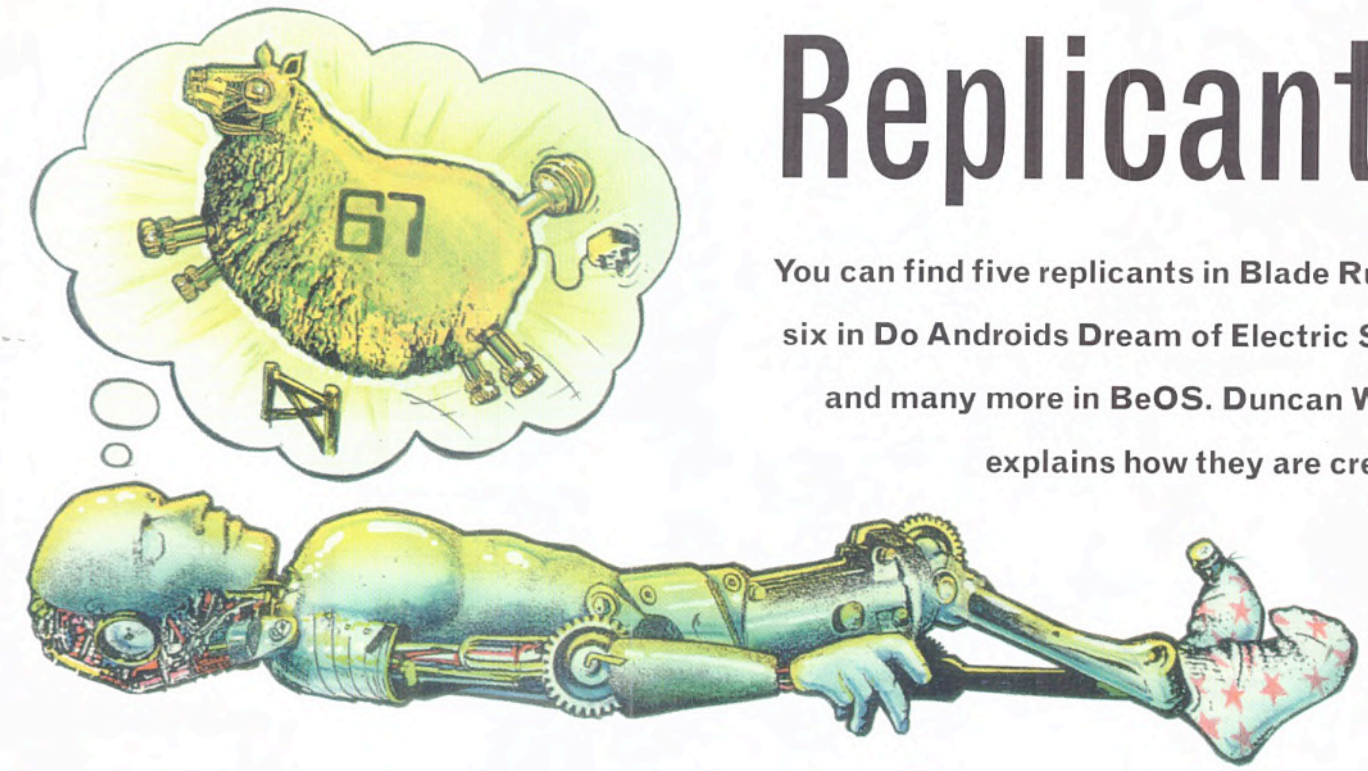


Replicants

You can find five replicants in Blade Runner, six in Do Androids Dream of Electric Sheep and many more in BeOS. Duncan Wilcox explains how they are created.

Replicant technology is a surprisingly simple object embedding feature of BeOS. In this article we'll dissect a replicant object, a replicant container and the protocol that lets you move objects across address spaces and around applications.

Visually a replicant is a view within an application which 'belongs' to another application. From an implementation point-of-view, it's a framework and a set of rules for archiving views and passing them to other applications where they can be unarchived.

The problems that replicant technology solves include archiving an object in a package, moving the package across address spaces to a user-specified target application, locating the object implementation executable, instantiating a C++ object of a class unknown at compile-time, initialising the object with the information in the package and adding it to the target application's views.

The foundation for replicants is the object archiving framework, built around the `BArchivable` class. Archiving an object is the process of saving the minimum amount of information needed to get back to the same state when unarchiving. The `BMessage`, omnipresent information vehicle of BeOS, is the package that will contain the state information.

Every class that might have to be archived and unarchived should have `BArchivable` among its ancestors and override three `BarchivAble` methods: `Archive` to support archiving, `Instantiate` and a constructor accepting a `BMessage` to support unarchiving.

Archiving an object

Archiving an object is simply a matter of creating a `BMessage` and passing it to the object's `Archive` method:

```
BMessage data;
object->Archive(&data);
```

The first information an object should store in the `BMessage` is the data of the parent class, by explicitly calling its `Archive` method. Every class will call its parent `Archive` method, walking up the inheritance tree to the `BArchivable` version of `Archive` which only stores the object's class name.

The class name is acquired through C++ run time type information (RTTI). The Metrowerks compiler only associates RTTI with classes that have a `vtable`, but this is not a problem since `BArchivable` has a few virtual methods and hence a `vtable`, so all of its descendants will have one too.

Class specific data should then be stored in the `BMessage`. Since the data is stored with a descriptive string, just like for global C/C++ namespace, care has to be taken to avoid conflicts in the `BMessage` data namespace. Be's kits prepend an underscore to the names of all data they archive, you should choose a unique convention to prevent this problem.

A replicant is required to store the MIME signature of the executable containing the implementation of the object under the `add_on` name. The signature must be the same as that of the executable (set through the Filetypes preferences). If the executable is an application, the same signature will be used for the `BApplication` constructor.

A typical `Archive` method will look like:

```
long Replicant::Archive(BMessage *data,bool deep) const {
   inherited::Archive(data, deep);
   data->AddString("add_on",
                "application/x-my-container");
   return B_OK;
}
```

The `deep` parameter (which defaults to true) is a flag that signals if the archiving should include other owned objects that are not part of the object being archived (for example sub-views of a view).

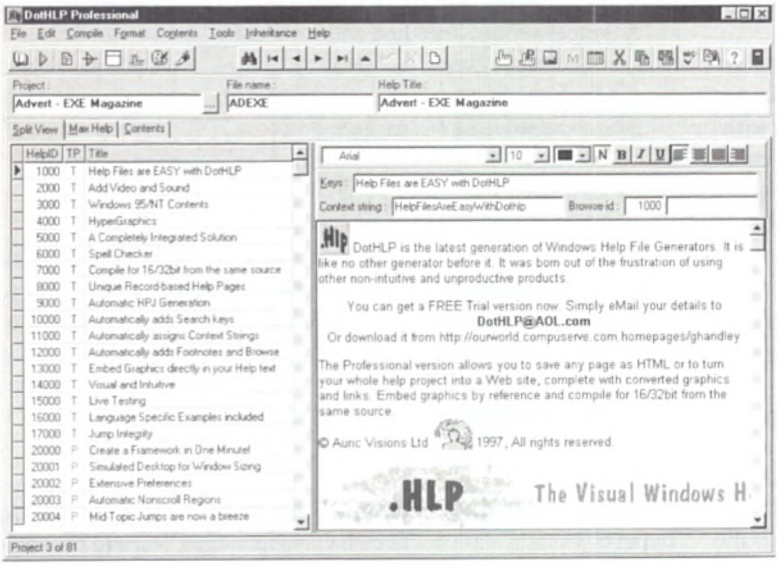
At this point, almost all pieces are in place. The `BMessage` will be *flattened* to cross machine boundaries or to be stored persistently, or it will be directly sent to another application.

Instantiating an object

This is the complex part. Starting from a `BMessage` we have to build a living object of a class not known at compile-time. Normal C++ object instantiation is through the `new` operator followed by the class name and constructor arguments. The compiler will roughly translate this to a memory allocation and constructor invocation for the specified class.

However, this approach requires the class name to be known and fixed at compile-time, because the compiler must know which constructor to call. The solution, sometimes called a *factory* function, is

Illustration: Carl Flint



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BeOS status

The BeOS Preview Release for BeBox, Macintosh and other PowerPC platforms was announced at the beginning of August, check Be's Web site for more details at *http://www.be.com.*

At the Be Developer's Conference (August 4-5) and at the following MacWorld, Be demonstrated a version of BeOS running on Intel processors, scheduled for release at the beginning of 1998

to move the instantiation where the class is known at compile-time, namely in the replicant object class itself. The factory function will have to return a pointer to an object of a class that descends from a known class in the calling code. C++ will take care of casting the pointer so that the calling code gets something meaningful.

`Instantiate` is the factory function for `BArchivable`, and is declared in `BArchivable` itself as returning a pointer to an object of class `BArchivable`, that is certainly known by code calling `Instantiate`. Since `Instantiate` is a static method of `BArchivable`, it can be called without an implicit `this` pointer and hence without compile-time knowledge of the class it refers to.

`Instantiate` must be exported from the executable containing the replicant, for example with `#pragma export on` before and `#pragma export reset` after the method definition (making sure the compiler switches are set to follow the `#pragma` based export conventions).

The archived `BMessage` contains a way of getting to the object implementation: the executable signature and the class name are stored under the `add_on` and `class` names. A helper function of the Support Kit called `find_instantiation_func` will load the executable and return a pointer to a factory function of the correct class.

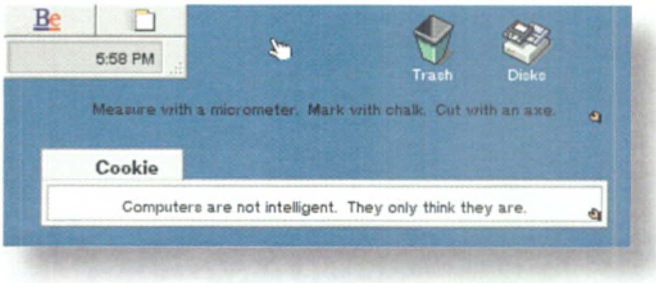
What `find_instantiation_func` has to do is deal with the symbols exported by the executable, and with C++ name mangling. Metrowerks' compiler conforms to the draft ANSI C++ name mangling standards, so an `Instantiate` method accepting a `BMessage *` of a class called `Replicant`, would be mangled as:

```
Instantiate__9ReplicantFP8BMessage
```

where `F` means it's a function and `P` means what follows is a pointer. This is the symbol `find_instantiation_func` would look for (in the executable owning the specified signature) if passed a `BMessage` containing an archived object of class `Replicant`.

Name mangling, in this circumstance, helps in allowing for more than one replicant in one executable, since the mangled symbol includes the class name and `Instantiate`, methods of different classes will have different mangled symbols.

These are excerpts from lists of exported symbols, obtained by running the `listimage` tool against Pulse, Clock and NetPositive, three applications provided with BeOS that have replicant portions:



Measure with a micrometer. Mark with chalk. Cut with an axe.

Cookie

Computers are not intelligent. They only think they are.

Figure 1 – Fortune cookies can be placed on any shelf.

Pulse:

```
TEXT Instantiate__9CPUButtonFP8BMessage
```

Clock:

```
TEXT Instantiate__13TOnscreenViewFP8BMessage
```

NetPositive:

```
TEXT Instantiate__8TResizerFP8BMessage
TEXT Instantiate__8TDraggerFP8BMessage
TEXT Instantiate__8HTMLViewFP8BMessage
TEXT Instantiate__12ProgressViewFP8BMessage
```

A typical `Instantiate` for a class called `Replicant` will look like:

```
Replicant *Replicant::Instantiate(BMessage *archive) {
  if(validate_instantiation(archive, "Replicant"))
    return new Replicant(archive);
  return 0;
}
```

The `validate_instantiation` simply checks that the class name in the `BMessage` matches the one being constructed. The constructor that accepts a `BMessage` is the third `BArchivable` method that should be implemented to build the object from the essential, archived data.

Another helper function, `instantiate_object`, will automatically find the correct `Instantiate` method through `find_instantiation_func` and call it, getting in return a descendant of `BArchivable`. Of course if the original executable disappears, the instantiation will gracefully fail and the `BView` won't be shown.

We have gone from a live object to another live object, passing through a representation (the `BMessage`) that can be moved across address spaces, across a network or stored on disk.

Draggers and shelves

Adding an `Archive`, `Instantiate` and a special constructor to a class is pretty simple. To make interaction with the system even simpler, two additional classes in the BeOS hierarchy complete the picture by letting the user drag a `BView` derived class to other applications.

The `BDragger` is a little widget that looks like a hand, and is designed to be attached to a replicant view (remember to select Show Replicants from the Be menu to show the `BDraggers` and be able to use Replicants). When the user clicks on the dragger, the dragger will create a `BMessage` of type `B_ARCHIVED_OBJECT`, fill it via the `Archive` method of the view it's attached to, and prepare for a drag. The following line will add a dragger to the view, attaching it to the specified target view:

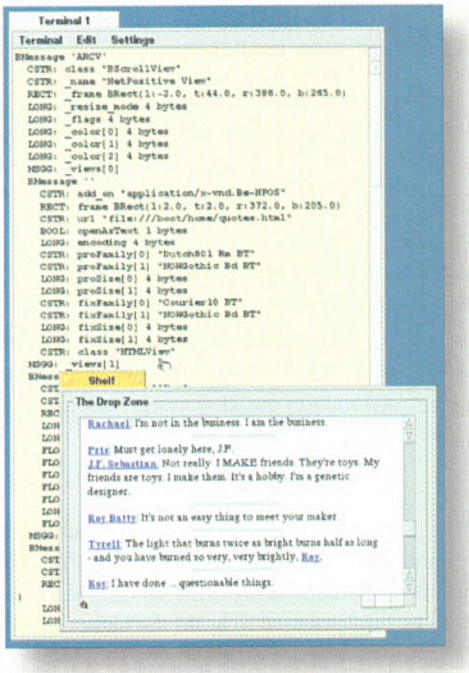
```
view->AddChild(new BDragger(bounds, target));
```

Vice-versa, instantiation of a replicant in a container can be simplified by attaching a `BShelf` to a container view. The `BShelf` which derives from a `BHandler` (basically a participant in a message handling hierarchy), will watch for `B_ARCHIVED_OBJECT` messages.

When it receives a `B_ARCHIVED_OBJECT`, the `BShelf` will go through the instantiation process, including attempting to cast the `BArchivable` object returned by `instantiate_object` to a `BView` (using RTTI and the C++ `dynamic_cast` operator) and adding the resulting `BView` to the view it's attached to. The simplest way to attach a shelf to a `BView` is through something like:

```
new BShelf(view);
```

A `BShelf` can also be associated with a stream thus trivially adding persistence to contained objects. Finally a `BShelf` descendant can override some methods that allow it to selectively reject dropped replicants based on their `BMessage`, for example when they are oversized.



```
BMessage 'ARCV'
  CSTR: class "BScrollView"
  CSTR: _name "NetPositive View"
  RECT: _frame BRect(l:-2.0, t:44.0, r:386.0, b:265.0)
  LONG: _resize_mode 4 bytes
  LONG: _flags 4 bytes
  LONG: _color[0] 4 bytes
  LONG: _color[1] 4 bytes
  LONG: _color[2] 4 bytes
  MSGG: _views[0]
  BMessage ''
    CSTR: add_on "application/x-vnd.Be-NPOS"
    RECT: frame BRect(l:2.0, t:2.0, r:372.0, b:205.0)
    CSTR: url "file:///boot/home/quotes.html"
    BOOL: openAsText 1 bytes
    LONG: encoding 4 bytes
    CSTR: proFamily[0] "Dutch801 Rm BT"
    CSTR: proFamily[1] "MONGothic Bd BT"
    LONG: proSize[0] 4 bytes
    LONG: proSize[1] 4 bytes
    CSTR: fixFamily[0] "Courier10 BT"
    CSTR: fixFamily[1] "MONGothic Bd BT"
    LONG: fixSize[0] 4 bytes
    LONG: fixSize[1] 4 bytes
    CSTR: class "HTMLView"
  MSGG: _views[1]
  BMess
    CST
    CST
    REC
    LON
    LON
    FLO
    FLO
    FLO
    FLO
    FLO
    LON
    FLO
  MSGG:
  BMess
    CST
    CST
    REC
}
    LON
    LON
```

Rachael: I'm not in the business. I am the business.

Pris: Must get lonely here, J.F.
J.F. Sebastian: Not really. I MAKE friends. They're toys. My friends are toys. I make them. It's a hobby. I'm a genetic designer.

Roy Batty: It's not an easy thing to meet your maker.

Tyrell: The light that burns twice as bright burns half as long - and you have burned so very, very brightly, Roy.

Roy: I have done ... questionable things.

Figure 2 – NetPositive is a very sophisticated replicant, with a few nested views. Part of the dump of the first (and most interesting) view is shown in the Terminal window.

A simple replicant

Cookie is a simple replicant that shows fortune cookies in a window. The full code of the application is available on EXE OnLine and directly via ftp at *ftp://ftp.exe.co.uk/pub/exestuff/9710_Replicants*. A `BDragger` attached to the `Cookie` view object lets the user drag the cookie to the desktop, to the demo Container application or to any other `BShelf`. Double clicking in the view will load another fortune cookie.

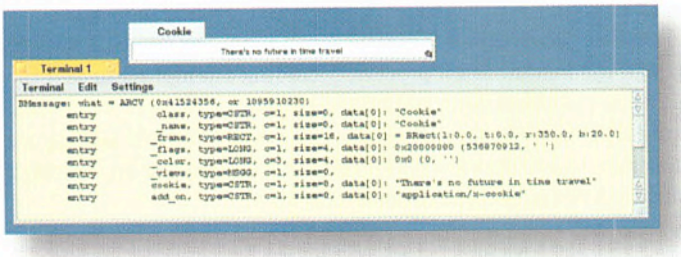
The `Cookie` class code is very straightforward. The three `BArchivable` methods are implemented to support replication. A regular constructor and destructor are implemented for use within the application. The 'engine' is the `NewCookie` method that uses Posix-like code to fetch a random fortune. Finally the `AttachedToWindow`, `Draw` and `MouseDown` methods make up the user-interface.

A `listimage` of the Cookie executable shows that the instantiation factory function is correctly exported:

```
TEXT Instantiate__6CookieFP8BMessage
```

Dumping the message contents at the end of `Cookie::Archive`, shows what is going to be sent to the container the user chooses:

```
BMessage B_ARCHIVED_OBJECT:
   class="Cookie"
   _name="Cookie"
```



```
BMessage: what = ARCV (0x41524356, or 1095910230)
        entry         class, type=CSTR, c=1, size=0, data[0]: "Cookie"
        entry         _name, type=CSTR, c=1, size=0, data[0]: "Cookie"
        entry        _frame, type=RECT, c=1, size=16, data[0] = BRect(l:0.0, t:0.0, r:350.0, b:20.0)
        entry        _flags, type=LONG, c=1, size=4, data[0]: 0x20000000 (536870912, ' ')
        entry        _color, type=LONG, c=3, size=4, data[0]: 0x0 (0, '')
        entry        _views, type=MSGG, c=1, size=0,
        entry        cookie, type=CSTR, c=1, size=0, data[0]: "There's no future in time travel"
        entry        add_on, type=CSTR, c=1, size=0, data[0]: "application/x-cookie"
```

Figure 3 – This is the message containing the archive cookie, built when the user clicks on the dragger. It will be sent to the target shelf with little additions.

```
   _frame=BRect(0, 0, 350, 20)
   _flags=0x20000000
   _color[0]=0x0
   _views=Message
   cookie="There's no future in time travel"
   add_on="application/x-cookie"
```

The names preceded by an underscore are, as mentioned, data added by the BeOS kits, `BView` contents in this case. `_color` is an array of values and only the first colour is shown, while `_views` is a flattened `BMessage` containing archived sub-views because of a deep archiving, here it's the `BDragger`.

Exploring replicants

A simple change to the Container application, shipped with BeOS in the `optional/sample-code/container/` folder will let you see what real world replicants (like NetPositive) save in the archived `BMessage`.

The patch consists in adding a message filter just after the creation of the of the Container's `TWindow`, with:

```
w->AddCommonFilter(new BMessageFilter(
   B_ANY_DELIVERY, B_ANY_SOURCE, printfilter));
```

and integrating the code in listing 2 that recursively dumps messages of type `B_ARCHIVED_VIEW`. This is useful since the deep archiving stores sub-views within sub-messages.

Pitfalls

A few common pitfalls will make a replicant simply not work or behave erratically.

The first problem is not exporting correctly the `Instantiate` symbol, and to be sure of this both `listimage` and `pefdump` are enough. When the mangled `Instantiate` symbol doesn't show up it's usually a matter of fixing the options in the CodeWarrior 'PEF' settings page and relinking.

The second problem is not setting the correct MIME type signature to the executable. Notice that the file type (set in the 'PPC Project' page of CodeWarrior) must always be `x-be-executable`. The signature is set through the Filetypes application in the preferences folder.

The procedure that usually work is to link the application without resources, drag the application on the Filetypes application and set the signature exactly like the one used in the `Archive` method, save the settings and also save to a resource file, and then include that resource file in the project. On subsequent links, the signature should be correctly set.

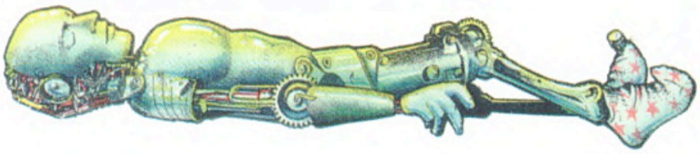
One way to check that the signature is correctly set is to use the following program (I call it `Launch`):

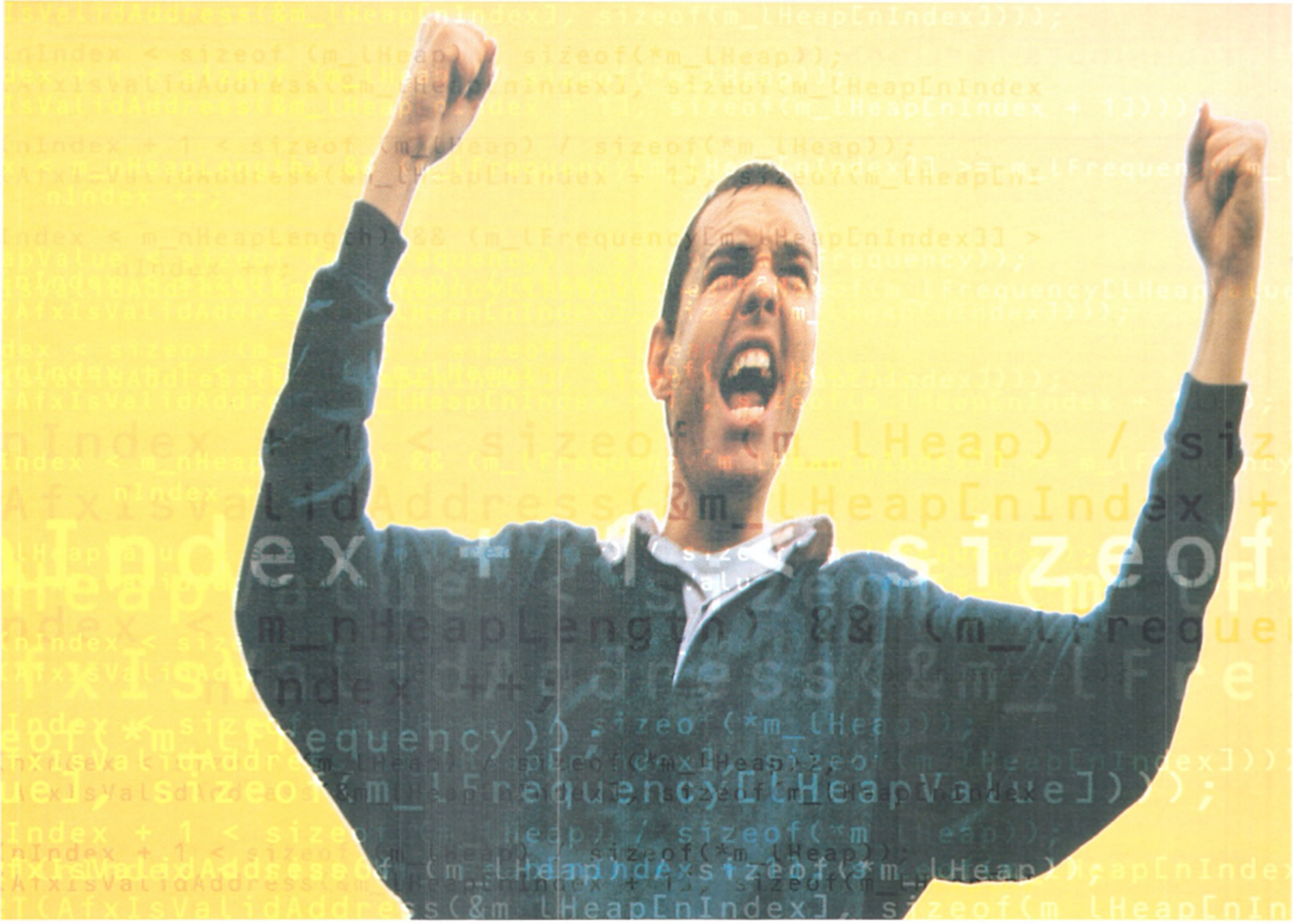
```
main(int argc, char **argv) {
   BApplication app("application/x-sample-launch");

   if(argc == 2)
     be_roster->Launch(argv[1]);

   app.PostMessage(B_QUIT_REQUESTED);
   app.Run();

   return 0;
}
```




nIndex + 1 < sizeof(m_lHeap) / sizeof(*m_lHeap));
AfxIsValidAddress(&m_lHeap[nIndex + 1]
m_nHeapLength) && (m_lFrequency
sizeof(*m_lHeap));
&m_lFrequency[lHeapValue]));

```
const char *signature = "application/x-cookie";

class Cookie : public Bview {
   char *cookietext;

public:
   Cookie(BRect r) : BView(r, "Cookie", 0, B_WILL_DRAW),
         cookietext(0) { NewCookie(); }

   Cookie(BMessage *data) : BView(data) {
      char *str;
      if(data->FindString("cookie", &str) == B_OK) {
         cookietext = new char [strlen(str) + 1];
         strcpy(cookietext, str);
      }
      else NewCookie();
   }

   ~Cookie() { delete [] cookietext; }

   long Archive(BMessage *data, bool deep) const {
      inherited::Archive(data, deep);
      data->AddString("cookie", cookietext);
      data->AddString("add_on", signature);
      return B_OK;
   }

   static Cookie *Instantiate(BMessage *data);

   // ... code for NewCookie(), AttachedToWindow(),
   // Draw(BRect r), and MouseDown(BPoint) ...
};

#pragma export on
Cookie *Cookie::Instantiate(BMessage *data) {
   if(validate_instantiation(data, "Cookie"))
      return new Cookie(data);
   return 0;
}
#pragma export reset

class CookieWin : public Bwindow {
public:
   CookieWin(BRect r)
    : BWindow(r, "Cookie", B_TITLED_WINDOW,
       B_NOT_RESIZABLE | B_NOT_ZOOMABLE) {
      r.OffsetTo(B_ORIGIN);
      Cookie *v = new Cookie(r);
      AddChild(v);
      r.top = r.bottom - 7; r.left = r.right - 7;
      v->AddChild(new BDragger(r, v));
   }
   // ... code for QuitRequested() ...
};

int main(int, char **) {
   BApplication Cookie(signature);
   (new CookieWin(BRect(50, 50, 400, 70)))->Show();
   Cookie.Run();
   return 0;
}
```

Listing 1 – Portions of the Cookie replicant.

and trying to open the application that contains the replicant through its signature, for example:

`Launch application/x-cookie`

If the application doesn't open, chances are the MIME signature is not correctly set, and anyway `find_instantiation_func` won't be able to open it either.

The most important thing to consider, since it influences the design of the replicant, is that the view will be running out of the context of the original application, and it shouldn't rely on any global variable being initialized, on sibling or parent views existing or still on the application correctly handling messaging.

This is important if, for example, the replicant includes system objects that are derived from `BInvoker`. Objects derived from `BInvoker` can target a `BLooper` or `BHandler` and send a message, typically as the result of user interaction. An example is the `BButton`, that will send a message when the user presses it.

```
void dumpmsg(int32 level, BMessage *message) {
   const char *indent = "                              ";
   printf("%.*sBMessage '%.4s'\n", 2 * level,
      indent, &message->what);
   int32 max = message->CountNames(B_ANY_TYPE);
   int32 i;
   for(i = 0; i < max; i++) {
      char    *name;
      type_code t;
      int32   found;

      message->GetInfo(B_ANY_TYPE, i, &name, &t, &found);

      for(int32 j = 0; j < found; j++) {
         void *data;
         ssize_t size;
         message->FindData(name, t, j, &data, &size);
         printf("%.*s%.4s: %s",
            2 * (level + 1), indent, &t, name);
         if(found > 1)
            printf("[%d]", j);

         switch(t) {
            case B_STRING_TYPE :
               printf(" \"%s\"\n", data);
               break;
            case B_MESSAGE_TYPE : {
               printf("\n");
               BMessage nested;
               message->FindMessage(name, j, &nested);
               dumpmsg(level + 1, &nested);
               }
               break;
            case B_RECT_TYPE :
               printf(" ");
               ((BRect *)data)->PrintToStream();
               break;
            default :
               printf(" %d bytes\n", size);
               break;
         }
      }
   }
}

filter_result printfilter(BMessage *message,
   BHandler **, BMessageFilter *) {
   if(message->what == B_ARCHIVED_OBJECT)
      dumpmsg(0, message);
   return B_DISPATCH_MESSAGE;
```

Listing 2 – A recursive message dumping function and a filter.

The `BInvoker` lets you customise the message content and target, so you should perform a

`SetTarget(this);`

in the view's `AttachedToWindow` hook.

Components!

Archiving an object is a powerful feature that isn't limited to replicants, although that's where it is more visible.

Interface generators are available that let developers generate the user-interface in a visual way and then simply unarchive it from their application's resource.

To create end-user applications through the composition of replicants, another element is required: the scripting architecture. Scripting should be completed and documented by the time you read this, and is necessary for replicants to learn about each other's features and connect with high level semantics.

The simplicity of the archiving process and of the dragger/shelf interface will hopefully encourage all developers to write replicant savvy applications, where the integration will make a component based application much more powerful than the sum of its parts. ■

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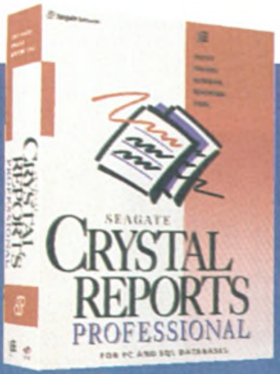

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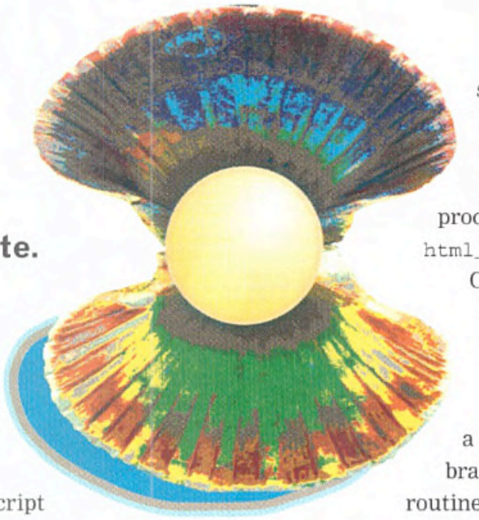
(Really) enough Perl to get by

Peter Collinson concludes his exploration of Perl 5 with a complete CGI script to handle email notifications on a Web site.



Last month, I started working on a Perl CGI script that could be used to service a Visitors book application for the web. The idea is to take some text from the user, send the text by email to someone, and respond to the Web user with a page that says 'OK, I've done that'. I didn't get too far with the script, but did manage to take the information that the user had typed into the Web page and load it into a Perl associative array in a decoded state so that it could be used in the remainder of the script.

The other aim of last month's article was to explore the basics of Perl and I looked at variables, string constants, lists, associative arrays, two of the fundamental string matching and manipulation primitives, and two of the basic control statements of the language, all this in eleven lines of Perl.

I did lay out some ground rules in last months article. First, I'm not using any of the public libraries largely because I feel that I need to understand the code that I am writing. Second, this article talks about Perl 5 which is the latest release of the language.

Subroutines

There's a great temptation to write Perl CGI scripts as one monolithic chunk where the program enters at the top of the script and steams through the code falling out of the bottom. I have found that a basic knowledge of Perl subroutines can help to make the code somewhat more comprehensible and also you will tend to reuse those routines in later scripts.

For example, any CGI script will want to return different pages to the viewer. At a minimum, you'll want a page saying 'yes that was OK' and one saying 'no, sorry, it failed'. The job of a CGI script is to send some HTML (or some graphics) to its standard output, providing a page for the user to see. It's an obvious saving in code and will also clarify the source if we put some of the program into subroutines and use calls to the routines in several places in the source code.

For a start, let's think about two primitive routines: `html_hdr` will send the start of the HTML page and `html_foot` will send the bottom of the page. By using these routines, we can make the active code just concentrate on the output of the page content.

Subroutines in Perl are defined by:

```
sub html_hdr {
 ...
}
```

The `sub` statement defines a global name of a subroutine. You'll notice that even though I will be giving this subroutine a parameter or two, you don't define local parameter names like C or other procedural languages. You can call the procedure using regular function syntax:

```
html_hdr("Error!");
```

Older versions of Perl insisted that you marked a procedure call by using an ampersand before the name:

```
&html_hdr("Error!");
```

The ampersand is optional in Perl 5. Perl is a little ambivalent about the need for the round brackets around the parameter list. If the `html_hdr` routine is defined before its use, then you can say:

```
html_hdr "Error";
```

If you prefer this style of working, but want to put your subroutines at the end of the script (I do), then you can give the Perl compiler notice that you will be defining a procedure later by including a prototype at the top of your code:

```
sub html_hdr;
 ...
 ... loadsa code
 ...
sub html_hdr {
 ...
}
```

If a procedure has no parameters, then you may want to write

```
noparams;
```

to call it. However, Perl must know that the word `noparams` is a routine. Using a prototype is one way of achieving this, alternatives are to call the routine using an ampersand before the name:

```
&noparams;
```

or by supplying an empty parameter list:

```
noparams();
```

Parameters (and results) are passed as lists. A subroutine can access its list of parameters using the magic list called underscore: `@_`, you may recall that when we talk about lists as a whole we precede the name by the `@` character. So the first parameter to the routine will be `$_[0]`, the `$` character tells Perl that we are expecting a scalar value, the `[0]` is an array index returning the first item of the array. We can use the direct value `$_[0]` in the routine whenever we want to access the parameter, but this isn't exactly user friendly. We'd much prefer to give the parameter a name. One option is to say:

```
sub html_hdr {
  $title = $_[0];
  ...
}
```

assigning the parameter to a variable. An alternative is to use a list assignment:

```
sub html_hdr {
  ($title) = @_;
  ...
}
```

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References & where to get Perl

The book *Programming Perl (2nd Edition)* by Larry Wall, Tom Christiansen and Randal L. Schwartz is published by O'Reilly & Associates and is ISBN 1-56592-149-6. Just in case you didn't know, Larry Wall is the originator of Perl.

Learning Perl is by R.L. Schwartz, again from O'Reilly & Associates. It's ISBN 1-56592-042-2.

The Perl script I am describing is lifted, stolen, and plagiarised from the excellent book *Managing Internet Information Sources* by Cricket Liu, Jerry Peek, Russ Jones, Bryan Buus and Adrian Nye. It's published by, you guessed it, O'Reilly & Associates and is ISBN 1-56592-051-1.

You can get Perl source from the Web: you are looking for the *Comprehensive Perl Network* or CPAN, the main URL for this is *http://www.perl.com*.

If you are a Microsoft user, then you are not left out. Perl is distributed by Microsoft for Windows NT 4.0, it's part of its resource kit.

Finally, if you want to see the code that I've been talking about in action then check out *http://www.hillside.co.uk/visitor.html*. You'll also find a link to the complete source of the CGI script on the *EXE* section of my Web site at *http://www.hillside.co.uk/articles/exe.html*.

Note that we are now dealing with the whole list on the right hand side. By putting brackets around a list of variables on the left-hand side, we are indicating that we want a list assignment, placing a single element from the parameter list into the `$title` variable. Single item lists are somewhat of a special case, list assignment is perhaps more comprehensible if we have two parameters:

```
  ($title, $msg) = @_;
```

We'd call the routine with two parameters, and these would be assigned in one operation to the variables `$title` and `$msg`.

By default, all variables in Perl are global. Ideally, we really want variables in procedures to be local to that procedure, so there is less chance of one procedure interfering with another. We can declare that names are local to the current block by using the keyword `my`, so the `html_hdr` header procedure is better defined as:

```
sub html_hdr {
  my ($title) = @_;
  ...
}
```

which tells Perl that the `$title` variable is local to the procedure block. It behaves exactly like a C local declaration, only statements in this procedure can see the variable.

Generating an HTML header

Having talked about how to define procedures and how to call them, we can now write the complete code to generate the HTML header.

```
sub html_hdr {
  my ($title) = @_;

  print "Content-type: text/html\n\n";
  print "<HTML><HEAD>\n";
  print "<TITLE>$title</TITLE>\n";
  print "</HEAD><BODY>\n";
  print "<h1>$title</h1>\n;
  print "<p>\n";
}
```

The output is a standard HTML page header preceded by a MIME specification giving the browser the type of document that we are sending, don't miss that there's a blank line after the MIME header. I've used Perl's ability to interpolate variable values into strings to print values that contain the title of the page. Perl does have a `printf` routine but this is seldom used, because string concatenation and replacement will do the job for us most of the time.

If you want to output many lines of HTML, it can be tedious to use separate `print` statements. It's quite common to use Perl's *here* documents. Here's the footer routine using a here document:

```
sub html_foot {
  print <<'END_OF_TEXT';
</BODY>
</HTML>
END_OF_TEXT
}
```

The notion of the here document is lifted from the Bourne shell. Here documents are a great way of getting chunks of HTML into a CGI script, and writing that HTML as if it were on a page. The here document allows you to insert inline text that will be printed verbatim from the first line after the << up to (but not including) the end-of-text marker. As you can see, the object after the << character pair is taken as the end-of-text marker. In the example, I've quoted the end marker using single quotes, which tells Perl that the text should not expand any variables that it finds. If I had used double-quotes or omitted any quotes then Perl would scan the text and expand any variable values.

Note the semicolon at the end of the `print` statement. This feels a little strange at first, somehow you feel the statement should be terminated after the end of the here document. Another gotcha is to put a space between the << and the end-of-text string. Perl will take the space as the end-of-text marker, it will treat it as a null value and will terminate the here document on the first blank line. This has somewhat unpredictable results.

Sending mail

Having created the basics for replying to the user, let's look at how to send email. Perl can easily start new programs and send information to them. I'm assuming here that you are running on a Unix system that supports `sendmail`. However, the routine should be easily changeable for other systems and other mail sending programs. The routine will take four parameters: the destination for the mail, the name that the person typed onto the web page, the email information that the person supplied to the web page and the information that they typed.

```
sub mail_send {
  my ($to, $name, $from, $msg) = @_;

  open MSG,"| /usr/lib/sendmail -t";

  print MSG "From: The Web Server <www\@site>\n";
  print MSG "To: $to\n";
  print MSG "Subject: Message from the Web\n";
  if ($from ne "") {
      print MSG "Reply-To: $from\n";
  }
  print MSG "\n";
  print MSG "A person called $name";
  if ($from ne "") {
      print MSG " (email $from) ";
  }
  print MSG "said:\n$msg\n";
  print MSG "--- ends ---\n";
  close MSG;
}
```

Of course, if you plan to use this, you'll need to do some tailoring. I am using the ability of `sendmail` to read all the information that it needs to send a message from its standard input. The `open` statement is used everywhere in Perl to create a file handle that is then used to pass streamed data out of (or into) the Perl program. Here, I am using it to create a pipe to a running command. I am intending to write data down that pipe, this is shown by the vertical bar in the second parameter of the `open` statement. Once I have the program open and running, I can simply throw data down the pipe using `print` statements. Of course, I should check that the open has succeeded.

The contents of the mail message are straightforward. When getting email from the Web, I tend to add a `Reply-To:` field in the mail header so that when the mail ends up in my mail reader I can simply reply to it, should the originator have managed to type in a correct email address. Quite often people don't do this, so beware. It's a good idea to pick up the name of the originating machine from the CGI script environment and pass that in the mail message, this can sometimes tell you what the correct email address should be.

When I have finished creating the mail message, I can close the file handle and `sendmail` will deliver the message. The ability to create crafted data like the mail message and send it out using a variety of other programs is one of the reasons why Perl is such a useful language and tool.

Putting this together

We can now put things together to generate the calling CGI script that provides support for the Visitors book:

```
#!/usr/bin/perl5
$webmaster = 'www@site.uk';
$mailto = 'person@site.uk';

sub html_hdr;
sub html_foot;
sub mail_send;

if ($ENV{'REQUEST_METHOD'} eq 'POST') {

  read(STDIN, $buf, $ENV{'CONTENT_LENGTH'});
  @pairs = split(/&/, $buf);
  foreach $p (@pairs) {
    ($name, $val) = split(/=/, $p);
    $val =~ tr/+/ /;
    $val =~ s/%([a-f0-9][a-f0-9])/
                pack('C', hex($1))/gie;
    $FORM{$name} = $val;
  }

  mail_send($mailto, $FORM{vis_name},
            $FORM{vis_email}, $FORM{vis_comments});

  html_hdr("Thanks");
  print "Your message has been";
  print "sent to $webmaster\n";
  html_foot;

} else {
  html_hdr("Comment Form Error");
  print "Form not processed. ";
  print "Please contact $webmaster.";
  html_foot;
}
```

The script starts by establishing some constants, the local webmaster name and the destination mail address. I've written some scripts that have taken the destination address from a hidden input field on the Web page. I now think that this is unwise. You don't want to create the ability for someone to take a local copy of your HTML page, change the hidden field and then use your CGI script to send mail to some random person.

If you are worried about this kind of misuse, you should include something in your CGI script that verifies that the script has been called from a page that you have control over. My Apache server places the name of the referring page into the script environment using the name `HTTP_REFERER` so you can check the value is what you would expect and bomb out if it's incorrect. Adding an explicit match to the test for POST would do the trick:

```
if ($ENV{'REQUEST_METHOD'} eq 'POST' &&
    $ENV{'HTTP_REFERER'} =~ m,^yoururl.*$,) {
```

The additional test binds (`=~`) a regular expression to be matched against the appropriate environment variable. Usually, we use the slash character to delimit match strings but *yoururl* is likely to contain a slash, so I've used a comma to mark the start and end of the regular expression used to test the environment variable. The regular expression matches the start of the string (`^`), the text of *yoururl*, followed by any character repeated zero or more times (`.*`) up to the end of the string (`$`).

Having defined the constants, I've placed prototypes for the three routines I've developed. You can insert the routines inline here, or place them at the end of the code.

The next chunk of code was developed last month. We check that the CGI script has been called using the `POST` method of forms processing, and if so we read the data that the user has typed in. The data will be several *name=value* pairs separated ampersand characters. First the data is split into a set of pairs and then each pair is processed to create an associative array `FORM` where each key in the name of an input field from the CGI form and its value is the text that the user supplied.

Having decoded the data, we send mail and then create a response page for the user telling them what has happened.

If the page has been called using some other method than POST from a form, then we send an error message. This means that should someone type the URL of the script they will get a sensible reply page. It's also a way of testing that the script compiles and some of the routines work. You can throw the raw script into Perl and you should get some HTML from it.

Well, the object of these two articles has been to give you enough Perl to get by, and I believe that many quite complex web services can be created using the simple tools I've given you. You should worry about the input from users of your web pages and wonder whether that input can be used to subvert your system or your web site. It is usually sufficient to check that the data that the user has supplied makes some sort of sense. ■

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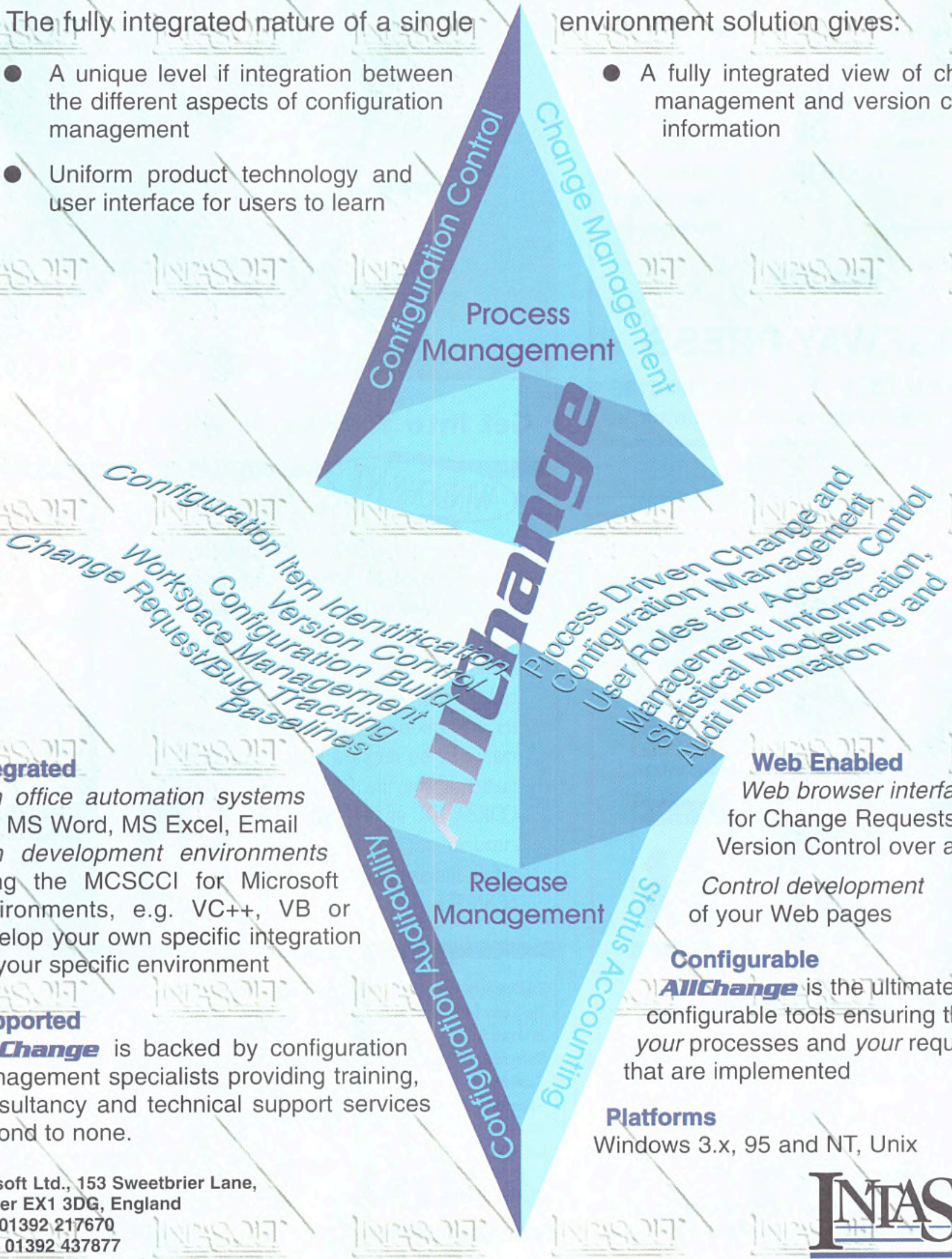

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Mixing constituents

By mixing Basic Constituents you can create new ActiveX controls. Dave Jewell puts on his chef's hat and tries to invent a new recipe.

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Basic Constituents is a recently released collection of ActiveX controls which provide enhanced functionality to the Visual Basic developer. The collection is aimed at Visual Basic 5 users and – according to maker BeCubed – is intended 'specifically for use in ActiveX control creation'. This might seem bizarre until you remember that VB 5 allows you to create a new ActiveX control by aggregating existing controls into a new, enclosing control. Effectively BeCubed is suggesting that you use its controls as building blocks to create controls of your own. If I understand the BeCubed licence agreement correctly, you're entitled to create new controls which you can then market as your own, providing you distribute only the run-time parts – the OCX files – of the BeCubed software to your customers. It's because BeCubed expects you to use its software as *constituent* components of a larger control that the product is called Basic Constituents.

Let's get the bad news out of the way first; unlike many similar products, Basic Constituents ships with printed documentation. Why is this bad news? Well, the printed manual is of mediocre quality with an index which is nothing short of pathetic – less than a page and a half of material for a 482-page book. Things would be pretty desperate if this were all you got, but fortunately Basic Constituents also includes on-line help which is available from the Visual Basic IDE in the normal way. It's essentially the same material as in the printed manual, but since it's in WinHelp form, you're not stuffed by having a virtually non-existent index.

Ingredients

A primary aim of Basic Constituents is to expose the base functionality inherent in many Windows controls, making it available to the application programmer or the control developer. Any API-level developer will tell you that the built-in Windows controls (those contained in `USER.DLL`) and the so-called 'Common Controls' all contain a lot more functionality than is exposed through the properties, methods and events which Visual Basic makes available to you.

To take a simple case, consider the humble Windows push-button. It's not obvious to the end-user, and (unless he's dabbled with the API) it probably isn't even obvious to the average Visual Basic programmer, but at the API level, checkboxes, radio buttons, icons, group

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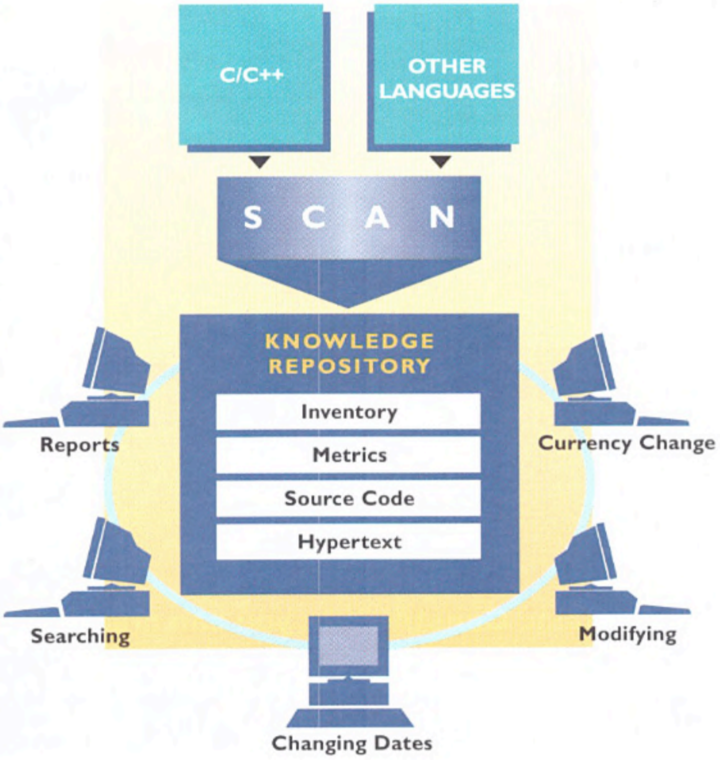

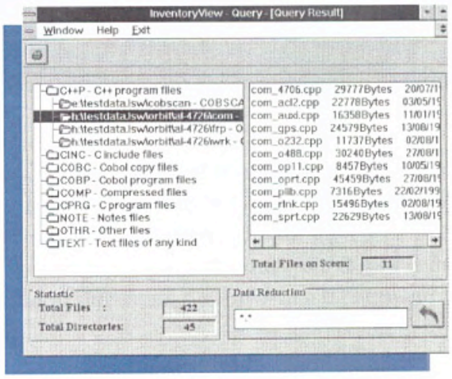
InventoryView - Query - [Query Result]

Window Help Exit

```
-C+P - C++ program files                         com_4706.cpp   29777Bytes  20/07/1
  -e:\testdata.lsw\cobscan - COBSCA              com_acl2.cpp   22778Bytes  03/05/19
  -h:\testdata.lsw\orbit\al-4726\com -           com_aud.cpp    16358Bytes  11/01/19
  -h:\testdata.lsw\orbit\al-4726\frp - O         com_gps.cpp    24579Bytes  13/08/19
  -h:\testdata.lsw\orbit\al-4726\wrk - (         com_o232.cpp   11737Bytes  02/08/1
-CINC - C include files                          com_o488.cpp   30240Bytes  27/08/1
-COBC - Cobol copy files                         com_op11.cpp   8457Bytes   10/05/19
-COBP - Cobol program files                      com_oprt.cpp   45459Bytes  27/08/19
-COMP - Compressed files                         com_pilb.cpp   7316Bytes   22/02/199
-CPRG - C program files                          com_rlnk.cpp   15496Bytes  02/08/19
-NOTE - Notes files                              com_sprt.cpp   22629Bytes  13/08/19
-OTHR - Other files
-TEXT - Text files of any kind
```

Total Files on Screen: 11

Statistic
Total Files : 422
Total Directories: 45

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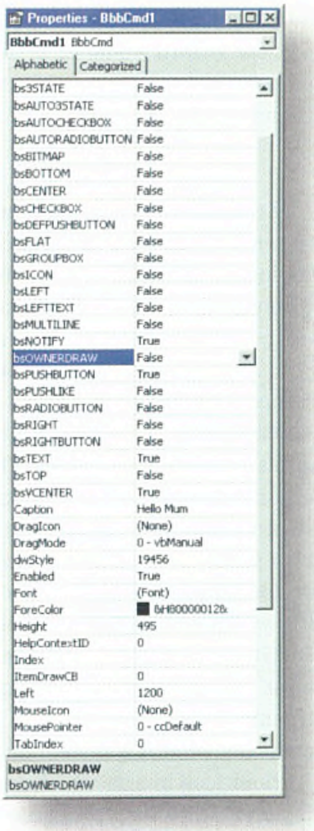


Properties - BbbCmd1

BbbCmd1 BbbCmd

bs3STATE	False
bsAUTO3STATE	False
bsAUTOCHECKBOX	False
bsAUTORADIOBUTTON	False
bsBITMAP	False
bsBOTTOM	False
bsCENTER	False
bsCHECKBOX	False
bsDEFPUSHBUTTON	False
bsFLAT	False
bsGROUPBOX	False
bsICON	False
bsLEFT	False
bsLEFTTEXT	False
bsMULTILINE	False
bsNOTIFY	True
bsOWNERDRAW	False
bsPUSHBUTTON	True
bsPUSHLIKE	False
bsRADIOBUTTON	False
bsRIGHT	False
bsRIGHTBUTTON	False
bsTEXT	True
bsTOP	False
bsVCENTER	True
Caption	Hello Mum
DragIcon	(None)
DragMode	0 - vbManual
dwStyle	19456
Enabled	True
Font	(Font)
ForeColor	■ &H80000012&
Height	495
HelpContextID	0
Index	
ItemDrawCB	0
Left	1200
MouseIcon	(None)
MousePointer	0 - ccDefault
TabIndex	0

bsOWNERDRAW
bsOWNERDRAW

Figure 1 – The Visual Basic Properties window with a Button Constituent control selected. You can clearly see how BeCubed has aliased a boolean property with each of the possible style bits associated with the BUTTON window class. While flexible, this approach is sure to cause confusion to programmers who aren't familiar with the Windows API.

boxes and push buttons are all implemented through a single window class called `BUTTON`. The different types of control are implemented as distinct styles of the `BUTTON` class. Thus, to get a push button, an API programmer might create a `BUTTON` window using the `BS_PUSHBUTTON` style. To get a radio button, he'd use the `BS_RADIOBUTTON` style, and so on.

The inherent multipurpose nature of the `BUTTON` class becomes much more obvious when we look at the BeCubed implementation of the button control interface. This is provided courtesy of `BBBCMD.OCX`, resulting in a control of type `BbbCmd`. From the partial view of the Properties window (Figure 1), you can see that the component sports a large number of Boolean properties with names such as `bsCheckBox`, `bsPushButton`, and so forth. Many of these properties are mutually exclusive (a `BUTTON` can't be a checkbox and a push button at the same time!) but other style bits can be logically OR'd with other styles to give options such as `WS_OWNERDRAW`. In addition, the control provides a callback hook for setting up a routine to handle owner-draw buttons, and another two hooks which allow you to implement custom message processing (one hook being fired before the call to `DefWindowProc`, and the other after).

Wonderful as all this is, I suspect that it will be somewhat mystifying to the average Visual Basic developer. To get the best out of Basic Constituents, I reckon that you really need a solid grounding in the API. I feel that the decision to expose the full `BUTTON` functionality in the one control was a bad one. It's great to have access to all the available API style bits, together with owner-draw and messaging hooks, but it would have been more sensible to implement one control for radio buttons, another for push buttons and so forth.

This raises another issue – code size (as regular readers will know, code size is one of my favourite bugbears). In the BeCubed manual, it states that using the standard `ListView` component requires the presence of Microsoft's `COMCTL32.OCX`, which weighs in at nearly 580 KB. However, we're confidently told that by using the equivalent BeCubed Constituent, we get far more functionality and only need a relatively small OCX of 50-60 KB. It sounds great, but the comparison is nonsense for at least two reasons. Firstly, the equivalent BeCubed OCX control only provides functionality for the `ListView` control, whereas `COMCTL32.OCX` provides the Visual Basic interface for the *entire* set of Common Controls implemented in `COMCTL32.DLL`. More significantly, the comparison neglects to tell you that the BeCubed OCXs are built using Microsoft Visual C++ and therefore require the presence of `MFC42.DLL`, a 942 KB DLL containing the dynamically linked MFC 4.2 code. Needless to say, this library isn't required by `COMCTL32.OCX`.

So what else does Basic Constituents give you? Aside from the previously mentioned Button Constituent, you get OCX wrappers for the Windows combo box control, edit control, extended combo box, header, image list, listbox, listview, panel, progress bar, rebar (also known as the Coolbar), status bar, toolbar, tooltip and other built-in and common controls. As with the Button constituent, various hooks are provided for exploiting API-level functionality. The combo-box and listbox controls, for example, include hooks for application-supplied callbacks which measure and draw individual list items (corresponding to `WM_MEASUREITEM` and `WM_DRAWITEM` at the API level). There's even a hook for providing your own non-standard comparison routine in sorted listboxes and combo-boxes. Again, this corresponds to the `WM_COMPAREITEM` API message.

Using these various Constituents, it's possible to achieve effects that would otherwise require a certain amount of complex API programming, window sub-classing and so forth. As I pointed out in the July issue, using Visual Basic 5.0's `AddressOf` operator alone can cause all sorts of unpleasantness when it comes to debugging an application – or indeed – whenever a sub-classing application is stopped within the IDE. Much as I dislike the idea of shipping an application with assorted OCX files in tow, there doesn't seem to be any realistic way of avoiding it if you want full access to the API.

Aside from the aforementioned controls, a number of more interesting components provide some higher level functionality. For example, a Task Bar Icon Constituent can be used to add an icon to the system tray area of the Windows 95/NT taskbar. It's easy to use and has relatively few properties and methods; to use it, you just need to set the `Icon` and `Tip` properties to the wanted icon image and tip text (the tip text appears as the mouse is moved over the icon in the tray area) and then call the `AddIcon` method to add the icon to the taskbar. To remove the icon, call `RemoveIcon`, and to modify it, just alter the tip text and icon properties before calling `ChangeIcon` to update the taskbar. Easy!

A pinch of this

Unfortunately, even with a control as simple as this, BeCubed seems to have got things badly wrong: in order to receive events from the taskbar icon, you need to set up an event handler for the control. This handler might, for example, be called BbbTray1_MouseDown, BbbTray1_MouseMove, or whatever, depending on the name of the component and the type of event that you want to receive. For consistency with Visual Basic's standard event types, these handlers take four parameters as shown in the code snippet below:

```
Private Sub BbbTray1_MouseDown(Button As Integer,
        Shift As Integer, x As Single, y As Single)
   Debug.Print "MouseDown" & Button & " " & Shift
        & " " & x & " " & y
End Sub
```

So far so good. However, when you come to use this event handler in anger, you'll quickly discover that irrespective of the mouse button pressed, the Button parameter will always be set to 1! Not only that but the Shift, x, and y parameters are always set to zero! BeCubed seemed to think it was enough to merely signal that the event had taken place, rather than reporting the details of the event. In the present case, it's important to discriminate between left-button and right-button clicks because tray icons typically do different things according to which is pressed (try left and right-clicking the Microsoft volume control applet on the system tray and see the different behaviour that results). Worse, it's important for the application to establish where the mouse click occurred because it will almost always want to display a popup menu in response to a right-click. If we don't know where the tray-click occurred, how do we know where to display the menu? It should be obvious that these considerations render the Task Bar Icon Constituent useless for real-world applications. BeCubed just didn't bother to think things through.

I also encountered numerous problems with many of the supplied sample projects. When installing Basic Constituents, I didn't accept the suggested destination pathname, but instead opted to install into a directory of my own choosing. Silly me. It turned out that many of the samples had project files containing hard-wired pathnames and – not unnaturally – Visual Basic refused to properly load these projects when asked to do so. Surely all this sort of stuff should have been handled by the install program?

Another deficiency I encountered concerned the BeCubed Constituent Control Wizard (let's call it BCCW for short). The BCCW is a Visual Basic add-in that's intended to simplify the creation of ActiveX controls which use BeCubed controls as constituents of the aggregated control. The manual devotes an entire chapter to the BCCW, showing a series of tantalising screen shots with examples of how to add subsidiary components to an ActiveX control, which properties, methods and events of subsidiary components should be exposed by the new control, and so forth. The Wizard includes the useful ability to map properties, methods and events to more than one subsidiary control so that (for example) if the user were to change the background colour or font of the aggregated control, then the property change could transparently be received by all subsidiary components. Once you've set up the various mappings as you want, BCCW will generate all the necessary source code for you.

So where exactly is it? Nowhere. An accompanying readme file confesses that the Wizard 'is not complete as of the shipping date' (7th May 97). I couldn't help wondering why they didn't defer the shipping date until the product was complete. The aforementioned readme offered a ray of hope by stating that the Wizard would be made available on the BeCubed Web site. With eager, trembling fingers I fired up Internet Explorer and found – nothing. According to the information posted on the Web site, the Wizard would be available 'within a few weeks', but at the time of writing it's almost four months since the shipping date and still no wizard. Ho hum.

A pinch of that

Now the good news. There are some genuinely useful components in the Basic Constituents package. Feast your eyes on Figure 2 where you'll see what looks very much like the Windows Explorer. This sample application is made from a single, compound ActiveX control of type xExplorer in conjunction with a very few lines of code. In turn, the xExplorer control is comprised of a number of lower level constituents. Along the top, there's a toolbar control while to the left you can see a Tree View control. On its right, there's a List View control. The aggregate also contains a panel control, a tips control and a number of system image list controls. All the glue which links these controls into a coherent whole is hidden inside the aggregated control but naturally you get the source to all this code which effectively forms part of the sample. (But of course, you don't get the source code to the constituents themselves.)

Maybe you're wondering what is a system image list control? It makes available the various icon images which are used by Windows itself (notably the Explorer) when displaying files of a specific type. This applies not only to files but also to namespace objects such as the printer, the waste paper bin, and so forth. On the subject of namespaces, a shell namespace constituent can be used to give Visual Basic developers access to the Windows shell namespace including Control Panel, Network Neighbourhood, etc.

One potentially interesting control in the Constituents arsenal is the snappily named bbbBrowser component. Using this constituent, it's possible to programmatically read the type library information from a DLL or OCX control where it can be enumerated using installed callback routines. Although this is a pretty specialised com-

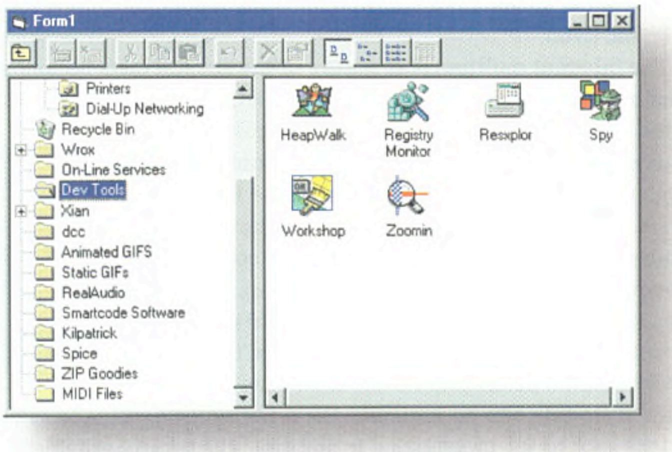
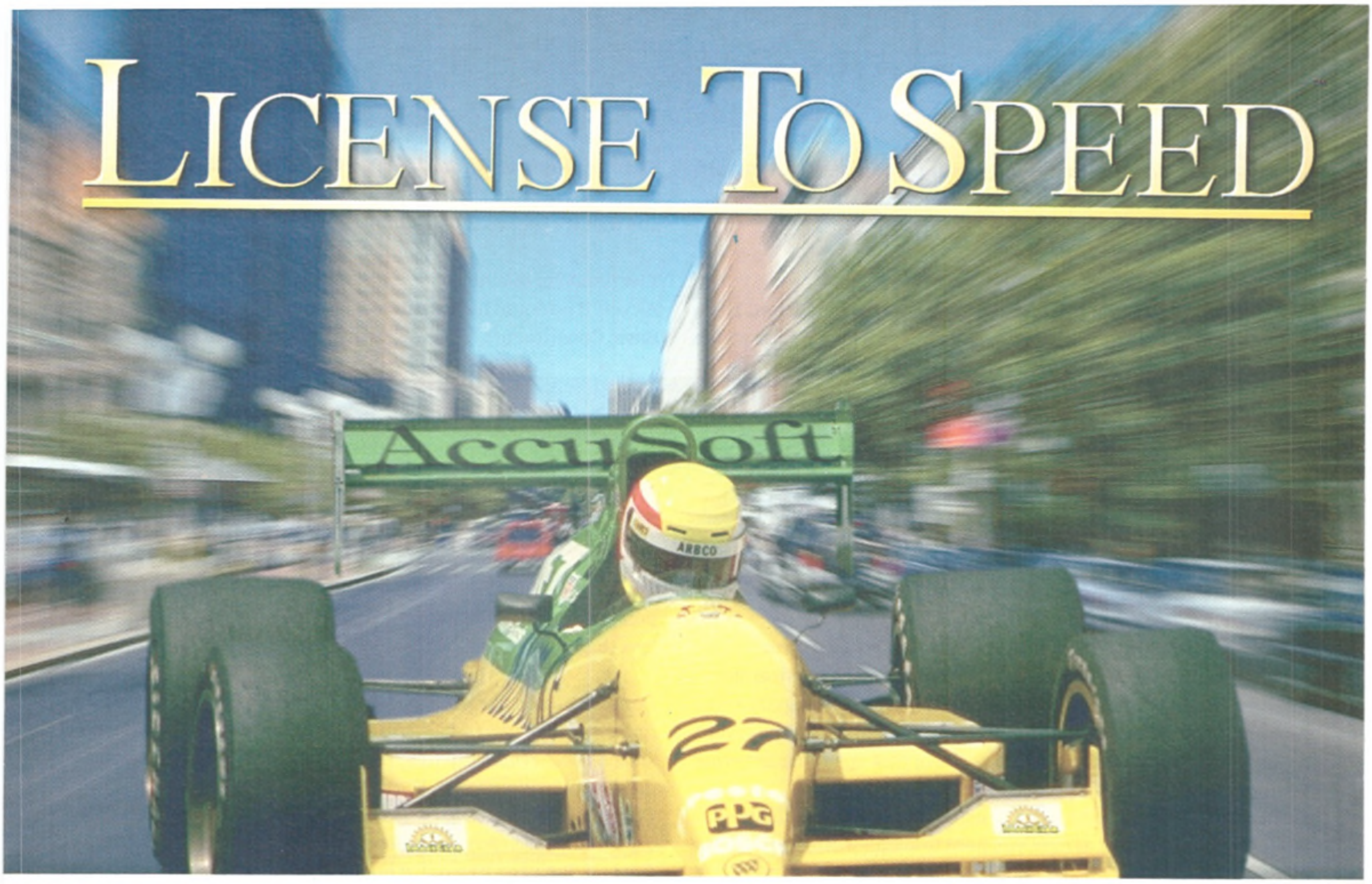


Figure 2 – This Explorer-style demo program illustrates how to put a series of Constituents together to create a single, aggregate control. Here, the entire content area of the window corresponds to a single ActiveX control which has been created from a number of Constituents. See the accompanying text for a description of what controls were used.



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ponent, it can be quite fun to play with (hint: check out my old favourite, the MSO97.DLL which implements much of the user interface for Microsoft Office 97).

With a cherry on top

The EllTech ZIP component is worthy of special mention. It's a stripped-down version of a product called Compression Plus which is available separately from EllTech and has been bundled into Basic Constituents to provide some added value. The documentation accompanying the ZIP component is the most comprehensive and professional in the manual, extending to almost 40 pages. As implied earlier, the documentation you get relates to the full version of the product, but those parts of the manual which aren't applicable to the stripped-down version have been crossed out.

The stripped-down component can add files to a ZIP archive and delete or extract them, but the ability to freshen or update archives has been removed and it's not possible to perform integrity tests. Automatic creation of stored directory names, handling of password-protected entries and the ability to perform disk spanning are other features which have been disabled in this version.

Despite its limitations, the ZIP component ranks as the best in Basic Constituents. But as ever, you need to keep a weather eye on the subsidiary files required. The ZIP control is implemented via a 68K OCX file which, as ever, requires `MFC42.DLL`. This OCX file is essentially a wrapper which interfaces Visual Basic to the 'real' ZIP engine that's implemented in an EllTech-supplied DLL called `COMPPL32.DLL` (237 KB). I suspect that this is the full version of Compression Plus and that it's the OCX which limits the calls that can be made.

The finishing touch

As you'll no doubt have gathered, I wasn't wildly enthusiastic about Basic Constituents. The overall quality isn't up to the standard that one would expect, the software is clearly still in development, and the whole thing smacks more of a beta than a finished product. I was particularly irritated by the missing add-in Wizard, the poor documentation and the lack of dependency information. OK, it's only version 1.0, but things should really be better than this. My advice would be to wait for the next version. And if you really need the ZIP capabilities provided by the EllTech component, you can purchase the full version of Compression Plus for less than the cost of Basic Constituents. ■

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 Dave@HexManiac.com.

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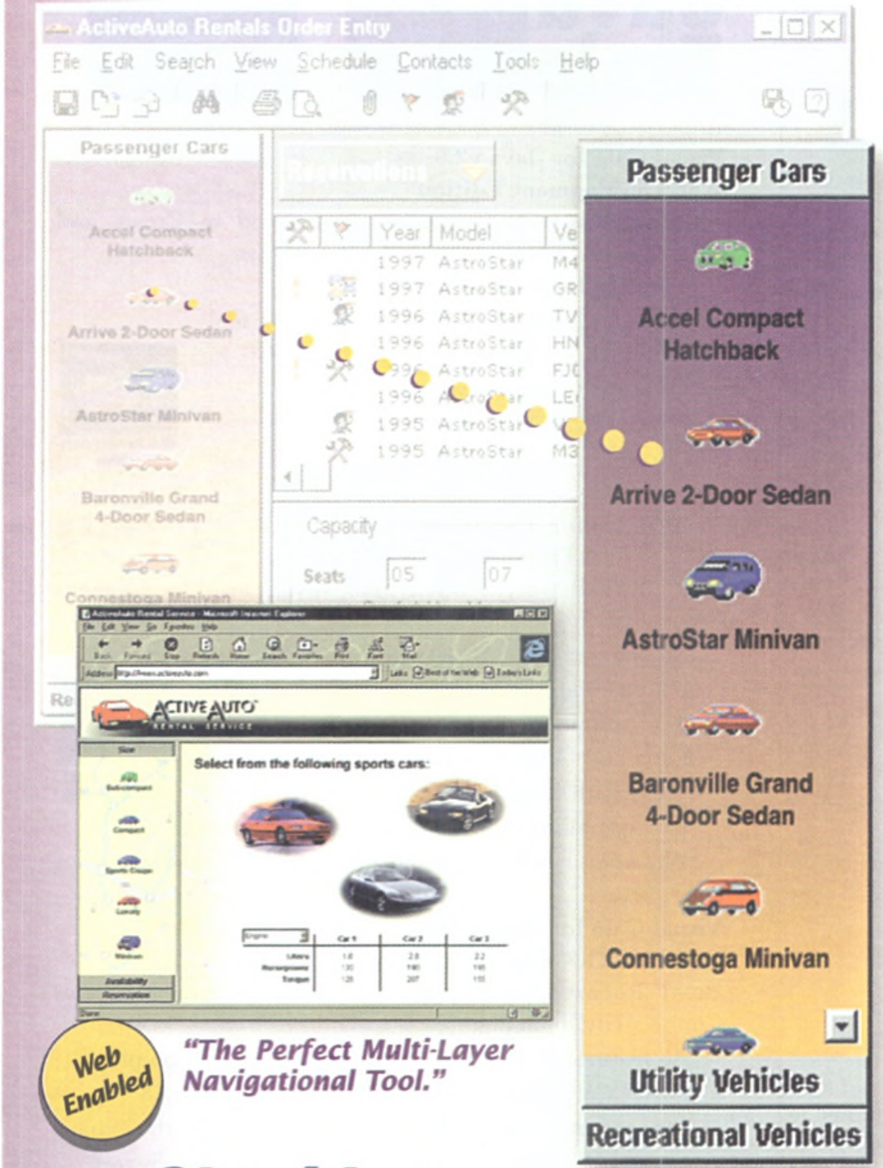

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Java for Windows

It might make Microsoft deeply unpopular with the rest of the Java community, but the days of the Windows-only Java application have arrived in the form of J/Direct. Tom Guinther wonders what makes it tick.

For some time, Microsoft has been working to integrate Java more tightly with the Windows platform. A major part of this effort has materialised in the form of J/Direct, which provides a simple and transparent mechanism for calling Win32 API functions directly from Java code.

In this column we'll cover the basic usage of J/Direct and discuss data type translation, known to COM types as marshalling.

So what is it?

J/Direct is a component of the Microsoft Java SDK 2.0. It allows you, with little or no pain, to call Win32 API functions, such as `Shell_NotifyIcon` or `CreateWindow`, as well as functions in your own custom DLLs. Although the same thing can be accomplished with RNI (Raw Native Interface), J/Direct is designed to work with code that is not specifically Java-aware, while RNI functions must be written to cooperate with the VM.

J/Direct automatically handles cooperation with the VM (much of the guts of J/Direct are implemented in the VM) and most importantly, it automatically marshals Java data types to their C/C++ equivalents. If you are not familiar with the term, think of it as translating from one data type to a different but semantically equivalent one. Marshalling is also used to describe moving a data type from one process or machine to another.

So what does it mean?

The only arguments the developer is required to provide are the function name, the location of a function, the parameters and their types, as well as the return type of the function. In the case of user-defined data types (such as C/C++ structures) the developer must also provide a description of the type that is adequate to make data conversion possible.

In the case of Win32 functions and data types Microsoft has done all the hard work by providing a package with all the common Win32 API functions and types. You can create a simple application that uses Win32 APIs quite easily as the following code shows:

```
public class SimpleTest
{
  public static void main(String args[])
  {
    try {
      MessageBox(0,
        "Calling User32.MessageBox() from Java.",
        "J/Direct Test", 0);
    } catch (Exception e) { System.err.println
        ("Unexpected Exception: " + e); }
  }
  /** @dll.import("USER32") */
  static native int MessageBox(int hwndOwner,
    String text, String title, int style);
}
```

In this case, we are directly declaring a prototype for the `MessageBox` function which resides in `USER32.DLL`. The `MessageBox` function prototype is a standard Java declaration of a native function. What *is* unusual is the documentation comment that precedes the function declaration. It contains a special directive, `@dll.import("USER32")`, that informs the Java compiler that the function should be dynamically linked from `USER32.DLL`. Because this is a 'SimpleTest' the method is declared inline. You probably don't want to do this in every class where you need to call the `MessageBox` API, so use the `User32` class provided in the `com.ms.Win32` package of the Microsoft Java SDK. This class provides the prototypes for the most common `USER32` functions. There are also corresponding classes for `KERNEL32`, `GDI32`, `SHELL32` and a few of the other common system DLLs.

So how does it work?

J/Direct works by using directives embedded in the standard Java Documentation comment `/**`. The compiler parses the directive and adds a special attribute to each J/Direct method or field in the class file. The VM then uses the information encoded in the attribute to determine how to execute the method or marshal data.

The primary directive, `@dll.import`, is used to declare that a native function will use the J/Direct protocol rather than the RNI protocol, and is placed directly above the method declaration. Optionally, the `@dll.import` directive can be placed above the class declaration, which indicates that all native methods should use J/Direct.

The standard syntax for the `@dll.import` directive is:

```
/**@dll.import("LibraryName",<Modifier>)*/
```

where `LibraryName` is the name of the DLL that exports the function. Table 1 lists the range of available modifiers and their meanings.

A second directive, `@dll.struct`, is used to describe a C/C++ structure as a Java class. The `@dll.struct` directive should be placed above the class declaration.

The standard syntax for the `@dll.struct` directive is:

```
/**@dll.struct(<LinkTypeModifier>,<pack=n>)*/
```

where the optional parameter `LinkTypeModifier` specifies the representation of `String` and `char` types and can be `ansi`, `unicode`, or `auto` (in which case the VM will detect the appropriate type at runtime). The optional parameter `pack` specifies the alignment of the structure members and can be either 1, 2, 4 or 8 (the default is 8).

The final directive, `@dll.structmap`, is used to handle declarations of fixed-size array elements within structures. This includes declaring fixed-sized strings, which is necessary because Java treats all `String` data types as having a dynamic size. The `@dll.structmap` directive should precede the string or array declaration in the Java class.

The standard syntax for declaring fixed-size strings using the `@dll.structmap` directive is:

```
/**@dll.structmap([type=TCHAR[size]])*/
```

where `size` indicates the number of characters in the string, including a space for the NULL terminator.

The standard syntax for declaring fixed-size strings using the `@dll.structmap` directive is:

```
/**@dll.structmap([type=FIXEDARRAY,size=n])*/
```

where the parameter `n` indicates the number of elements in the array.

So what's the catch?

The first step in marshalling data is to find an equivalent physical representation. The Java `long` type and the C/C++ `long` type are name equivalent but do not have a compatible physical representation. The Java `long` is 64-bits while the C/C++ `long` is typically 32-bits. Under Win32 operating systems, marshalling a Java `long`, requires the use of the `__int64` data type.

The second step is to ensure that semantic equivalence, or meaning, is maintained. For example, the Java `boolean` type can have one of two values, `true` or `false`. Until recently C/C++ did not have a direct equivalent and code written prior to introduction of the C/C++ `bool` type typically uses an `int` type to represent a boolean value. For legacy code, the Java `boolean` type must be marshalled to a C/C++ `int` type, with the value `false` translating to 0. The two most logical choices for translating the `true` value are 1 or -1. Microsoft chose to translate `true` to 1, which is reasonable but might cause problems with languages that specifically expect or require -1.

The Java `char` type is a 16-bit unsigned character so you might expect a straight physical translation to a C/C++ `unsigned short`. Fortunately, this is not the case, and for good reason. By default, a Java `char` type is translated to an 8-bit `signed char`; the type most commonly used to represent characters in C/C++. Ultimately, the `char` type can be translated according to your specification using the `ansi`, `unicode`, or `auto` directives described previously.

Beyond the simple scalar types, marshalling arrays, the Java `String` type (which is a special form of an array), and C/C++ structures are probably the most essential things to understand. In C/C++, arrays and pointers are equivalent. Thus if you marshal a Java `int[]`, its corresponding C/C++ type will be `int *`.

In the case of the `String` type (or `char[]`) the corresponding marshalled type will be `const char *`. It is `const char *` because a Java `String` type is read-only. This means that you cannot directly pass a Java `String` type to a C/C++ API that intends to modify it. In order to pass a `String` type to a C/C++ API, you must create an instance of the `StringBuffer` class, and set its buffer capacity (`StringBuffer.setCapacity(int)`) to a value which is appropriate for the API you are calling. After the API call you can use the `StringBuffer.toString` method to extract the `String`.

Finally, C/C++ uses many user-defined structures. These are very similar to a Java or C++ class with variations on member access (the default is `public`). Java classes have one property that is not shared by C/C++; the order and offset of the members within the class are not specified. These characteristics of the class are determined by the VM at run-time. When the `@dll.struct` directive is specified the VM treats the Java class as if it was a C++ structure. Whenever an instance of the translated Java class is created, it will be allocated from memory that will not move during garbage collection. The alignment of the structure members will be controlled by the alignment (`pack=`*n*) specified in the `@dll.struct` directive. Also, any `String` type that appears in the Java class will be marshalled according to the `ansi/unicode/auto` specification of the `@dll.struct` directive.

`Ole` – Tells the VM to use special semantics required by OLE APIs

`Ansi, unicode, auto` – Specifies a specific form of a function (`ansi, unicode`) or the most efficient form (`auto`) to be detected at run-time.

`SetLastError` – Indicates the function uses `SetLastError` to set important error information. Use this modifier to prevent the VM from clobbering the API result.

`Entrypoint="DLLFunctionName"` – Used to create an alias for a function name.

`Entrypoint="#ordinal"` – Used to link to an entry-point that is only exported by ordinal (ie it is not named.)

Table 1 – Modifiers for @dll.import.

So where's the example?

To get a feel for how marshalling works we'll take a look at how to define a Java function prototype for the Win32 `RegisterClass` API, and declare a Java class for its `WNDCLASS` data structure. `RegisterClass` API takes as its only parameter a pointer to a `WNDCLASS` structure that describes the window class that is to be registered. We don't have pointers in Java, so we'll pass a `WNDCLASS` reference to the native function. The VM will manage translation of the reference to a pointer as necessary.

The first thing required is to declare a Java equivalent of the C/C++ `WNDCLASS` structure. By declaring a Java class `WNDCLASS` and defining its members, in structure order, with the appropriate marshalled Java to C/C++ data types, and using the `@dll.struct` directive we have essentially created a 'Java struct'.

```
/** @dll.struct(auto) */
public class WNDCLASS {
      public int style;
      public int lpfnWndProc;
      public int cbClsExtra;
      public int cbWndExtra;
      public int hInstance;
      public int hIcon;
      public int hCursor;
      public int hbrBackground;
      public String lpszMenuName;
      public String lpszClassName;
}
```

For the function prototype we use the `@dll.import` directive to specify that the `RegisterClass` API should be linked from `USER32.DLL`. We also want the system to dynamically determine which form of the function (`ansi` or `unicode`) should be used.

```
/** @dll.import("USER32",auto) */
public native static short RegisterClass
   (WNDCLASS lpWndClass);
```

So what's the point?

J/Direct is obviously a powerful way to bridge the gap between new Java technology and the large base of C/C++ legacy code. Next month we'll examine using J/Direct with OLE, and interfacing to custom DLLs. ■

Tom Guinther is a Software Architect for NuMega Technologies in Nashua NH, USA. He can be reached via e-mail at tomg@numega.com. The Microsoft Java SDK 2.0 is in public beta and can be found at http://www.microsoft.com/msdn. The SDK contains the complete documentation for using J/Direct and marshalling data types.

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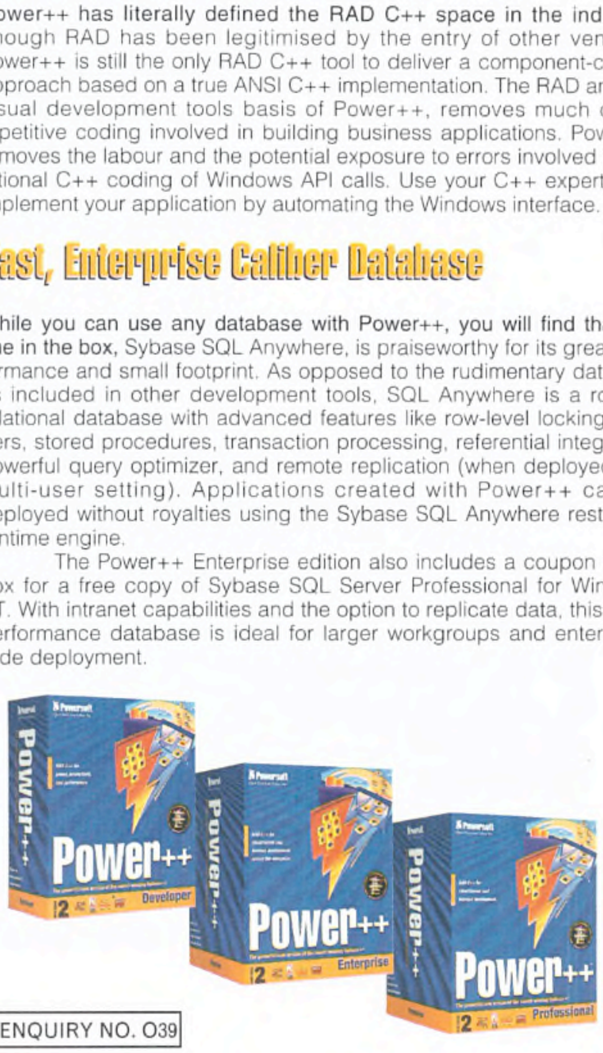

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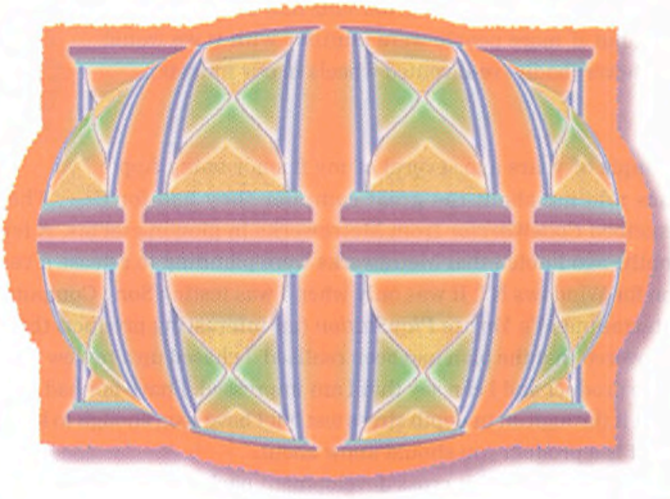

Stroustrup's C++ reference evolves to reflect the major changes in the language while Knuth's legendary The Art of Computer Programming has remained almost unaffected over the years. Here are Francis Glassborow's first impressions.

In my last column I reported very briefly on the publication of *The C++ Programming Language, 3rd edition* (ISBN 0 201 88954 4) and exhorted you to read it. Let me expand a little further.

The three editions of this book represent three key stages in the development of C++. In the first edition (closely modelled on K&R) the C++ is substantially C with a number of interesting extensions. The book clearly addresses C programmers who are looking for support for a higher level of abstraction. This phase of the development of C++ is the one typified by the description 'a better C'. I do not want to get into an argument about that description because whether you find C++ better or worse than C largely depends on what you are using it for.

The second edition represents a stage when C++ was metamorphosing from 'almost C with extras' to a full fledged free standing language. At that stage (1991) C++ was rapidly becoming popular (not, thank goodness, as explosively as Java in 1996) but it was still clearly regarded as a dialect of C. The natural route to C++ proficiency lay through a C style apprenticeship. A major problem with this was that the newcomer was faced with all the complexity of C (doing good work with minimalist tools requires skill and understanding) and then all the added complexity of C++ under development. To make matters worse, many writing about C++ had only half digested the implications of both the actual and proposed extensions. While I am sure that Bjarne Stroustrup had a clear vision of where he was going, much of the middle ground was still only partly formed from primordial chaos.

In the intervening six years a great deal has happened. C++ has matured into an independent entity which should be learnt as a language in its own right. New and powerful idioms have been developed. The experts have refined their view of what is appropriate. We now have an excellent vehicle for a wide range of people from students taking their first tentative steps at programming to distributed teams developing large scale products.

The third edition of *The C++ Programming Language* presents a much cleaner introduction to modern C++. I think that many would be less keen to jump into the cauldron of Java if their first introduction to C++ had been to the language Stroustrup presents here. This book is the product of many years spent listening to the ideas and fears of others by someone who is willing to change. As a single example consider the problem of whether a parameter should be by-value, a pointer type or by-reference. Bjarne Stroustrup is now quite clear and explicit. Small objects can usually be passed by value, larger ones by `const &` (ie the semantics of value but without the overhead of copying). He recommends that you use a pointer rather than a reference for a parameter where the state of the original argument is subject to change by the function. Note that he is writing about declared parameters not the implicit `this` parameter used by a member function, which has always been a pointer.

The second edition of Bertrand Meyer's *Object Oriented Software Construction* (0 13 629155 4) landed on my desk a few weeks earlier. I have always recommended the first edition of this book even to people who had no interest in Eiffel because it was an excellent introduction to OO. Like Stroustrup's book above, *Object Oriented Software Construction* is the product of much thought and a maturing insight into the reader's needs. It's also effectively an entirely new book built on the skeleton of the first edition. You should read this book if you want to understand the subject rather than just use development tools provided by your employer.

Knuth is back

A few days ago the third edition of volume 1 (*Fundamental Algorithms*, 0 201 89683 4) of Donald Knuth's seminal work *The Art of Computer Programming* arrived. I was still doing my Maths degree when Knuth started planning this book in 1962. By the time of first publication, it had grown from a 12-chapter book to a planned 12-chapter work in seven volumes. The second edition of volume 1 was published in 1973 along with the first edition of volume 3. The second edition of volume 2 (*Seminumerical Algorithms*) came out in 1980. Since then, *The Art of Computer Programming* has remained one of the few constants in our world of programming, a half-finished classic.

If you expect an entire rewrite twenty-nine years after the first edition then you have probably not read the original. Few things have changed in the area of fundamental algorithms during that time. 'Proving Fermat's Last Theorem' as an end of chapter exercise has been downgraded in difficulty from 50 (research subject) to 45 (very hard term paper). A slightly cleaner implementation of Euclid's Algorithm appears in the solutions section. The changes are all of this kind, adding polish and updating an already outstanding work. You can't quite use the index of the second edition with the third but you won't be many pages out.

As well as new editions of each of the first three volumes (I expect more change in volume 3 *Sorting and Searching* as a lot of work has been done in this area) we are promised volume 4, *Combinatorial Algorithms*. I am awaiting this with interest, not least because while it only covers two of the original chapters it is being published in three parts. Is this the first time a volume of a multi-volume work is itself a multi-volume publication? And a chapter takes more than a volume?

The Art of Computer Programming may be an academic work, but if more people were familiar with it we would have fewer (badly) re-invented wheels in our industry.

Another compiler

A couple of years ago several of my friends using Apple Macs told me about the great compiler they had for C++. They described *CodeWarrior* from Metrowerks in glowing terms. A few months ago I noted that Metrowerks were planning to release a version for Windows NT. It was only when I was testing Sony Computer Entertainment's *Yaroze PlayStation* (an interesting product) that I discovered that the plan had been realised. I chased up a review copy of the product and I can say that I am impressed. I have not had time to put it through an in-depth stress test but I have seen enough to know that it is a product you should know about.

Briefly, it is a 32-bit cross development package that handles not only C and C++ but also Java and Object Pascal (it can even manage much Delphi source code). In general, the compilers compile to an intermediate language (similar to the excellent JPI TopSpeed compilers) which is then used for chip-specific code generation. In the current version, Java is excluded from this mechanism but I understand that this is going to change some time in the future.

One interesting result of providing compilers for several languages in a single package is that mixed language development becomes standard. Another is that the intermediate language must support the needs of all the high-level languages. This means that array bounds checking is available to C and C++ (you need to do some work, but the compiler can support your efforts). It also implies that future releases may support garbage collection in the intermediate language (required by Java).

There is a special single-platform version for non-professionals (though I believe the licence allows its use for shareware as well as PD development) called *CodeWarrior Discovery Edition* at £59.50. For details and supply of this and the professional versions contact Full Moon Software Distribution Ltd (tel 01628 660242, *http://www.fullmoon.com/*)

Last month's problem

What is wrong with the following code that results in broken code if an exception is thrown from within the try block?

```
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
  };
}
```

This is one of those coding problems that you either spot straight away or miss altogether. What makes it worse is that the problem will only surface when an exception has been thrown. That is about the worst scenario for debugging that I can imagine. At the very least test harnesses need to generate fake exceptions, that means that you need a toolkit of special purpose functions. For example, you need a way of getting `new` to throw `bad_alloc` even when there is plenty of memory. You cannot simply over-ride operator `new()` with a version that always throws `bad_alloc()` because that would be triggered too early. I wonder if anyone knows of debugging tools that allow you to force the throw of a specific exception at your chosen point. If so please do not keep it to yourself.

Now have a quick look at my code above and see if you can spot the problem. It is there in the very first line where I change the value of `len`. If an exception does come out of the try block, the `my_string` instance will have the wrong value of `len` for its current array of `char`. So `len` must not be changed until after the call to `new`.

To the best of my knowledge, deleting an array of `char` cannot generate an exception, but in general programmers also need to be very careful of destructors. Any destructor that leaks an exception is very bad news. Consider:

```
Mytype * mt = new Mytype[10];
  // other code
delete [] mt;
```

What happens if one of the calls of `~Mytype()` during the deletion of the array throws an exception? Almost certainly your program is in a mess and needs to use whatever emergency exit is available. This exit should be provided by a call to `unexpected()`. By default, this will call `abort()`. You may not be enthusiastic about this but at least the program will not continue to thrash around doing untold possible damage.

How do we ensure that we get this behaviour? By requiring that all destructors in the code we write have an exception specification of `throw()`. In other words the prototype for `~Mytype` should be:

```
~Mytype() throw();
```

It is time that we started using exception specifications, both to get sane behaviour from application code and to sensitise ourselves to the need to think about what we are going to pass on to others to deal with.

This month's problem

Many of us are aware of the need for using casts when manipulating addresses through `void *` in C++. Unlike C, C++ requires a cast to convert a `void*` to a `T*`. We are also aware that it is good practice to use the new style C++ casts. In that context, can you see any problem with the following code?

```
int comp(void const* vp1, void const* vp2) {
  T const* tp1=reinterpret_cast<T const *>(vp1);
  T const* tp2=reinterpret_cast<T const *>(vp2);
  return tp1->compared_with(*tp2)
}
int main(){
  T array_of_T[10];
  // do something to initialise members of
  // array_of_T
  qsort(array_of_T, 10, sizeof(T), comp)
  // do whatever
  return 0;
}
```

Assume that `compared_with` is a suitable `const` member function of class `T`. ■

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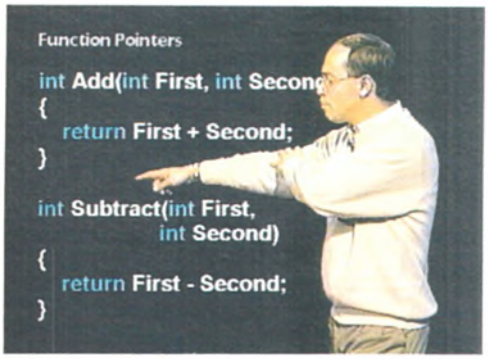

```
Function Pointers

int Add(int First, int Secon
{
   return First + Second;
}

int Subtract(int First,
             int Second)
{
   return First - Second;
}
```

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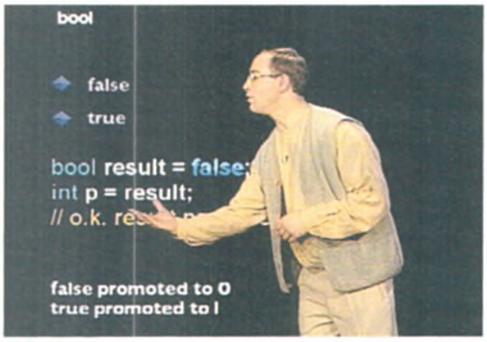

```
bool

  false
  true

bool result = false;
int p = result;
// o.k. re

false promoted to 0
true promoted to l
```

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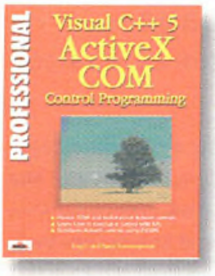
ENQUIRY NO. 042

Professional Visual C++ 5 ActiveX COM Control Programming reviewed by Gavin Smyth



First of all, if you haven't heard of ATL, have a look at Dave Jewell's *Glad you could COM* in June's EXE: the Active Template Library is Microsoft's latest library for creating slick ActiveX objects. I found that my attempts to use the ATL were frustrated by the inadequacy of introductory material supplied with the library, and that is where this book comes in, as it covers ATL as well as other approaches to writing ActiveX controls in C++.

Overall the book is up to the customary high standards of Wrox's Professional series: there are very few typos and the authors do not waste paper with complete code listings. There is no accompanying disc, but complete source code can be found on the Wrox Web site (*http://www.wrox.co.uk*). As well as control development, deployment and testing of controls in C++, Visual Basic and Internet Explorer is covered extensively. The book is very pro-Microsoft; some of the sections read like marketing blurb. Although the book says that Visual C++5 is required, you can get away with 4.2b plus the ATL download from Microsoft's Web site and still gain a lot from it.

There is a very good introduction to COM concepts, starting sharing binary objects, through to interfaces and object factories. Having taken a theoretical look at ActiveX, the authors develop a simple control from scratch showing that, although the code is not difficult, it is tedious to get right. After this they dive into ATL, rewriting and extending the previous control illustrating how much simpler the task is. Knowledge gained from the earlier section proves to be valuable in demystifying the contents of the myriad of files generated by the ATL wizard. The ATL chapters cover control activation, drawing, properties and property pages, methods and events. Surprisingly the authors omitted scripting and initialisation safety (how to prevent warnings when a control is used within an Internet browser). Fortunately, that is one area covered well in Microsoft's ATL documentation. After ATL derived controls the book moves on to an explanation of bulkier OCXs using sophisticated MFC support.

All of this is put into practice in a larger application – a distributed enterprise-wide event calendar. The controls used range from front-end user interfaces to worker objects, and are written using ATL or MFC, though the authors do not explain why they chose one and not the other for any particular control. My favourite quotation from the book is 'DCOM is just COM with a longer wire'; the ease with which a set of objects working together on one machine can be expanded to the same objects on a number of platforms illustrates the truth of that statement. The book closes with a discussion of control security and licensing, and the deployment of controls via the Internet.

If, like me, you find the Microsoft ATL documentation heavy going, reading this book clarifies much about ActiveX programming.

✓ ***Verdict:*** *Recommended.*

Title:	*Professional Visual C++ 5 ActiveX COM Control Programming*
Author:	*Sing Li & Panos Economopoulos*
Publisher:	*Wrox Press Ltd*
ISBN:	*1-861000-37-5*
Price:	*£36.99*
Pages:	*480*

Framing Software Reuse: Lessons from the Real World reviewed by Mary Hope

Do not be misled by the upbeat title; this is a book in a time warp. The foreword explains how Ed Yourdon and the author mooted this book ten years ago. A long genesis is not in itself a bad thing but this book manages to misrepresent reuse in object-oriented programming, ignore the work of reuse through patterns and the reuse of binary components such as VBX/OCX/ActiveX, and attack yesterday's demons such as the Waterfall method. Bassett proposes a reuse maturity model with no apparent awareness of the various similar theories and models.

The warnings are present right from the start in those awful 'Real World' words in the title. I have always had difficulty with the concept that some worlds are more real than others. Different yes but equal in their existence. A title that better reflects the contents might be 'Reuse with pseudo objects and Cobol' but no publisher would go with that one.

This book could be useful to an unreconstructed Cobol programmer. If the reader has managed to be either ignorant or unenthusiastic about reuse this book has some convincing (but not very original arguments) for its use. It also acknowledges that reuse is not just a technical issue but a cultural and organisational one.

The opening shot is a hard sell about the productivity gains of using the 'frame' approach in software development. When teaching I have often lamented the dearth of hard evidence about the promised benefits of reuse. Superficially, the first few chapters of this book remedy this deficit. However there is a spuriousness about the evidence. It reminded me of pyramid selling meetings designed to inspire where rounds of applause greet the latest staggering success stories. The oft repeated phrase used to describe frames is 'the same as, except'. One waits with bated breath to find out exactly how to use the 'frame approach'.

Well what a disappointment that is. It seems to boil down to writing a Cobol source file that you anticipate might be reusable if parts of it could be changed. This is a frame. You modify the frame, ie reuse it, with a small selection of commands. These commands are implemented by putting the frame through a 'frame processor'. To my way of thinking, this is not much more than a souped up word processor. Possibly useful, but it is not going to replace sliced bread.

Tucked away on page 119 is a small paragraph headed 'language richness' explaining that some languages, such as C++, cannot be used with this method. The main reason being that, in these languages, there are too many ways to do the same thing. Bring back Cobol, all is forgiven.

This book is a useful reminder that we have not yet cracked the reuse problem in software development.

✗ ***Verdict:*** *Only suitable for unreconstructed Cobol Programmers.*

Title:	*Framing Software Reuse: Lessons from the Real World*
Author:	*Paul Bassett*
Publisher:	*Yourdon Press Computing Series*
ISBN:	*0-13-327859-X*
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Martin Fowler

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Jennifer Stapleton

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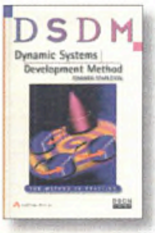

The Dynamic Systems Development Method provides a framework of controls and best practice for rapid application development. It explores the day-to-day realities of implementing the Method. It is a practitioner's guide, dealing with issues such as getting people from different disciplines to work as a team. It has proved extremely effective in delivering maintainable systems which match the needs of the business better than those produced using traditional life cycles.

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Bjarne Stroustrup

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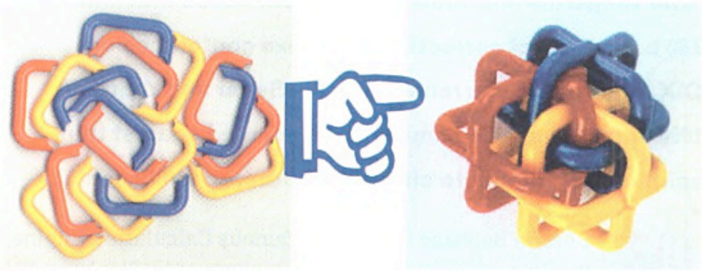
Twisted fingers

This month, Ctrl-Break received an anonymous parcel containing eighteen similarly shaped plastic objects, six red, six yellow and the rest blue. The only written text accompanying this suspect invention was a URL. Is that a sign that the Web is not powerful enough yet to convey physical objects – after XML, teleportation?

After having spent too much time working on cracking the damn puzzle, finished a roll of tape, and on a sure road to RSI, Ctrl-Break, on the verge of a nervous breakdown, eventually went to find the key to these Space Cubes on www.spacecubes.com.

Now, the cube is easy peasy, the link and the chain not much of a challenge but the double cube, the knot, the hypercube and the famous blob still remain far, far out of our reach at the time this story is written.



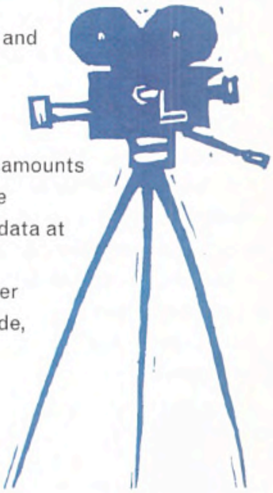
Life would be so much easier with six hands! ■

Writing software for Hollywood

A source from a well-known software tools company (one which writes compilers – hint), who will remain unnamed, got involved in the making of a spoof video. These are the rules he was forced to follow:

Twenty-four interesting things that you learn about computers in the movies...

1. Word processors never display a cursor.
2. You never have to use the space bar when typing long sentences.
3. All monitors display 2-inch high letters.
4. High-tech computers, such as those used by NASA, the CIA, or some such governmental institution, have easy-to-understand graphical interfaces.
5. Those that don't will have incredibly powerful text-based command shells that can correctly understand and execute commands typed in plain English.
6. Corollary: You can gain access to any information you want by simply typing 'ACCESS ALL OF THE SECRET FILES' on any keyboard.
7. Likewise, you can infect a computer with a destructive virus by simply typing 'UPLOAD VIRUS.' Viruses cause temperatures in computers, just like they do in humans. After a while, smoke billows out of disk drives and monitors.
8. All computers are connected. You can access the information on the villain's desktop computer, even if it's turned off.
9. Powerful computers beep whenever you press a key or whenever the screen changes. Some computers also slow down the output on the screen so that it doesn't go faster than you can read. The *really* advanced ones also emulate the sound of a dot-matrix printer as the characters come across the screen.
10. All computer panels have thousands of volts and flash pots just underneath the surface. Malfunctions are indicated by a bright flash, a puff of smoke, a shower of sparks, and an explosion that forces you backward. (see #7, above)
11. People typing away on a computer will turn it off without saving the data.
12. A hacker can get into the most sensitive computer in the world before intermission and guess the secret password in two tries.
13. Any PERMISSION DENIED has an OVERRIDE function.
14. Complex calculations and loading of huge amounts of data will be accomplished in under three seconds. In the movies, modems transmit data at two gigabytes per second.
15. When the power plant/missile site/whatever overheats, all the control panels will explode, as will the entire building.
16. If you display a file on the screen and someone deletes the file, it also disappears from the screen. There are no ways to copy a backup file – and there are no undelete utilities.



17. If a disk has got encrypted files, you are automatically asked for a password when you try to access it.
18. No matter what kind of computer disk it is, it'll be readable by any system you put it into. All application software is usable by all computer platforms.
19. The more high-tech the equipment, the more buttons it has. However, everyone must have been highly trained, because the buttons aren't labelled.
20. Most computers, no matter how small, have reality-defying three-dimensional, real-time, photo-realistic animated graphics capability.
21. Laptops, for some strange reason, always seem to have amazing real-time videophone capabilities and the performance of a Cray Y-MP.
22. Whenever a character looks at a monitor, the image is so bright that it projects itself onto his/her face.
23. Computers never crash during key, high-intensity activities. Humans operating computers never make mistakes under stress.
24. Programs are fiendishly perfect and never have bugs that slow down users. ■

8086 and all that

'The Tangerine Microtan 65 was a 6502 based machine, not Z80 based' – fact correction in the exe conference on CIX.'History as you remember it' – Sellar and Yeatman, 1066 and all that. (Or some such: it seemed against the spirit of the original to check the quote, so we haven't.)

1835 Charlie Babbage invents his famous Calculating Engine, the first ever computer, which is powered by Stephenson's Rocket, and consequently four foot eight and one half inches wide. Genius *père et fils* engineering double act Marc and Isambard Brunel offer to create a seven foot version but, as a result of an unfortunate error in the copying of the plans, instead build the South Devon Atmospheric Railway. Stung by disappointment, Babbage switches his efforts to a dual gauge Analytical Engine, and places the first ever advertisement for the first ever programmer – an advert which has been used ever since as a model by recruiting agencies ('Mr Charles Babbage of 147 Coprocessor Lane, Westminster Village seeks the assistance of a programmatic person, to aid him with his Government researches. On-the-job training will be given, but applicants with Visual C++, Oracle, Tuxedo, UNIX and NT4 will be preferred. Babbage Calculating Engines Ltd is an equal opportunities employer. Either sex may apply for this post, but breast feeding abilities considered an advantage').

Babbage is lucky enough to secure the services of Countess Ada Lovelace, at that time best known as the star of many early-Victorian pornographic lithographs. Although Babbage's working relationship with Lovelace is excellent, his interest in a practical engine for analysing coefficients of Taylor's theorem according to sundry measurements of external objects wanes, and his interest in going to bed in the afternoon waxes. Babbage's work is never completed; but this doesn't matter because nobody else does any work on it either. Thus England is Top Nation in computing for the next 100 years – a Good Thing.

1936 In Hitler's Nazi Germany, a beastly German person whose name is not important attempts to reinvent the computer 10 years too early, using the bakelite knobs that have fallen off Ferguson wireless sets. Unfortunately for Herr Not Important, Lawrence of Arabia and Lawrence of Olivier are soon both on the case, and turn the tables on him using a black-and-white John Buchan plot. Thus the Empire is preserved for people who pronounce the word hands as 'hends'.

Meanwhile, in England, mathematician and pipe smoker Alan Turing proposes his famous Turing Machine, a contraption which can display and interpret a sequence of odd-looking, arbitrary symbols. Predictably he fails to interest the British Government in his idea – with all resources committed to the Appeasement Effort, there is no money available to fritter away on infinitely long paper tapes – but it is taken up by the hotel and catering industry, who subsequently manufacture a slightly modified version in large quantities. This commercial version is named after the man who effected the modifications: Professor J R Fruit.

1942 At Bletchley Park, Turing invents Robbie the Robot, a fantastic automaton which can decrypt the secret Enigma codes of the U-boats, play chess, accurately forecast greyhound and horse racing results and make polite smalltalk at dinner parties. Prime Minister Winston Churchill wants to send Robbie on a special mission to kidnap Hitler and end the war; but he is foiled in this wish when it turns out that Robbie is unable to override his own Prime Directive: the robot cannot harm a human being no matter how evil, or how silly her moustache. Despondent at his failure, Robbie sets about a career as a Shakespearean actor, and eventually achieves fulfilment; his portrayal of Ariel in a 1950s production of *The Tempest* being particularly well received.

1950 The American company IBM launches UNIVAC, a dual vortex dataprocessor which beats as it sweeps as it cleans. Not to be outdone, British company Lyon's Maid launches Leo, a gargantuan hulk of machinery which turns out to be useless for office automation, but excellent for keeping ice lollies cold.

1954 At Manchester University, Alan Turing is fatally wounded in a laboratory accident, when the subject of his latest Turing Test turns out not to be, as he believed, a Mark II Electronic Brain running at half clock speed, but instead an irate builder's labourer, Mr Arthur Wit. Turing dies tragically on the operating table while surgeons battle to retrieve his own left upper canine from inside his kidneys.

Back at the Manchester University labs, Turing's former colleagues make what turns out to be a fatal mistake for British Computing: they decide to abandon his theoretical efforts on computer science, and instead concentrate on his pipe smoking work. Thus America becomes Top Dog in Computing, a Bad Thing.

1960s The UK continues to lag behind. In 1966, pressed by the Wilson Government 'yellow glimmer of know how' technology policy, Edinburgh University manages to build a noughts-and-crosses machine which, while not unbeatable, 'puts up a jolly good show'. It is opened by the Beatles, and in an exciting and tense match the machine loses five games to nil to Ringo (this was of course before mind-bending drugs took the edge off Ringo's noughts-and-crosses abilities). In 1968, English Home Counties Electric Valves produces Sir Ernie, the Premium Bond random number generator, a primitive forerunner of the exciting and leading edge technology which today drives the National Lottery.

1971 Edsger Dijkstra delivers his famous ACM paper dealing with naming conventions: 'Excessive consonants considered hard to spell'.

1979 At last a triumph for Great Britain! Sir Clive Sinclair's Z80-based Tangerine Microtan 65 launches. With its handsome (for its time) 'dead flesh' keyboard, its ability to drive a modified TV at a startling (for its time) rate of 405 lines per minute and its startling (for its time) sixteen byte memory, all for a knockdown price of £599.99, the machine is an immediate hit. For a while, it outsells even the former market leader the Apple Big Jobs, but eventually tragedy strikes when somebody else offers a much better computer for rather less money.

1980 IBM asks Gary Kildall to invent an operating system for the future PC, to be called OS/2. Kildall refuses, and then makes matters worse by flying around and around IBM headquarters in a biplane taunting the IBMers about 'their silly blue shirts'. IBM hires Bill Gates to blow Kildall out of the sky with an anti-aircraft gun, and as a token of gratitude for accomplishing this successfully hands over the rights to all computing technology forever.

And that is the end of computing history. ■

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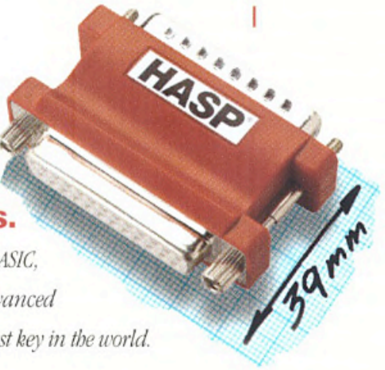

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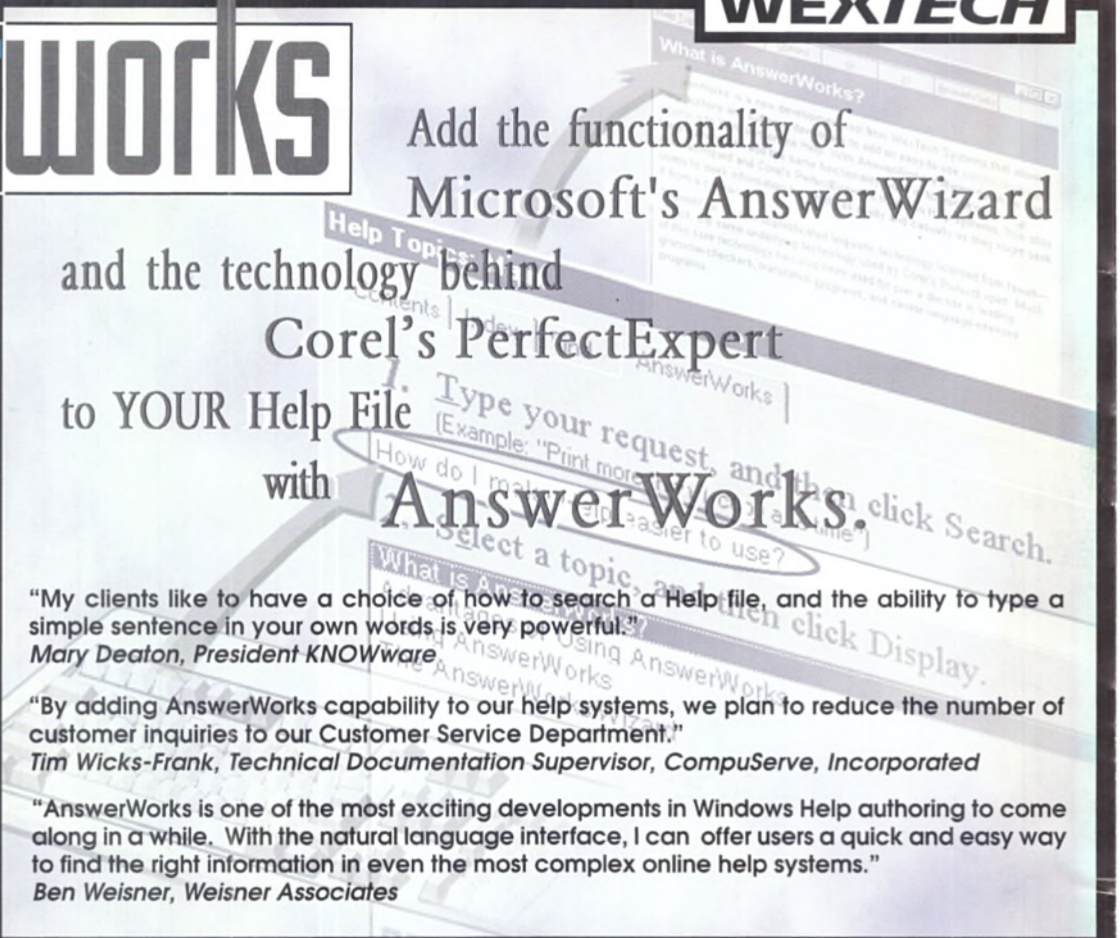
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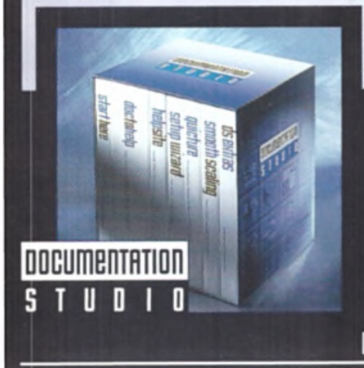

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