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with three
Web controls

Interpreter
as compiler

Unix and NT:
Unlikely
dance
partners?

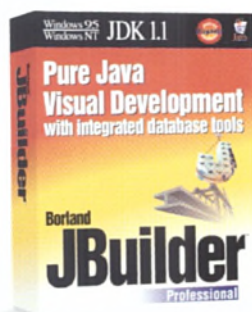
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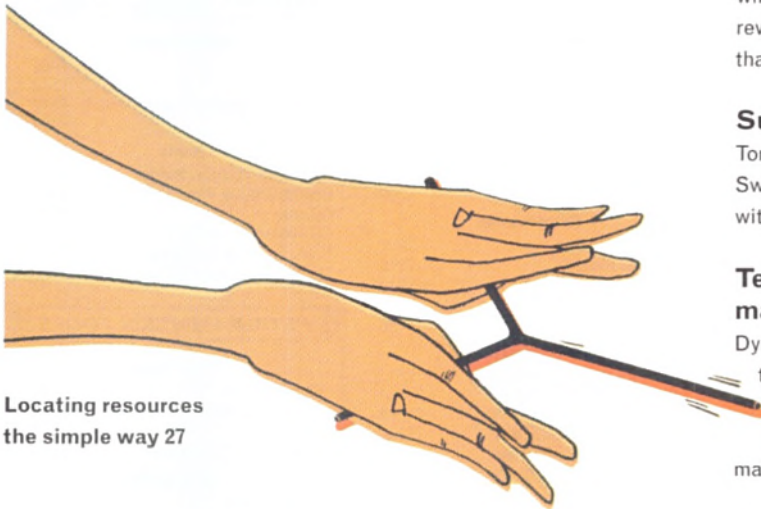
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 - **TOC Composer** visually creates the Contents Tab of a WinHelp system.
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- RoboHELP 5 Special Edition is also now available with Blue Sky's new native HTML Help authoring tool, RoboHTML.

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Who cares about reuse?



Reuse is a hot topic when discussing object-oriented software

engineering and components seems to be the latest buzzword. But what are components? According to Ivar Jacobsen in *Object Oriented Software Engineering*, 'Components are already implemented units that can be used to enhance the programming language constructs'.

Because of their nature, components typically are used during the implementation phase of the software life cycle, and programmers should be able to browse through a repository of reusable components, and pick those they want to use.

This raises two interesting questions. Firstly, how do you get a reusable component? Secondly, how do you know which ones to use?

The first question can be answered by anyone who has gone through more than one OO project. You don't *get* reusable components: you have to *design* reusable components. The component repository can be populated with every single software partition ever created in the company; but, if it is not properly designed, this 'parts bin' will be end up being that old filing cabinet at the back of the office containing old or useless information. This actually also answers the second question – software design enables you to find out which parts of the new system can benefit from previously created components.

Once again, we face an area which many programmers have shied away from – software *design*. Why is it that twenty years after DeMarco's *Structured Analysis and*

Systems Specification a large proportion of software is still being built without properly undertaking analysis and design? No other self respecting industry builds something without a correct design. After all, who would step onto an airplane that, without a proper design, was built from off-the-shelf parts? Who wants to be responsible for building a house without having the blue-prints

Object Oriented Analysis and Design (OOA/OOD) techniques have been in use since the late eighties: OMT (Object Modelling Technique) being the most popular one, and UML (Unified Modelling Language) being touted as the most promising new standard. Object-oriented design focuses on describing a system in independent units with specific responsibilities. These units

should be able to do, and does not consider implementation issues such as hardware or programming language. This is the perfect environment to look for similar requirements between different projects. If the requirement descriptions are similar, there may be a similar design or even a similar implementation. Again, 'patterns' play an important role in all this. General problem descriptions (for example, a customer ordering a new product) might be modelled in pattern diagrams. This will make it easier to find existing designs which handle that specific type of problem.

Reuse at the analysis and design level requires object-oriented analysis and design tools that are able to store analysis models separate from design models, but are able to share these models at an enterprise level. Their repository should be able to identify user or workgroup development environments, but at the same time it should make reusable designs or units easily accessible for every developer independent of the project he or she is working on.

It becomes clear that reuse at the code or component level gives you only one small piece of the pie. Not only can programmers benefit from reuse, but the software analysts and software designers can also benefit from previously recorded experience, thereby avoiding mistakes made in the past. Object technology is therefore not a 'too fine grained, too technical religion': it provides a very useful mechanism to achieve the real benefits of reuse.

Dirk Hus
Technical Manager
Cayenne Software
(www.cayennesoft.com)

Why is it that twenty years after DeMarco's *Structured Analysis and Systems Specification* a large proportion of software is still being built without properly undertaking analysis and design?

available? Reuse would be the least of your concerns!

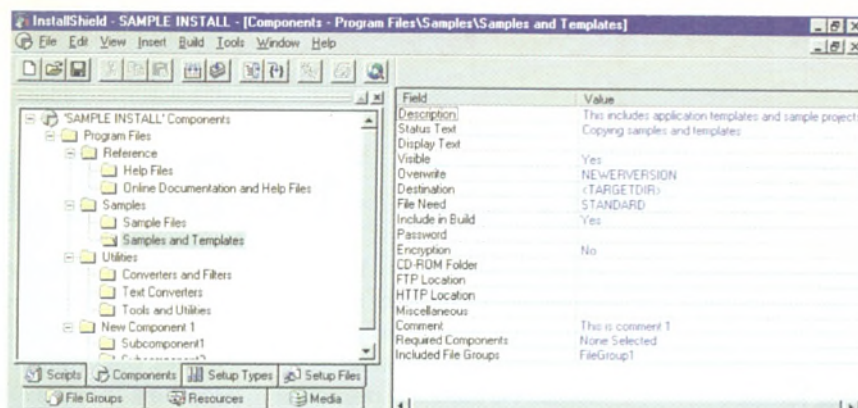
Remarkably, because of thousands of years of experience in design, reuse is widely practiced in the construction industry. One of the reasons why software programmers are not bothered with analysis and design might be that software is built on top of ten to fifteen year old, well designed, well proven legacy systems. Generally, programmers only benefit from reuse when designers do a good job. However, since design seems to be the key factor in the reuse of code, what would be the outcome of companies taking reuse one step further and trying to reuse successful designs from the past?

The object-oriented approach seems a perfect fit.

may be built up from many other smaller units. If properly designed, companies can reuse these units in future projects. Even if reuse cannot be achieved at the code or component level, design patterns can certainly be identified and reused to create a new component with the same structure and similar behaviour.

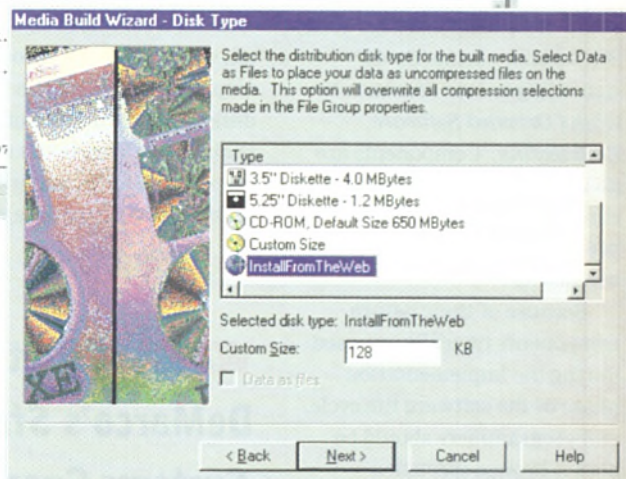
It seems only a small step to think about reuse at the analysis level. In the design phase the 'how' of the system is described, whereas the analysis phase focuses on the 'why'. One of the problems of reuse is understanding what it does, and why a system has been built in the first place. Analysis models describe what can be called the application domain. This only considers what the new system

FORWARD



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'...
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Build completed successfully at March 6, 1997

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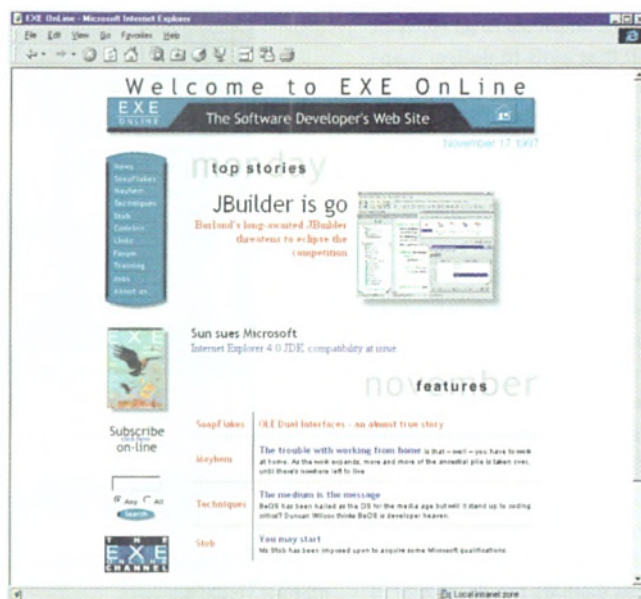
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Rogue Wave	01734 880224	System Science	0171 8331022
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EXE OnLine Mark III hits the Net

Following a switch of service providers and a change of platform from Unix to NT, EXE OnLine has been revamped and updated with the aim of improving the service to our readers and users. Complaints about the registration system and forums have been listened to, and both have been drastically improved and simplified. Extensive new content has been added – including the final and complete Stob archive – and with our server sitting comfortably on a 2 Mbps IP connection we hope that the speed of access and download will be more to your liking.

Among the new features we've added are a revamped Software Training Guide, a site-wide freetext search engine, and dual-mode discussion forums with Web and NNTP (Usenet) interfaces. Thanks to automated site updates we can bring you much more regularly updated news including plenty of stories which will never make it into the print magazine. There will also be a full archive of all feature articles published in the magazine – with a one-month delay – which is fully searchable.



Possible future projects include personalised home pages and an EXE OnLine Channel, to name but two. Reader feedback is crucial to helping us decide where to improve things, however, and we'd be more than happy to hear what you think of the redesigned site. Also, don't hesitate to participate in the forums.

Current EXE OnLine users will be migrated automatically when

they first log in to the new system, and all new users will be offered a seven-day trial period during which they can get a feel for the site before completing the full registration form. As ever, registration remains free of charge and open to all.

The new EXE OnLine goes live on 1 December at the same address as before.

W www.exe.co.uk.

A new line of Visual Cafés

Symantec was demonstrating Visual Café for Java 2.0 at the SoftDev/Webdev show at Olympia. It includes full JDK 1.1 support, a new Event Model in the Form Editor, and a just in time compiler. JavaBean support consists of new libraries to enable the plug and play of JavaBean components, and the ability to customize and enhance JavaBeans. Netscape browser debugging allows bugs to be fixed from within the browser. JFC libraries are included to help developers build applications quickly. These can be recompiled as part of an application and distributed with the user written software.

Visual Café for Java 2.0 is actually combined with other Symantec tools to form three separate editions: Web Development, Professional Development, Database Development. These will replace previous Visual Café lines.

The Professional and Development editions add native compilation features, the ability to compile Java source code into native executables. Incremental, on the fly, debugging and remote debugging are supported.

The Visual Café environment itself is made up of COM objects. The interfaces will be published on the Web, allowing customisation.

Pricing starts from £79 for the Web Development Edition. The Professional Development Edition costs £249 and the Database Development Edition for £429.

W www.symantec.com

EXE trip to SF

The Software Development Show 1998 is happening in San Francisco from February 9 to 13. We thought it could be fun to organise a group trip to this exhibition. In addition, this would allow all of us to travel at discounted rate. The plan is to leave on Saturday 8 and come back on Friday 13. We could organise some events for the Sunday.

Since the show is earlier in the month this year, we need to organise this trip as early as possible, preferably before Xmas. Please register your interest before 15th December.

From our enquiries we should be able to offer a return flight on Virgin for £395 (list price is £650) including taxes, and six hotel nights for £75 per night (list price £92).

Contact David Mery at dmery@dotexe.demon.co.uk or by phone on 0171 287 5000.

GEO Interactive have released **Emblaze Creator 2.5**. Users are able to quickly create multimedia Web sites without the use of server applications. New video, audio, animation, interactive programming, and general graphics features have been added. Sites can be viewed without the need for installing browser plug-ins. Compression ratios can be set for individual media types or the entire production. www.emblaze.com

Interactive 3D web authoring comes courtesy of **3D Webmaster**, apparently providing all that is needed to create complete 3D web pages or add 3D pages to 2D sites. Incorporating **Superscape's** new renderer, it can deliver Gouraud shading, improved texture wrapping, and a move and resize scaffold for direct positioning, resizing, and rotations. www.superscape.com

Magic Software has created a unified development engine for Internet and Enterprise RAD. The **V8 API** allows full application lifecycle support through integration with third party tools and the **Enterprise Edition** includes the Internet Transaction Processing (ITP) engine, MagicWeb. www.magic-sw.com

Database Xcessory DX 1.5 is a tool to speed the development of Unix client/server applications with graphical user interfaces. It includes a suite of GUI development tools such as a library of 27 reusable advanced **Motif** components and a **C++** code reuse framework. www.scl.com

How to map from a to z with ActiveX

ComponentSource is distributing **ActiveListBar v1.0** from **Sheridan Software**. The ActiveX component allows the user to have a multi-layer navigational tool.
www.componentsource.com

For a limited period, **Codehigh** offers **Inside Information** (normally £145) in exchange for a £25 donation to Amnesty International. It's a 3 year index to **EXE** and nine other UK computer titles and a comprehensive directory of software and hardware for PCs and networks. It runs on Windows 3.X, 95, or NT.
www.inside-information.com

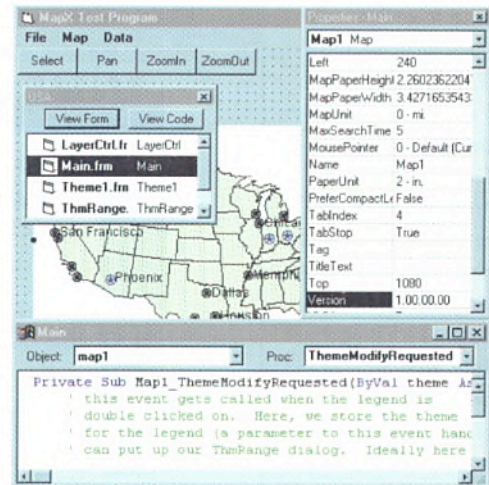
Derwent Information has launched **Patent Explorer**, internet service to provide both full text searching and facsimile images of documents from European and US Patent Offices. Users can now monitor research activities.
www.patentexplorer.com

Object-oriented Programming with Prolog (**OPL**) is a third-party add on library from **Amzi!** for Prolog + Logic Server. **OPL** can be used in embedded **Prolog** modules within Java, C/C++, VB, and Delphi. Prolog's pattern-matching and backtracking mechanisms can be used with equivalent OO paradigms.
www.amzi.com

System crash support is provided by Compuware's **Fault-XPERT 1.1** for Unix. In addition to support for SunOS and Solaris platforms: the **C/C++** code where a process failed is captured; an image of the faulting machine's desktop is preserved; and extra control over the storage of fault dump files is provided.
www.compuware.com

MapInfo's MapX 3.0 is an ActiveX control that aims to deliver mapping functionality to desktop applications. It provides full programmatic control of the features previously available in MapInfo Professional. Among other functions, the ability to zoom in or out and to pan around a geographic area enables the quick development of professional looking map-enabled applications.

Developers use workspaces, incorporating up to 52 layers of relational data, to visualise the spatial attributes of a map. From a single geographic item of data, ie a post code field, a one-pass *GeoCoding* process enables the developer to extrapolate associated data. Geographic processing is done on the server side for the sake of thin clients. The control supports all international standard mapping references and apparently there is ODBC access to underlying data. In fact, a subset of MapInfo technology can be found in current releases of Microsoft Excel under the name of Microsoft Map. It provides a higher



level view of spreadsheet data on a map for visual analysis.

For the Internet, MapXsite enables Web developers to quickly embed a 'find the nearest' capability into web sites. This particular searching function enables organisations to share the geographic location of points of presence with customers via the Internet. It incorporates HAHT Software's HAHTsite integrated Internet development system.

MapXsite can be seen in action by following a link from the MapInfo Web site. The user fills in a form to provide search criteria to display the nearest Wal-Mart store.

The MapX SDK is available for £895 through Component Source (a paper manual is supplied separately). A time-limited version can be downloaded from the web. MapXsite retails at £3495. The cost of associated mapping data begins at £4000.

www.mapinfo.com

Visual Basic apps analysis

A couple of new tools will help VB developers analyse an under performing application. Visual Quantify, from Rational Software, is a performance analyser to assist the development of faster applications. It incorporates a PerformanceTune feature which allows the user to control what data is collected and the level of analysis conducted.

TrueTime Visual Basic Edition is the NuMega contribution which extends its SmartDebugging range. It is another automatic performance analysis tool, but one that can show how an ActiveX component affects the application's performance. C++ and Java editions are scheduled for early next year. It is one of the suite of tools in the newly released DevPartner for Visual Basic.

www.rational.com

www.numega.com

Middleware extends DCOM to Unix and mainframes

Software AG has added ActiveX to its Entire middleware, taking Microsoft's DCOM technology into Unix and mainframe environments. EntireX, extends the potential benefits of DCOM to new platforms such as Sun Solaris, HP-UX, IBM AIX, and Linux.

The middleware of DCOM is supplemented with Software AG's Message Broker which supports a variety of connections between clients and servers and includes Web and message-handling interfaces. An option for persistent message storage enables guaranteed message delivery, even if a server component is not available when the client tries to access it or a transmission breaks down.

For developers there is the prospect of removing network design from consideration during application design, that an application could be written once and deployed many times. Existing server or mainframe based applications are simply wrapped by the broker services of EntireX. A VB client, for example, could view a server as just another component, accessing a C++ application running on Unix or an RPG program on RS4000, in a standardised manner.

To plug any gap in the coverage of EntireX, another ActiveX control is provided to make DCOM services available to PC based tools. For example, should a client-side application itself be a legacy system it will need to be integrated with EntireX to take full advantage of DCOM features.

www.softwareag.com

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dBarcode - 2D Developers Kit V1.0 (32Bit OCX/DLL)	£225.00	SOS Help! Info Author V2.3 (Win3.1/95/NT3.51)	£160.00	TX Text Control V5.01 (16&32Bit ActiveX/DLL)	£210.00
dFont Barcode Fonts for Windows - from	£55.00	VideoSoft VSODOC V1.0 (32Bit)	£145.00	ALL Text HT/Pro. V4.0 (16&32Bit OCX)	£195.00
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Buttons & Cursor Design		ImageFX PhotoPRO V1.0 (32Bit ActiveX)	£165.00	Exacticks V1.1 (16&32Bit DLL)	£75.00
FarPoint ButtonMaker V1.0a (16&32Bit ActiveX/DLL/VBX)	£45.00	ImageMan ActiveX Suite V5.04 (16&32Bit ActiveX/OCX)	£260.00	User Interface	
Calendar Controls		ITWAIN OCX V2.0 (32Bit OCX)	£99.00	ActiveListBar V1.0	£79.00
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iCalendar V2.0 (32Bit ActiveX)	£39.00	Installation		ActiveThread V2.01 (32Bit ActiveX)	£69.00
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NuMega CodeReview Pro. V5.0 (16&32Bit)	£190.00	Setup Factory V4.05 (32Bit)	£99.00	VideoSoft VS-OCX V5.0 (16&32Bit ActiveX/OCX)	£60.00
NuMega VB Dev. Suite (CodeReview Pro./FailSafe Pro.)	£299.00	WISE V5.0 Enterprise Edition (16&32Bit)	£285.00	Version Control	
Pretty Printer V5.0 (16&32Bit VB3/4/5)	£49.00	WISE Installation System V5.0f (16&32Bit)	£99.00	GP-Version V2.11 (16&32Bit) Single User Licence	£60.00
Communications - Libraries		Instrumentation Controls		Versions 2.0c (32Bit)	£59.00
App-Link V2.0 RADX Control Set (16&32Bit ActiveX/VBX)	£75.00	Instrumentation ActiveX Lib. V3.1 (32Bit ActiveX)	£180.00	VersionStomper V5.0 (16&32Bit ActiveX/VBX)	£69.00
Crescent PQComm V3.3 (16&32Bit ActiveX VB5 Ready)	£95.00	RSAnimator V1.0 (32Bit ActiveX)	£99.00	Windows API Tools	
SuperCom V3.5 (32Bit W95/WNT)	£220.00	RSToolPak I V1.00.19 (32Bit ActiveX)	£95.00	SpyWorks Pro. V5.0 Incl. Subs. (16&32Bit ActiveX)	£135.00
Communications - Message Brokering		RSToolPak II V1.00.19 (32Bit ActiveX)	£119.00	WWW & Internet Tools	
Active Gateway SDK V1.32 (32Bit ActiveX/DLL)	£145.00	List Controls		App-Link IMS (workstation) V1.0	£219.00
Communications - NetWare		FarPoint List Pro. V2.0 (16&32Bit ActiveX/DLL/VBX)	£115.00	Astra Site Manager V1.01 (Win95/NT)	£235.00
Developers Suite for Netware V5.0 (16&32Bit)	£235.00	The List Collection V3.0 (16&32Bit OCX/VBX)	£120.00	Complete Mail Suite V2.0	£199.00
Compression Tools		Tlist Pro. V3.0 (16&32Bit ActiveX/OCX)	£99.00	Crescent Internet ToolPak V3.01 (16&32Bit ActiveX)	£95.00
Crusher! Data Comp. Toolkit V3.12 (32Bit DLL)	£170.00	Lotus Notes Integration		Distinct TCP/IP SDK V2.0 (32Bit DLL)	£290.00
Data Entry Controls		VBLink for Lotus Notes V4.2 (16&32Bit ActiveX/OCX)	£545.00	Distinct Visual Internet Toolkit V2.0b (32Bit ActiveX)	£175.00
FarPoint Input Pro. V2.0 (16&32Bit ActiveX/DLL/VBX)	£69.00	Mapping & GIS Tools		IdleY ISAPI V2.0 (32Bit ActiveX/DLL)	£119.00
ProtoView WinX Component Library V1.0 (32Bit ActiveX)	£105.00	GeoView IT V5.0 (32Bit ActiveX) - Royalty free	£140.00	IDSMail OLE Server V4.1 (Win 3.1/95/NT)	£235.00
Vantage Control Set V2.0 (16&32Bit ActiveX/VBX)	£75.00	MapInfo MapX SDK V2.0 (32Bit OCX) includes 1 Run-Time	£895.00	J-BOTS V1.0 (32Bit for Microsoft FrontPage 97)	£20.00
Data Import & Export Tools		Maths, Stats and Financial		Mabry Internet Pack (16&32Bit ActiveX/VBX)	£70.00
OpenExchange Dev.Kit V1.0x (16&32Bit OCX/VBX)	£270.00	Eval-O-Matic Suite V2.0 (32Bit ActiveX/VCL)	£120.00	NobleNet Web V2.0 (16&32Bit)	£1190.00
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DirectX Controls		Crescent QuickPak VB/J++ V1.0 (16&32Bit ActiveX/DLL)	£119.00		
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iDraw V2.0 (32Bit ActiveX)	£99.00	Productivity Tools			
iSound V2.0 (32Bit ActiveX)	£99.00	ProtoView ActiveX Component Suite V1.0(ActiveX/DLL/VBX)	£150.00		
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Facsimile Tools & Controls		softSENTRY V1.11 Full Version (16&32Bit)	£275.00		
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Find & Replace Utilities		Mabry MIDI Pack (16&32Bit OCX/VBX)	£55.00		
SPEED Ferret for Visual Basic 5 and Access 97 (32Bit)	£99.00	Spell Checking			
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Sybase updates development tools range

Java Studio, from Sun Microsystems, features a 'live' environment for simultaneous development and testing of applications which access or publish information on the Internet. Visually connecting **JavaBeans** components enables users to build dynamic, network-aware Web pages.
www.sun.com

The HTML editing tool, **HomeSite 3.0**, from **Allaire** adds support for FTP remote file access, and tag completion for quick **HTML** editing. Improved features include internal browser previewing capabilities and pre-built template support.
www.allaire.com

The component-based application development suite **SuperNova/Visual Concepts**, based on CORBA/IIOP and OLE/COM, provides a single environment to manage and integrate multi-vendor systems. Components are created using standard development tools (C++, etc), logged in a repository. A set of rules defines component interaction.
www.supernova.com

Cayenne Software has introduced **GroundWorks.net** to view data models on intranets. It makes it possible to share **live data models** with anyone sharing a standard Web browser.
www.cayennesoft.com

SilverStream Software has launched **SilverStream** in Europe. It's a Web Application Platform enabling corporations to build and deploy **Java-based applications**. It integrates business logic, database access, content creation, publishing, and communications.
www.silverstream.com

The enterprise application development tool **PowerBuilder Enterprise 6.0** has been released by Sybase. It includes capabilities for creating Web applications, distributed development, expanded Unix platform support, and component generation (PowerBuilder and C++ objects). Enterprise is seen by Sybase as an important step in the delivery of products to support its Adaptive Component Architecture. Corba and ActiveX component formats will be supported 'soon'.

The debugger for this 4GL RAD environment includes just-in-time capabilities and a redesigned interface. A trace engine and application profiler capture and present

Borland acquires Visigenic

Borland has acquired Visigenic Software, best known for its Corba (Common Object Request Broker Architecture) technology. The companies announced the agreement at the Comdex show. The boards of directors of both companies have approved the acquisition, which is subject to approval by the shareholders, as well as to customary regulatory approvals.

Through its licensing agreements with such as Oracle, Netscape, Novell and Sybase, Visigenic has established its VisiBroker as a de facto standard ORB technology.

The acquisition of Visigenic is apparently aimed at accelerating Borland's growth as a technology provider for the distributed enterprise market. The addition of Visigenic's distributed object technologies should eventually allow Borland customers to mix legacy, client/server, Internet, and object-based applications into a single, distributed Information Network application. These allow organisations to give their employees, customers, and suppliers access to real-time information from data sources across an enterprise.

www.borland.com

PowerSite

application execution profiles. In the 6.0 release HP-UX and IBM AIX join Sun Solaris, Windows NT and 95 and MacOS as platforms supported by PowerBuilder.

The updated development tools range of Powersoft is also to include a new Web development tool, **PowerSite**. It is an application development environment for building, managing and deploying mission-critical Enterprise Web applications. PowerSite features a centralized component manager and Powersoft's DataWindow for database

integration. It is currently on beta-release and version 3 can be downloaded from the Web.

PowerSite works with ASP, Dynamo, and LiveWire. Other Web server support will be added in future.

The addition of Jaguar Component Transaction Server (CTS) to the Powersoft product line means that all standard components, including Java Beans, ActiveX, and Corba, can be used for development and distribution on an enterprise basis.

www.powersoft.com

Your place in a development environment

When programmers work in teams ideally the tools they use should reflect the multi-user, possibly distributed, environment. This is the area addressed by **Continuus/CM 4.4** from Continuus Software. The latest option in its suite for distributed change management enables the management of a decentralised development environment as if it were a single, centrally located team. It supports mixed NT and Unix servers and a range of development site sharing requirements.

To accurately determine the state of software at any given point is the goal of **RequisitePro 2.5** from Rational. Designed for multi-user environments, it aims to help teams manage and communicate changing requirements. It integrates with Rational's **SQA Manager** to enable the automation of testing by linking requirements to specific test suites and also with configuration management systems to ensure latest requirements are incorporated into the development process.

TakeFive Software is offering the programming environment **SNiFF+** for C/C++ with a free extension for software development with Java until the end of the year. It contains an integrated graphical Java debugger and all the tool support previously available for C/C++. It is being marketed as an opportunity to help C++ users make the transition to Java in their next project. TakeFive claims that its environment is non-intrusive in that a single user can use **SNiFF** without impact on any project files.

www.continuus.com www.rational.com www.takefive.co.at

And the competition winners are...

From the SoftDev/WebDev show at Olympia, the lucky winner of the new EXE subscriber draw was a Mr K Chapman. His prize, a copy of Visual J++, is in the post.

The skillful winners of the EXE juggling competition, by the subjective judgement of our resident expert, were Matthew Allum (for Wednesday) and Neill Robbins (for Thursday). They will receive a set of juggling balls. Congratulations.

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Here's what the users and press say about TRACK and TRACKWeb.

What Users Say:

"The ability to get users up and running with TRACK in a very short period of time is invaluable. Most people are able to use TRACK without ever reading the documentation."

— Greg Bryant, Principal Software Engineer, NEC Technologies, Inc.

"Using TRACK we're able to look at exactly what happened on a project and come up with accurate time estimates for future releases."

— Kirsten Thompson, Quality Assurance Analyst, Pepsi International

"After using TRACK for several months, we have found that it has streamlined our problem reporting and tracking efforts on a corporate basis."

— Rory Roybal, Director of Engineering, Phoenix Technologies, Ltd.

The Press Agrees:

"TRACK automates interactions with related tools."

— Peter Coffee, PC Week, March 4, 1996

"TRACK wins hands down in the flexibility, power and ease-of-use areas."

— Data Management Review, January 1996

The screenshot shows the TRACK software interface with a menu bar (File, Edit, Record, View, New, Query, Report, Setup, Window, Help) and a toolbar. The main window displays a defect report form for Defect ID 36. Fields include Priority (Medium), Status (Closed), Assign To (A.Lau), Product (DrawCAD), Module (Display), Version (2.00), Date (03/01/94), Time (14:30:43), and Copy To (admin). The Synopsis field contains the text "Overlapping viewports can't be displayed". The Detailed Description field lists steps to reproduce the issue: 1) Load DrawCAD by clicking its icon, 2) Create two viewports, 3) Choose EDIT, OVERLAP command. Other fields include Opened Date (03/01/94), Closed Date (10/21/94), Days Open (234), Last Change (10/21/94), and Changed By (admin). The Attached Files section shows "demo.log". At the bottom, there are fields for System (LCP286-4) and User (John Brokerage).

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Software integrated circuits

It's going too far to say that object orientation is dead, but it's certainly a little green about the gills. Its upstart younger brother, component programming, has stolen all its thunder, and is running away with all the rewards.

Actually, component programming is quite an old idea. I remember when the software ICs were being touted as the solution to programmers problems; prepackaged chunks of code, encapsulated in opaque wrappers which had well-defined interfaces, and which would be reliable no matter what you threw at them. Sounds a lot like components to me.

And object orientation is still working just fine in its own way. Objects were invented to handle simulations of real-world entities, and when you're trying to model something that behaves as if it were made of matter (such as windows and buttons) objects are still a jolly good solution. But otherwise the model starts to get a little strained.

Objects are supposed to promote reuse. So are components, but for some reason objects don't deliver. I think it's got something to do with interfacing. An object has its interface defined in a header file. What isn't defined in the header file is start up code requirements, memory strategies, and behaviour. That means that object programmers can either spend ages developing reusable objects in a vacuum, or they can get on with the project they're being paid for. You don't get reuse for free, any more than you did when using procedures.

The main problem with objects is that they're snobbish. A C++ object will connect to a C++ object – made by the same compiler – if you're lucky. All the

grand words about well-defined interfaces in header files are nothing when you're faced with proprietary name mangling protocols, algebraic calling conventions, and paginated vtable strategies. In contrast, a component will connect to anything. It publishes its interface at design time, and it internalises absolutely everything. A component, just like a software IC, requires nothing more than power and input to work. It's the responsibility of the glue code to get output from one component into the inputs of another. And so long as the glue code and the components agree on the interface specification protocol, everything will work with everything else. But, since the specification makes no mention of exactly how the interface works behind the scenes, it means the interface is strict. There's no chance of cheating a little by fiddling with globals or assuming things happen in a certain order.

What occurs to me, though, is that the reason why components are winning has nothing to do with the main problem of objects. It's got to do with the main problem of programming. When you're using components, writing a program is (generally) as simple as wiring up a hi-fi, or connecting up the bits of the computer. There may be several inputs to a component, but they are pretty much independent. You don't have to present twenty different values simultaneously as you do with procedure and method calls, because components expect things to arrive asynchronously.

The big deal about computers is the fact that they're grossly non-linear. The reason people have trouble taming them is also because of

Jules is becoming optimistic for the future of programming with components.

this non-linearity; tiny errors (both in logic and in data) are magnified out of all proportion. Programming is difficult for most people because they think in terms of linear systems with small, limited-scope exceptions, and this is exactly the model which components exhibit. Components work because they allow semi-skilled programmers to express what they want to do in almost natural language. In doing so, they apply control to the one thing which has hitherto been allowed to run riot – non-linearity.

It's funny – for years computer scientists have been trying to understand why programming is so difficult, first blaming gotos, then types, procedures, structures, libraries, and linkage. No matter where the blame was placed, these clever and motivated people still couldn't tell us why no solution, no matter how promising, ever really told us anything about how to write programs in the real world. Now we've found the solution almost by accident, and most serious programmers still think of it as toy like. They're conned by the very simplicity of the approach into thinking it's low-calorie visual objects.

It's not low-calorie. It only seems so because in today's systems there's a clear distinction between the components on one level, and the wiring on another. It doesn't have to be that way. Components could themselves have internal component-type structure. Programmers could build collections of editors and controls, and then package them

into higher-level components. Inheritance, too, is a concept everybody understands and default wiring on the periphery of the component, or patch panels inside components, could provide that kind of thing (much the way a hi-fi amplifier allows you to plug in equalisers and effects equipment).

It's also not object-oriented. Encapsulation there is a plenty, but where is the inheritance or the polymorphism? Components are just as ripe for objectification as were C and Pascal.

Finally, it's not visual. In fact, this is the oddest observation of the lot, because components are easier to make visual than almost any programming strategy we have. In electronics, circuit diagrams are well understood, and the concept of multiple asynchronous terminals is one which has a well-established engineering pedigree behind it. Programs made of components are immediately translatable into circuit diagrams, and the immense body of knowledge about static analysis becomes available to us.

For the first time in a long time, I'm starting to feel optimistic about the future of programming. All we have to figure out is how to get the *programmers* to steer this technology to maturity and eventual utility, instead of big business and standards institutions. ■

When not considering the calorific content of programming matters Jules can be emailed as jules@cix.co.uk.



Tangy processor

Dear Sir,

You say Tangerine Computer Systems Ltd did all the design for the Z80-based Tangerine Tiger, but this machine was never produced (Letters, EXE Oct 1997). In fact Tangerine sold the design to another Cambridge company, HH Electronics, who in 1982 put the machine into production under the name 'HH Tiger'.

Chris John Jordan, *Hybrid*.
chrisjj@cix.compulink.co.uk

Correction noted. And before Jules mentioned it, I had never heard of this machine! The book Oric – the story so far by Jonathan Haworth has changed URL since I mentioned it and is now at www.ensica.fr/oric/BOOK/contents.html – Ed.

Computing history

Dear Sir,

Mention of the Tangerine Microtan 65 in September's EXE sent me to the loft to retrieve the ZX81 I built with my own hands (and a soldering iron) just 17 years ago. Showing it proudly to my 1984-vintage son, I taunted him to program something – anything – which would fit inside 1 KB. I wasn't prepared for his bewildered look. 'How can you run Delphi on that?' he asked. 'You can't,' I smugly replied, 'because there's no CD-ROM. Neither is there a floppy disk drive.' I described how we loaded software from cassette tape, though I couldn't remember what the capacity of a cassette was in KB, largely because I never needed to know it.

He now thinks I'm the biggest liar in Europe. Under interrogation I admitted to having bought the 16 KB add-on RAM, held in place with a wide elastic band (not supplied). There are some supplementary



questions I am unable to answer, with which I'd appreciate some help from people with nothing better to do.

1. If Microsoft Office 97 were only available on C15 cassette tapes, how many tapes would be needed and how long would it take to load, given sufficient disk space to contain it?

2. While I was tinkering with my ZX81 at home, I was using an ICL mainframe at work which communicated with another machine in Walsall via acoustic coupler. I can't remember what baud rates would have been around in 1980 – any ideas?

3. Now that disk space and RAM are so plentiful, programmers have mastered the art of filling all the available space with program. What's the most impressive program that anyone has ever seen running in 1 KB of RAM?

When the dust has settled I plan to show him my Tatung Einstein and IBM PC Jr, but I don't think he's prepared mentally for them yet.

Graham Brack
GrahamBrack@compuserve.com

Your letter sent the whole EXE team on a memory trip... and a search for the long forgotten truth! The cassette interface worked at the astonishing transfer rate of 250 baud using a unique tape-recording format not compatible with other systems (the connection to a standard tape recorder was done via a 3.5mm jack plug). Since it was hard to find the start of a program, C15s were most commonly used. The theoretical maximum storage

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at 250 baud on a C15 is 27.5 KB. (On the Spectrum the recording speed was increased to 1500 baud.) Back to your list of questions:

1. The MS Office 97 Professional Edition, sitting on an easy to reach shelf, contains 630 MB of data. So, at 250 baud it would require 352,835 minutes of tape. With 15 minute tapes, you would just need 23,523 tapes, that is if all the space is used by data. Since there probably is some extra information stored (such as bit start and stop), you should probably add a few tapes to this count!

2. Most likely at that time you were using a V.21 acoustic coupler transmitting at 300 bps. Another type of modem widely available in that period was V.23 transmitting at 75 bps and receiving at 1200 bps.

3. No definite answer on this one. One program which one of us remembers with fond memories is the 1 KB chess which was released in 1982 by Artic Computing. It had no graphics and could only play white. Quite a lot of tight code is developed for the 3Com PalmPilot but most of it is still bigger than 1 KB. – Ed.

No Web, please

Dear Sir,

I have been an EXE reader since 1987, all the way through the 'Modula-2 years', and I still find it an invaluable resource as well as the source of the occasional chuckle thanks to Verity Stob.

But I must express my concern that the magazine seems to be drifting away from the real world. There seems to be rather too much Java and HTML and other Web stuff for my liking, and not enough practical code in languages I actually use, like C++ and Visual Basic. Java may well become an everyday language in the future, but right now my need to use it is nil.

Please stick to the mainstream and avoid the eccentric.

Phillip Sanders
Ipswich, IP4

Thank you for the praises; as for the criticisms, let me go through them. We do cover Web-related activity as far as software developers are concerned and this includes Java and Web site creation. In fact soon after the new EXE OnLine goes live (see p.9), Neil Hewitt will start writing articles on how he developed it. More and more companies and individual developers are getting online, it is becoming a necessity to think in terms of connected applications. This doesn't stop us from featuring articles on pure language issues or non-Internet related issues. In addition to the many articles on C++ products or using C++ as a language for examples we publish a monthly column by Francis Glassborow. As for Visual Basic, although we have had several VB-related articles, we don't yet have regular coverage as we are limited by space and can't dedicate pages in each and every issue to all computer languages. – Ed.



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Solutions for a small planet

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A man with short brown hair, wearing a dark suit, white shirt, and dark bow tie, is holding a black power drill with a silver drill bit. He is looking directly at the camera with a serious expression. The background is dark and out of focus.

DIY Agent

You too can create simple autonomous software agents. Armed only with standard programming techniques, Mark Harman covers the ground.

I believe that there is a pressing need for the creation of autonomous software agents that are tailored to an individual's tastes and requirements. These agents can sift the vast stores of available information for relevant data, or simply keep a watchful eye upon developments. They can also share the administrative load that the information society places upon humans. Perhaps agents will finally help us to achieve the long sought after goal of the paperless office.

An autonomous software agent is simply a program that is continually executing, or being periodically executed, and that gathers information (from the Internet, or elsewhere) to report back to its owner. Agents can be as simple or as sophisticated as the problem requires. Many very effective agents can be implemented without a great degree of programming sophistication. We just need to create a smooth interface between the Internet, other humans, and the program that implements the agent, thus allowing it to process information on behalf of its owner.

Let's look at how to build some simple agents using very basic programming skills based on facilities readily available from the Unix and Linux operating systems. None of these agents are particularly involved, nor will they provide facilities that are not already available 'off the shelf'. However, I hope to show that they are strikingly easy to implement and that readers will be encouraged to create their own particular agents.

Waking up and executing

The first step to take in setting up an agent is to find an appropriate machine on which to execute it. This will become the agent's life support system; switch it off and the agent will die. (It is possible to write agents that move from one computer to another, but we shall not be doing that in this article. This sort of mobile agent is more difficult to write and requires co-operation – willing or otherwise – on the part of the machine's owner.)

We then need a mechanism for ensuring that the agent runs regularly. Of course, we could simply let the agent be a continually executing program, but this is a little wasteful of resources. It would be better to execute the agent periodically. There will be different mechanisms for achieving this on different systems. On Unix it is particularly easy – we can use *cron*.

This Unix daemon is woken up and executed every minute. Each user has a *crontab* (*cron* table) that describes which programs are to be executed by *cron* and when. The important issue here is that *cron* allows us to execute a program at regular intervals. For example, given that we have a program, *p*, we can specify that *p* is to be executed every five minutes by typing *crontab -e*. This will put us in an editor in which we should create the file ** / 5 * * * * p*. The five entries (separated by white space) denote a minute, hour, day of month, month of year, and day of week. The asterisk denotes *every*. Therefore, the entry ** / 5 * * * ** means 'every five minutes'.

To remove our *crontab* entries we type *crontab -r*. This will be necessary if we want to 'switch off' our agent.

Ping

It's often nice to know when a machine becomes available. For example, if one of the machines on your network goes down for some reason, it would be nice to receive an automatic notification when the machine comes back online.

A simple way to find out if a machine is online is to use *fping* (a variant of *ping*). This is a Unix command which takes as its parameter the name of a machine (one which could be anywhere on the Inter-

net). If the machine is up and running then *fping* returns *true* as its exit status and *false* otherwise. We can test the exit status of a command execution using the *if then else fi* shell construct. So, we could write an agent to test if the machine we are interested in 'comes online'. The only remaining problem is how to get the agent to notify us when the machine does reach this state.

We could arrange for the agent to display a message on our screen or to ring the bell on our terminal or some such device, but these approaches have the drawback that the agent will need to keep track of where we are. A better solution is to use email. We will therefore give the agent a username and let it send email. In doing this we are making a subtle shift from thinking of the agent as a program that runs on the machine to thinking of it as a first-class citizen of the network – a bona fide user, just like ourselves.

To implement the agent we simply write a shell script that tests the machine in which we're interested (let's suppose this is called *machine.co.uk*) and emails us when the machine comes online. This small shell script is shown in Listing 1. The mail message is sent to the user *mark*, and it is quoted in the text of the shell script itself, using the *here document* operator *<<*. We can now use *cron* to execute the script at regular intervals, making it into a simple agent.

Accessing the Internet via an agent

To achieve its full potential as an information gatherer and filter, an agent will have to be capable of surfing the Internet. This might sound quite hard to achieve. However, using Unix shell script and *lynx* (a very simple, text-based, browser) it can be quite easy.

Using *lynx* will allow us to exploit the Unix concept of a pipe to feed data from the web into files or programs on our local system under the control of our agent. The command *lynx -source -dump url* copies the source of the web page located at *url* to the screen. Using redirection we can copy this to a file with *lynx -source -dump url > filename*. Our agent can use this command to access the source of any page it chooses.

Web pages continually change. Indeed most good web pages will necessarily change *frequently*, as any good page will need to be kept up-to-date. It will often be useful to know as soon as a change is made to a particular page, so that we can immediately check the new information. It would be a nuisance if we had to maintain a bookmarked list of such useful pages and check them ourselves; it would be far better to have an agent do the leg work for us.

We can use *lynx* to access the source code of the web page and compare this with the code for the page last time we looked at it. Listing 2 shows a shell script that does just this.

In the script, the shell variable *\$HOME* is used to ensure that files are stored in the home directory of the script's owner. If we've allocated the agent a username, then this will be the agent's home directory, otherwise it will be our own home directory. In either case, a subdirectory called *robot* is assumed to exist. As it stands the shell

```
# Simple script to report (via e-mail)
# when a machine comes online
if fping machine.co.uk
then mail mark <<'end'
machine.co.uk has come online
end
fi
```

Listing 1 – A simple script to report when a machine comes online.

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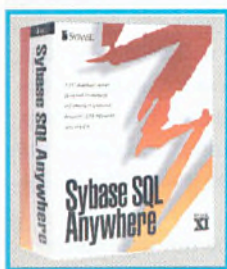
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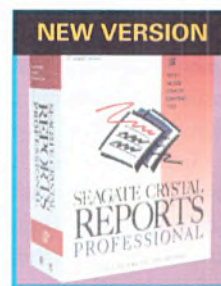
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Other possible agents

As with all programs, the aim is to take the drudgery out of processing large amounts of data quickly and correctly. In the new business world, the Web will act as an interface to the organisational database, and all employees will be able to communicate with one another via email. This creates a new programming paradigm in which programs have access to all data (potentially throughout the world) using a common interface and have the ability to communicate with all users.

Locating and reporting on dead links

The task of managing a Web site in which data is continually updated has become a full-time job. This is recognised by all organisations that are serious about the Web. The role of managing a Web site is likely to rely increasingly upon agent technology. For example, a simple agent could roam the site, following only links that remained inside the organisation's domain, and build a list of dead links, ie links that point to pages, both internal and external, that have become unobtainable. The agent could then email the (internal) page owner and ask that the links be updated. If the page remained uncorrected for a long period, then the agent would inform the Web manager who would decide what action needed to be taken. This agent is simply a variation on the URL monitor theme we implemented in Listing 2.

Data collection

The role of collecting data in an organisation typically falls upon an individual who becomes responsible for chasing his co-workers for information. This is a particularly debilitating process as it requires repeated reminders and checking and storing of data. In the past a well organised 'data collector' would have a database in which to enter the data. This database would produce reports of what was still required, thereby facilitating the 'chase'. Using agent technology, such a person can set up an agent that checks the date, chases individuals for information, stores the information received in a database, and simply sends the human 'chaser' status reports. This is simply a (much enhanced) version of the mail server agent.

Data mining

Many organisations have individual employees adding data to Web pages in an uncontrolled and unstructured manner. However, these Web pages provide a useful resource to the organisation as they represent readily available data. We could design an agent that scanned a particular web site looking for information that is likely to be useful. In this case, the power of the agent would depend critically upon the sophistication of the pattern matching algorithms it relies upon. This is where existing artificial intelligence work starts to play a role in the development of agent technology (although a lot could be achieved simply by using the Unix `egrep` utility). The basic mechanism for this agent is simply that which we used to implement the URL monitor.

I would be very interested to hear from readers about applications to which they think agents could be applied and also of those already working within reader's organisations (see my email address at the end of the article).

script is not robust, but it does the job and illustrates the ease with which simple agents can be established.

The assignment to `PATH` is required to ensure that only system versions of the standard commands are used, rather than any local alternatives that may exist in the file system. The shell command `A || B`, for commands `A` and `B`, executes `A` and if it fails, goes on to execute `B`. So `test -e file` fails if `file` does not exist. The next line therefore tests to see if the file `data.html` exists and, if it does not, creates it (from the web page <http://www.unl.ac.uk/~mark/welcome.html>).

Having established that the data file exists, we download the latest version of the web page and use an `if` construct to compare the new and old versions of the page. If the two pages are different then

Perhaps agents will finally help us to achieve the long sought after goal of the paperless office



we send an email message to the user `mark`. The text of the mail message is produced as a *here document*, using `<<`. An alternative would have been to create a file containing a message to be sent to the owner of the agent and pipe the contents into the `mail` command. Having sent the message the agent updates its local copy of the web page using the `cp` command.

If we run the agent program regularly using `cron`, it will send an email message to the user `mark` every time the Web page <http://www.unl.ac.uk/~mark/welcome.html> changes.

A simple mail server

An agent is an autonomous program, running continually on our behalf. Like any good apprentice, we shall want the agent to be capable of operating without command from us. However, we shall also want to be able to send the agent the odd command, altering its behaviour. We therefore need an interface mechanism that will allow us to send commands to the agent. A simple way to achieve this is to use email. After all, we have already used email as the medium through which the agent sends its findings to us.

This is not the only way to communicate with an agent. An alternative would be to use an HTML form to enter the data, which would then be sent to a `cgi` script using the `post` mechanism. However, the agent would then need to be sent the command by the `cgi` script (perhaps by email). To keep things simple, we shall simply send email direct to the agent.

In order for the agent to read email there is a little more work to do. The first step is to find out where new mail is stored. On my Linux system, supposing that the agent's username is `mark`, mail sent to the agent will be stored in `/var/spool/mail/mark`. This file will exist even if there is no new mail, in which case it is empty. To read the new mail for user `mark`, we therefore simply have to read the contents of the file. Having read the new mail, we shall copy an empty file to `/var/spool/mail/mark` so that the next time the agent code is executed it will only consider mail messages that it has yet to process.


```
# check if URL has changed
PATH=/bin:/usr/bin

test -e $HOME/robot/data.html ||
lynx -source -dump
http://www.unl.ac.uk/~mark/welcome.html
    > $HOME/robot/data.html

lynx -source -dump
http://www.unl.ac.uk/~mark/welcome.html
    > $HOME/robot/newdata.html

if ! cmp -s $HOME/robot/data.html
$HOME/robot/newdata.html
then
mail mark <<'end'
The page I'm monitoring has changed.

Yours sincerely,
The Robot.
end
cp $HOME/robot/newdata.html $HOME/robot/data.html
fi
```

Listing 2 – A simple URL monitor.

```
main()
{
FILE* mail;
char aword[100];
char user[100];

mail = fopen("/var/spool/mail/mark", "r");

while (!eof(mail)) {
do
fscanf(mail, "%s", aword);
while (!eof(mail) && strcmp(aword, "From:", 5));

if (!strcmp(aword, "From:", 5))
user = GetName(mail);

do
fscanf(mail, "%s", aword);
while (!eof(mail) && strcmp(aword, "Subject:", 7));

if (!strcmp(aword, "Subject:", 7)) {
fscanf(mail, "%s", aword);
if (!strcmp(aword, "sub", 3))
subscribe(user);
else if (!strcmp(aword, "unsub", 5))
unsubscribe(user);
else if (!strcmp(aword, "send", 4))
sendmail();
else Unknown(aword, user);
}
}
system("cp emptymail /var/spool/mail/mark");
}
```

Listing 3 – Outline of a simple mail server.

To use email to send messages (commands) to the agent, we shall need to work out a simple way to code up a command. One way this can be done is to put commands on the subject line of the email. This will be easy to locate, as the subject line is prefixed in the mail file by the word `Subject:`.

To see how this might work, we shall consider a simple agent that consists *entirely* of reading and sending email – a mail server. This is a mechanism for achieving asynchronous virtual conferencing. That is, any user may send a message to all users via the mail server. The users are therefore able to take part in a 'virtual conference'. The communication is asynchronous because the sending and receiving of email is asynchronous. To use an email server,

**In future, good agent
programmers may be as
highly sought after as good
network engineers are today**



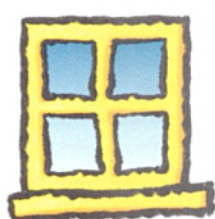
we send an email to the server and the server sends the message on to all users registered with the virtual conference. (Notice that this approach to mailing a list of recipients is superior to that of maintaining a simple distribution list, because it separates the process of joining and leaving the list from the process of sending messages to each registered recipient. It also centralises the distribution list, facilitating sharing among all users, and allows usage statistics to be collected at a central point.)

We don't have to use shell script to implement an agent; we could use any language. For simple agents, shell script is often the most suitable notation. For more complex agents it is usually more appropriate to use a programming language like C. An outline of a simple mail server program is implemented as a C program in Listing 3.

In this program, several auxiliary functions are used to process the text of incoming mail messages and to send out mail messages (these are not shown but are all simply string processing functions and email commands). The program scans the incoming mail for the `From:` line, which contains the sender's email address. This is stored in the string `user`, so that the agent can reply to the sender and store the sender's email address in the database of registered users. Next the agent scans for the `Subject:` line, that contains the command. Three commands are understood: `sub`, to register the user as a subscriber to the conference, `unsub` to remove the user from the conference, and `send` to post a message to all users registered with the conference. Each of these is implemented by an auxiliary function. Finally, if none of the three commands is found on the subject line, then the agent replies to the sender, indicating that the command was not understood. (The C function `system` allows us to pass a string to the operating system to be executed as a normal OS command.)

Once we have implemented a simple mail server like this, we could easily add many features to it. For example, we could add a command `who`, to which the mail server responds by emailing the sender with a list of registered users. We could allow the agent to maintain lists of registered users for several conferences and maintain a hierarchy of

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FEATURES DIY AGENTS

such groups. We could implement a voting mechanism among the registered users. We could implement a 'moderator' system, whereby each conference had an owner to whom all messages were passed for acceptance before being forwarded to the wider group of registered users. All these facilities can be implemented with the existing communication mechanism.

Life with software agents

We have only considered a few simple examples of agents, showing what can be achieved with a little bit of code, an internet connection, and a machine that can be left running continually. Perhaps this kind of agent barely deserves the title because it does not display a high degree of intelligence; it is true that much of the research work con-



More complex agents would require more complex programming, but not new techniques

cerned with the development of agent technology is simply a branch of artificial intelligence. However, I firmly believe that very simple agents such as the ones we've considered here will become useful and widespread as the Internet expands. Even with this simple approach, we could construct agents that are very adept at supporting internal and external commercial interaction. Moreover they can be constructed, maintained, and developed quickly and cheaply using existing technology and without additional staff training. See the box *Other possible agents*.

The ability to run programs regularly, combined with commands that allow programs to send and receive email and to access web pages, allows us to write simple software agents using straightforward programming techniques. As they reside on a single machine and use email to communicate with the owner, such agents are, in effect, playing the role of an automated user of the system. More complex agents would require more complex programming, but not new techniques. The added complexity is simply that required to pattern match and perform more sophisticated string processing.

Again, agent technology is currently in an embryonic state. However, the rapid growth of the Internet and our increasing reliance upon it as a source of information will demand that we adapt to life with software agents. In future, good agent programmers may be as highly sought after as good network engineers are today. ■

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Thanks are due to Sebastian Danicic and Ross Paterson who provided the original insight that lead to this article.



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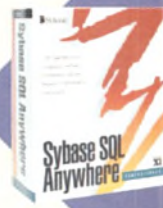
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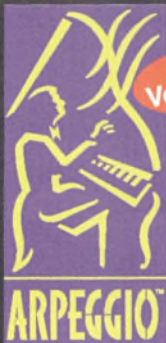


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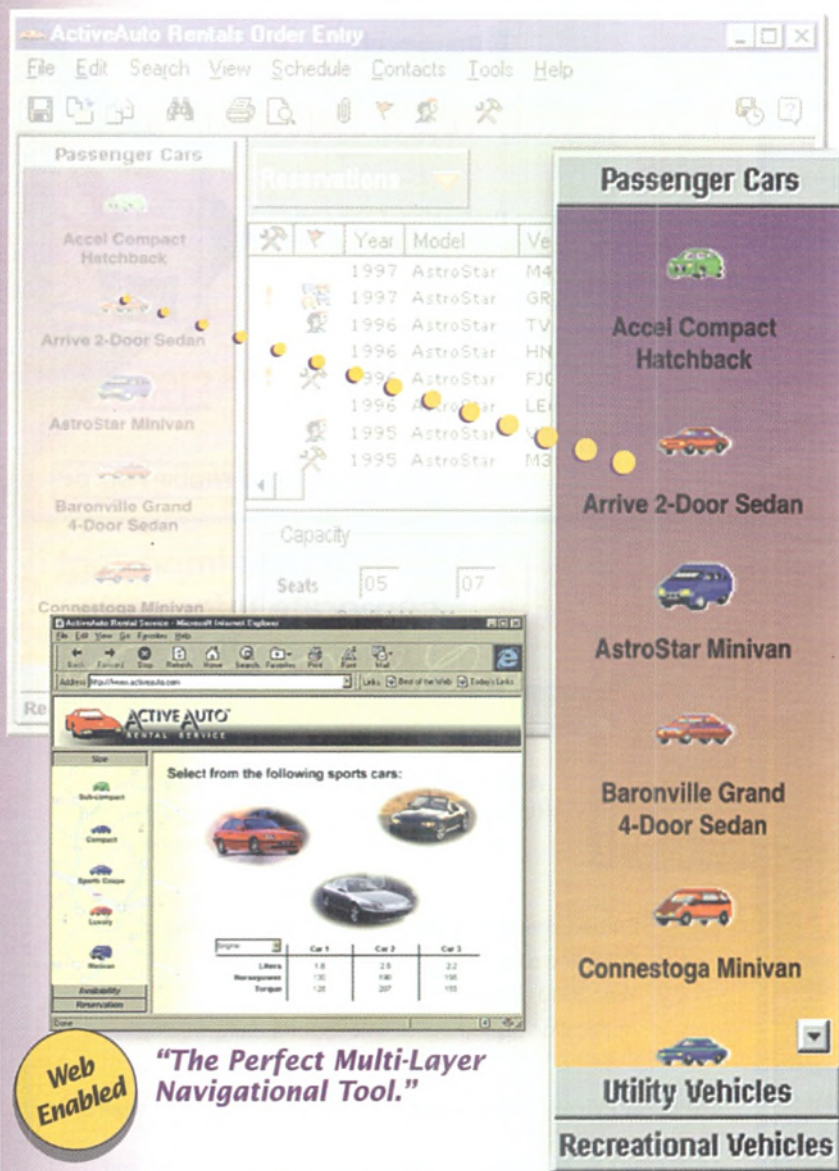
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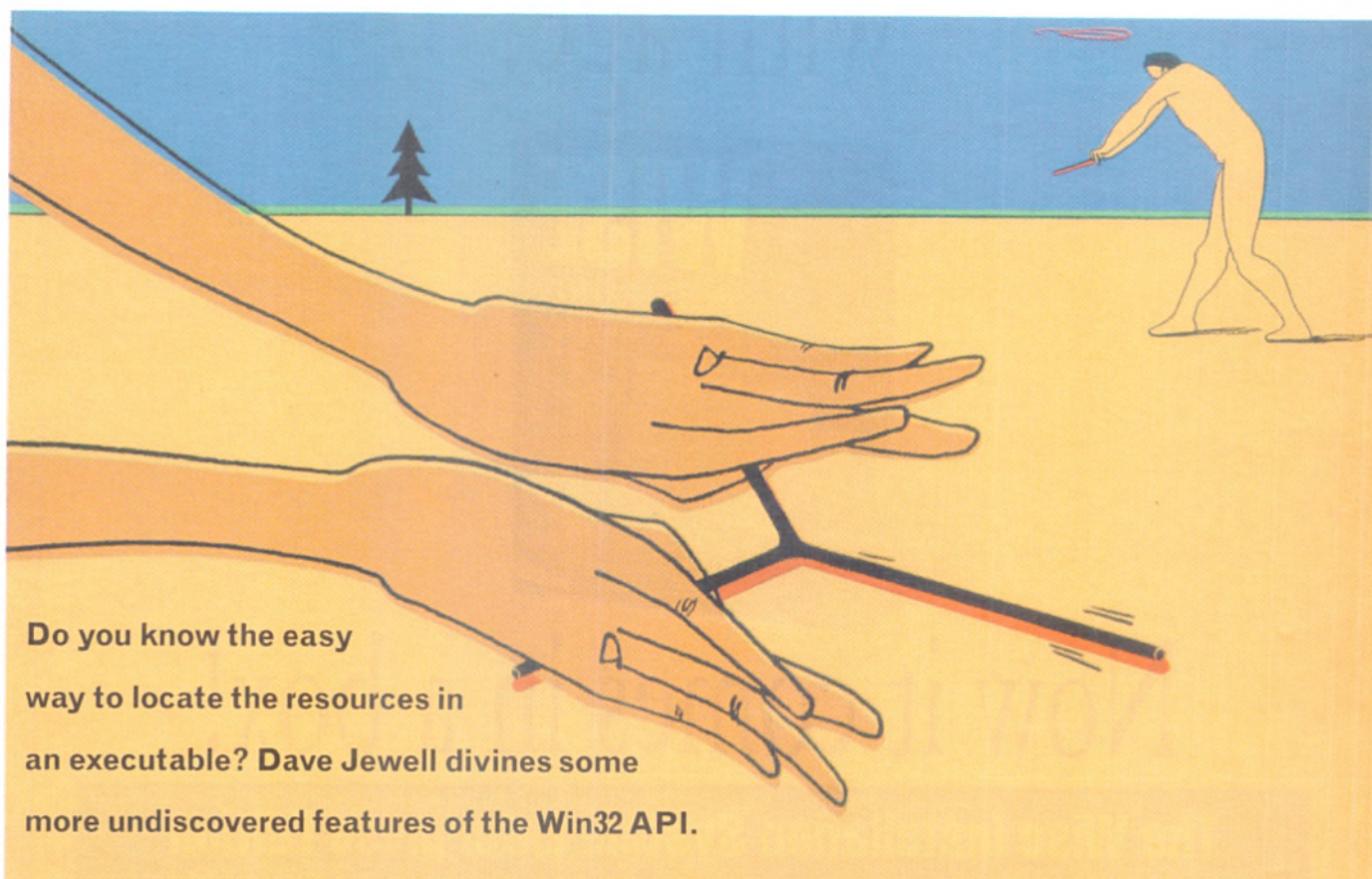


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Resource sleuthing made easy



Do you know the easy way to locate the resources in an executable? Dave Jewell divines some more undiscovered features of the Win32 API.

Now and again, Microsoft adds a juicy new call to the Windows API without telling anyone else about it. The problem is, with literally thousands of different calls in the API: how do you see the wood for the trees? Recently, I needed to write an application which could open an existing Win32 (PE format) executable and examine the various resources it contained. To do this under 16-bit Windows, you'd have to physically open the EXE file as if it were pure data, and then step through the file, manually locating the resource table information and enumerating the various resources it contained. I very much expected to have to do the same thing with 32-bit Windows but – quite by chance – I discovered a couple of useful new Win32 calls which make the job very easy. These calls are `EnumResourceTypes` and `EnumResourceNames`. As the names suggest, you use the first routine to enumerate the types of all the resources in a particular executable and then – for each encountered resource type – you can enumerate all the names by using the second routine.

My first thought was – wow, when did those calls get put in there? Fearing that I might be the last developer on the planet to have discovered them, I casually mentioned the routines to other keen Delphi developers and was very gratified to find that they hadn't heard of them either. Neither had Borland, apparently. If you're using one of the 32-bit versions of Delphi (2.0 or 3.0) then take a look in the DEMOS directory and you'll find a utility called `ResXPloR`, a program designed for browsing through all the resources in a particular file. (See Figure 1.) If you carefully examine the supplied source code for this utility, you'll find that even in its Delphi 3.0 incarnation, it laboriously walks

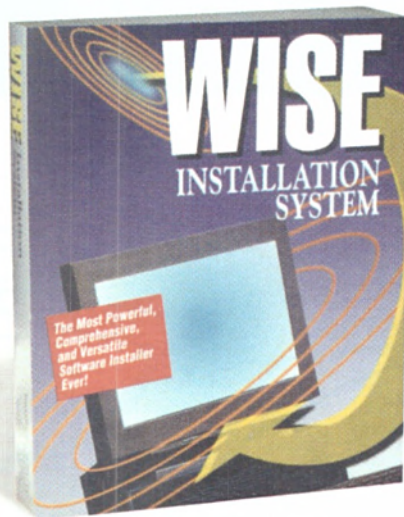
through the actual resource table structures in the file. It could have been made very much simpler if the two routines had been used...

Building a resource browser

Using these two routines, I wrote a little utility, `ResView`, that can be seen running in Figure 2, the Delphi source code for which is given in Listing 1. Here's how it works; when you click the Open button and select a file from the open file dialog, the `LoadLibraryEx` routine is called to load the specified file into the program's address space and return a module handle. (Why use the `LoadLibraryEx` routine? See the box-out *DLLs with a sting in their tail...*) If a valid module handle is returned, then a try-finally block is used to ensure that the library gets released no matter what. Within this protected code block, the `EnumResourceTypes` routine is called to enumerate all the resource types existing within the code module. The first parameter to this routine is the module handle, the second parameter is a pointer to an application-supplied enumeration routine (just like `EnumWindows`, `EnumFonts`, etc), and the third-parameter is used to supply some application-specific value to the enumeration routine – in this case, the form object.

Because it's a callback routine, the `ResTypeEnumerator` routine must be defined with the `stdcall` attribute. By default, 32-bit implementations of Delphi use the EAX, EDI and ECX registers (ADC – A Delphi Call, get it?) in that order to pass the first three parameters to a routine. Any additional routine parameters are pushed on the stack. Obviously, register-based parameters aren't compatible with the way in which Windows

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DLLs with a sting in their tail...

Incidentally, you might be wondering why it is that I've used the relatively new-fangled `LoadLibraryEx` routine to open the library, rather than the tried and trusted `LoadLibrary` call. Thereby hangs a tail...err... I mean tale. Believe it or not, there are actually some 32-bit DLLs around that can cause an application to crash simply by the expedient of issuing a `LoadLibrary` call on the DLL, followed by a corresponding call to `FreeLibrary`!

I recently discovered this while developing an application to scan designated executables, displaying a list of all the DLLs referenced by the application. To my surprise, I discovered one commercial DLL (part of a Delphi IDE add-on package) that consistently caused my application to crash. I reduced my program to the absolute bare minimum – just a `LoadLibrary` call, followed by `FreeLibrary` – and was amazed to find that my program still keeled over as soon as it tried to execute `FreeLibrary`, GPF'ing with an address violation. After a certain amount of investigation, I determined that the offending DLL was doing some rather dubious things in its initialisation, and of course this initialisation code was being called each time `LoadLibrary` referenced the DLL. Everything seemed fine until the call to `FreeLibrary`, at which point Windows 95 got rather upset.

The solution turned out to be the `LoadLibraryEx` call. Using this routine, and specifying `Load_Library_As_DataFile` as a second parameter, causes Windows to retrieve a module handle for the library, except that this time no initialisation code in the library ever gets called, and everything goes smoothly when it's time to call `FreeLibrary`. It's rather a quirky little programming scenario, but if you want to write code which routinely loads other people's DLLs and executables, it's a very good idea to use the `LoadLibraryEx` routine so as to protect yourself against 'rogue' DLLs.

expects to invoke a callback routine and if you forget to include the `stdcall` attribute, your program will compile without errors but you'll then find yourself faced with a challenging debugging exercise!

The callback routine, `ResTypeEnumerator`, takes three parameters; the module handle, a 32-bit identifier specifying the resource type being currently enumerated, and the 32-bit application-specific data which formed the last parameter to `EnumResourceTypes`. In this case, I've simply declared it as a variable of type `TForm1` so that it can be immediately used without further type-casting.

If you're at all familiar with resource management at the API level, you'll know that resources can be named with an ASCII string, or else given a numeric identifier. In the same way, the type of resource can also be a string or a number. All we get given is a 32-bit identifier, so how do we discriminate between the two different cases? Under 16-bit Windows, a far address was comprised of a 16-bit segment and a 16-bit offset. By convention, you specified a string (either for the resource's type or name) by providing a far pointer to the string; and a number by setting the segment part of the address (the top 16-bits) to zero. Under C/C++, this was most easily accomplished with the `MAKEINTRESOURCE` macro. With Delphi, it was easier (a lot less typing!) to just cast a number to a `PChar`.

But what about the situation in 32-bit land? In the enumerator callback routine, you could check to see if the top 16-bits of the received identifier were zero, but would this be an adequate way of distinguishing between a valid 'flat' string pointer and a simple numeric identifier? Maybe – but I'm not certain. A better approach is to let the

Windows kernel determine what is and what isn't a valid 32-bit pointer. By calling a little-used routine, `IsBadReadPtr`, we can reliably test whether or not an identifier is a string pointer or number. This seems to work well. (Internally, Windows makes extensive use of the `IsBadReadPtr` function when validating API calls passed from a client application.

If what we've been passed is a type number, then the `MapTypeNumToName` routine is called to convert this into a readable string. On the other hand, if we've been passed a valid pointer, then this is used as the resource type string. The `MapTypeNumToName` function simply checks the passed number against the pre-defined standard types, returning the corresponding string. If no match is found, then it defaults to returning a string in the form '#27', or whatever.

Having established the type name, `ResTypeEnumerator` then creates a `TStringList` object to hold the names of all the resources of this type. It then calls `EnumResourceNames` to build a list of resource names. This time, the routine takes an extra parameter – the type of resource whose names we want to enumerate. Rather than passing the form instance, the `TStringList` object is passed as the application-specific data so that the `ResNameEnumerator` code can directly add each encountered resource name to the string list, using the same `IsBadReadPtr` trick to distinguish between name strings and numbers. Last but not least, `ResTypeEnumerator` calls `AddObject` to add the type name (and its associated name list) to the `TypesList` listbox.

Finally, back in the button-click routine, the `ItemIndex` property of the `TypesList` list box is initialised to zero and the `OnClick` routine called, causing the `TypesListClick` routine to be invoked. This clears out the `NamesList` listbox and updates the contents with the names list for the currently selected resource type.

Time for an update

Interestingly, that's not the end of the story as far as resource-related goodies are concerned. I suppose we all have ideas for programming projects that we'd like to work on if only we had more time. For ages, I've wanted to build myself a decent resource editor – something like Borland's Resource Workshop. What's put me off is the apparent complexity of writing changes back out to the executable file. It's no big deal to extract icons, bitmaps, and other resources from an executable and write them out as .ICO, .BMP files, or whatever. But it's somewhat trickier to modify a resource within an executable, which will almost certainly necessitate changes to the file's header information and involve moving any data that comes after the resource information.

Here again, Microsoft has included the ability to write resources in the Win32 API – they just forgot to tell anyone. In this case, the

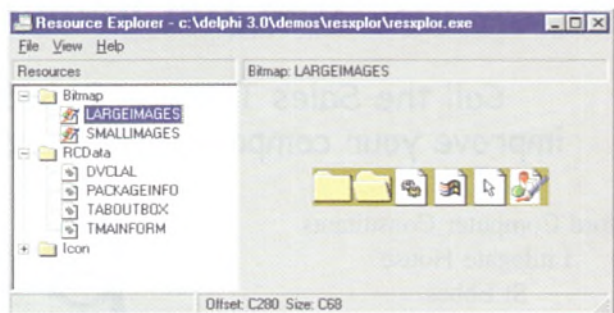


Figure 1 – Borland's Resource Explorer sample program could have been simplified by using the resource enumeration API routines.

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magic call is `UpdateResource`. Here's the C/C++ definition of `UpdateResource`, taken from the Win32 help file:

```
BOOL UpdateResource (
    HANDLE hUpdateFile,    // update-file handle
    LPCTSTR lpszType,      // addr of res type to update
    LPCTSTR lpszName,      // addr of res name to update
    WORD IDLanguage,       // language identifier of resource
    LPVOID lpvData,        // address of resource data
    DWORD cbData           // length of res. data in bytes
);
```

In a nutshell, a call to `UpdateResource` takes a type and name specifier (as ever, these can be strings or numbers) along with a language specifier, a pointer to the resource data and an indication of the size of the resource data, in bytes. The most important thing here is the first parameter – an update handle. This is returned from a call to `BeginUpdateResource`, and the update operation is terminated via a corresponding call to `EndUpdateResource`. Between these two calls, there can be an arbitrary number of calls to `UpdateResource`. This is done for reasons of efficiency; all the resource modifications are cached in memory until the final call to `EndUpdateResource`, at which point the various changes are applied to the executable file in one go.

The function prototype for `BeginUpdateResource` looks like this:

```
HANDLE BeginUpdateResource (LPCTSTR pFileName,
    BOOL bDeleteExistingResources);
```

When you make the initial call to `BeginUpdateResource`, the second parameter specifies whether you want existing resources in the executable file to be deleted. If this boolean parameter is set to `True`, then all previous resources are deleted before the list of resource changes in the update handle is processed. Ordinarily, you wouldn't want to do this – but see my later comments!

Unfortunately, the news isn't all good. The three `UpdateResource` routines I've listed here are currently only implemented under Windows NT – even Windows 95 OSR2 doesn't have them. They're just stubbed out in the usual way; a call to `BeginUpdateResource` will simply return an update handle of zero when executed under Windows 95. Sigh....

Undaunted, I decided to have a go at writing a little 'string editor' program. This program allows you to open an existing executable (be it DLL, EXE or whatever), edit the string resources it contains, and then write the updated strings back out to the file. This program works fine with the exception of one very important wrinkle you should be aware

of. Despite what the documentation says, I couldn't persuade the `UpdateResource` call to replace existing string resources *unless* I also specified (in the initial call to `BeginUpdateResource`) that I wanted to vape all existing resources not mentioned in the update list. The upshot of this is that my string editor will work fine – but any non-string resources will be deleted from the file! I wasn't sure whether this behaviour resulted from some error on my part, or whether it's a bug in the NT code. If you want to take my code and use it as the basis for a real-world string editor, or other resource editor, I'd suggest you cache *all* pre-existing resources and add them to the update stream. Because of the complexity involved, I haven't attempted to do this in my little demo program. You have been warned!

The user interface of the program is based around a `TListBox` component. This listbox displays the IDs of all the strings found in the selected executable. To understand how things work at the grass roots level, you need to realise that resource strings are stored in string resource blocks. A string resource block can contain up to 16 distinct strings, and there is a simple deterministic relationship between the resource ID of a given string, and the corresponding ID of the resource block. If you take a string ID, shift it right 4 bits and add 1 to the result, this will give you the ID of the resource block. Similarly, if you take a resource block ID, subtract 1 and shift it left by four bits, this will give you the ID of the *first* string that the resource block might contain. Thus, a resource block with ID \$EE1 might contain strings \$EE0 through to \$EE0F.

Resource string editing for profit and pleasure

Armed with this information, we can write the code for the Open... button handler, corresponding to the `Button1Click` method in Listing 2. As with the previous demo program, it uses `LoadLibraryEx` to open the executable, but doesn't bother with `EnumResourceTypes` because we're only interested in string resources. The various strings are enumerated by the `ResNameEnumerator` routine that is called once for each resource block, *not* for each individual string resource. It simply calls `LoadString` for each of the sixteen possible strings in the resource block, copying anything it finds into the `StringResList` listbox.

The `Button1Click` routine needs to call `FreeLibrary` after loading all the string resource information. The `UpdateResource` routines assume that they have exclusive write access to the executable in question and will fail if they don't get it. Therefore you must be sure to call `FreeLibrary` before the `BeginUpdateResource` routines gets invoked. Well, not quite.

What actually happens is that NT will create a copy of the executable file, giving it an extension of `.TMP`. When `EndUpdateResource` is called, all specified resource changes are committed to the temporary file and the operating system then tries to delete the original executable and rename the temporary file. It's at this point that write access is required. If the original executable is executing or loaded through a `LoadLibrary(Ex)` call, then NT seems to silently give up without deleting the temporary file.

I used a `TMemo` control to cope with very long strings, and the program relies on the `Modified` field of the `TMemo` control to detect whether or not a string has been modified. Each time you select a new string in the listbox, the code looks to see if the current string has been modified and, if so, updates the `Objects` array with the new string data. If this happens, then the `FileDirty` variable is set to indicate that one or more strings have been changed.

When it comes time to actually update the file, the `BuildUpdateList` routine is called to do most of the real work. Using a list of

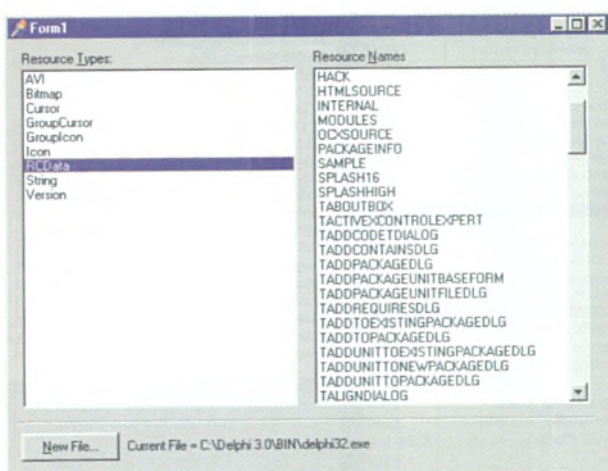


Figure 2 – My first attempt at a resource browsing utility. Not as fancy as Borland's demo, but the resource-handling code is much simpler.

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Stuck for what to buy your loved ones this year? Check these deals! **The Borland C++ Upgrade Bundle.** Borland C++ Development Suite and Borland C++Builder Pro (together worth £700) for just £199. Upgrade from any major Windows development system. First 30 purchasers get free Borland IntraBuilder (RRP £349). **Microsoft prices slashed!** on the following: Visual Studio - Professional & Enterprise; Visual Basic Professional & Enterprise; Visual C++ Professional & Enterprise. And upgrades. Check full pricing below. *All these specials apply this month only, while stocks last.*

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resource block IDs, it constructs each string resource block in turn. Each resource block is comprised of sixteen strings, arranged one after another. Each string is in 'classical Pascal' format, being preceded by a length count. Because of the way that string IDs are mapped onto string resource blocks, unused strings *must* be present in the block, appearing as a simple length count of zero. Once each resource block has been constructed, it's written to the update list using an appropriate call to `UpdateResource`. When all resource blocks have been written, `EndUpdateResource` is called to commit the operation, delete the existing executable, and rename the temporary file created by the operating system.

Closer alignment

I've tried to highlight some of the useful, but little-known, resource-related goodies that Microsoft has slipped into the Win32 API. It's a tragedy that Windows 95 doesn't support `UpdateResource` at the present time, but this functionality will undoubtedly be included in a later version of the product (Windows 98, maybe?) as Microsoft strives to bring the two operating systems into closer alignment. As I've indicated here, NT currently contains all the tools needed to

write a nice resource editing package without the need to manually parse a PE file's resource table, and that can't be a bad thing! With a little work, you could use the techniques described here to build yourself an automatic, script-driven 'internationaliser' program, a spell-checker for working with string and menu resources, or whatever. A nice feature of the Delphi VCL library is the `TResourceStream` class which enables you to view a particular resource as a stream. At some point, I'm planning to extend this class to implement the `Write` method, thereby encapsulating the `UpdateResource` functionality discussed here. As ever, stay tuned...



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 him at Dave@HexManiac.com
The full source code for the resource applications is available on EXE OnLine and directly via ftp at ftp://ftp.exe.co.uk/pub/exestuff/9712_Enumres.



```
unit uresview;
interface
uses
  Windows, Messages, SysUtils, Classes, Graphics,
  Controls, Forms, Dialogs, StdCtrls, ExtCtrls;
type
  TForm1 = class(TForm)
    TypesList: TListBox;
    Label1: TLabel;
    Button1: TButton;
    Bevel1: TBevel;
    OpenFileDialog1: TOpenDialog;
    CurrentFile: TLabel;
    NamesList: TListBox;
    Label2: TLabel;
    procedure Button1Click(Sender: TObject);
    procedure FormDestroy(Sender: TObject);
    procedure TypesListClick(Sender: TObject);
  private
    { Private declarations }
  public
    { Public declarations }
    procedure Clear;
  end;
var
  Form1: TForm1;

implementation
{$R *.DFM}

function MapTypeNumToName (dwType: Integer): String;
begin
  case dwType of
    1: Result := 'Cursor';           // rt_Cursor
    2: Result := 'Bitmap';           // rt_Bitmap
    3: Result := 'Icon';             // rt_Icon
    4: Result := 'Menu';             // rt_Menu
    // ...code cut, full listing on EXE OnLine
    else Result := '#' + IntToStr (dwType);
  end;
end;

function ResNameEnumerator (hLib: hModule;
  pType: PChar; pName: PChar;
  List: TStringList): Boolean; stdcall;
var
  ResName: String;
  dwType: Integer absolute pName;
begin
  Result := True;
  if IsBadReadPtr (pName, 1) then
    ResName := '#' + IntToStr (dwType)
  else
    ResName := pName;
    List.Add (ResName);
  end;
end;

function ResTypeEnumerator (hLib: hModule;
  dwType: Integer;
  Form: TForm1): Boolean; stdcall;
var
  TypeName: String;
  List: TStringList;
  pType: PChar absolute dwType;
begin
  Result := True;
  if IsBadReadPtr (pType, 1) then
    TypeName := MapTypeNumToName (dwType)
  else
    TypeName := pType;

  { Create a TStringList to hold all names for this type }
  List := TStringList.Create;
  { Now enumerate all the names for this type }
  EnumResourceNames (hLib, pType,
    @ResNameEnumerator, Integer (List));
  { Finally, add the type to the list }
  Form.TypesList.Items.AddObject (TypeName, List);
end;

procedure TForm1.Clear;
var
  i: Integer;
begin
  for i := 0 to TypesList.Items.Count - 1 do
    TypesList.Items.Objects [i].Free;
  TypesList.Clear;
  NamesList.Clear;
end;

procedure TForm1.Button1Click(Sender: TObject);
var
  hLib: hModule;
begin
  if OpenFileDialog1.Execute then begin
    Clear;
    CurrentFile.Caption := 'Current File = '
      + OpenFileDialog1.FileName;
    hLib := LoadLibraryEx (PChar (OpenDialog1.FileName), 0,
      Load_Library_As_DataFile);
    if hLib <> 0 then try
      { Enumerate the available resource types }
      EnumResourceTypes (hLib, @ResTypeEnumerator,
        Integer (Self));
    finally
      FreeLibrary (hLib);
    end;

    { Finally, make sure first type and name are selected }
    TypesList.ItemIndex := 0;
    TypesList.OnClick (Self);
  end;
end;

procedure TForm1.FormDestroy(Sender: TObject);
begin Clear; end;

procedure TForm1.TypesListClick(Sender: TObject);
{ Resource types selection has changed - redisplay names list }
// ...code cut, full listing on EXE OnLine
end.
```

Listing 1 – Building a resource browser.


```

unit uStringMunge;
interface
uses
  Windows, Messages, SysUtils, Classes, Graphics, Controls,
  Forms, Dialogs, StdCtrls, ExtCtrls;

type
  TForm1 = class(TForm)
    StringResList: TListBox;
    Label1: TLabel;
    Button1: TButton;
    Bevel1: TBevel;
    OpenFileDialog1: TOpenDialog;
    CurrentFile: TLabel;
    Memo1: TMemo;
    Label2: TLabel;
    procedure Button1Click(Sender: TObject);
    procedure StringResListClick(Sender: TObject);
    procedure Memo1Change(Sender: TObject);
    procedure FormCloseQuery(Sender: TObject;
      var CanClose: Boolean);
  private
    { Private declarations }
    CurStringIdx: Integer;           // current string index
    FileDirty: Boolean;             // file is dirty
    UpdateHandle: THandle;
    procedure Clear;
    procedure UpdateFile;
    procedure SaveModifiedString;
    procedure BuildUpdateList (StringIDList: TStringList);
  public
    { Public declarations }
  end;

var
  Form1: TForm1;

implementation
($R *.DFM)

function ResNameEnumerator (hLib: hModule; dwType,
  dwName: Integer; Form: TForm1): Boolean; stdcall;
var
  Idx, IdxB: Integer;
  szBuff: array [0..255] of Char;
begin
  Result := True;
  { No need to check for bad pointer because }
  { string resources are always numbered, not named }
  IdxB := (dwName - 1) shl 4;
  for Idx := IdxB to IdxB + 15 do
    if LoadString (hLib, Idx, szBuff, sizeof (szBuff) - 1) > 0
    then
      Form.StringResList.Items.AddObject (IntToStr (Idx),
        TObject (StrNew (szBuff)));
end;

procedure TForm1.Button1Click(Sender: TObject);
// ...code cut, full listing on EXE OnLine

procedure TForm1.SaveModifiedString;
begin
  with StringResList do
    if (Items.Count > 0) and Memo1.Modified then begin
      { String has changed - update string list }
      StrDispose (PChar (Items.Objects [CurStringIdx]));
      Items.Objects [CurStringIdx] :=
        TObject (StrNew (PChar (Memo1.Text)));
      FileDirty := True;
    end;
end;

procedure TForm1.StringResListClick (Sender: TObject);
// ...code cut, full listing on EXE OnLine

procedure TForm1.BuildUpdateList (StringIDList: TStringList);
var
  p: PWChar;
  S: String;
  Res, Idx, ResID, Which, StrID: Integer;
  Buff: array [0..(16 * 256) - 1] of WideChar;
begin
  { For each resource in the update list ... }
  for Res := 0 to StringIDList.Count - 1 do begin
    { New resource, so re-initialise vars }
    p := Buff;
    ResID := StrToInt (StringIDList [Res]);
    StrID := (ResID - 1) shl 4;
    for Idx := StrID to StrID + 15 do begin
      Which := StringResList.Items.IndexOf (IntToStr (Idx));
      { If string doesn't exist, default to empty string }
      if Which = -1 then S := '' else S :=
        PChar (StringResList.Items.Objects [Which]);
      { First, write the string length }
      p^ := WideChar (Length (S)); Inc (p);
      { Then the string itself }
      if Length (S) > 0 then begin
        StringToWideChar (S, p, sizeof (Buff));
        Inc (p, Length (S));
      end;
    end;

    UpdateResource (UpdateHandle, rt_String, PChar (ResID),
      GetSystemDefaultLangID, @Buff, PChar(p) - PChar(@Buff))
  end;
end;

procedure TForm1.UpdateFile;
var
  Idx: Integer;
  StringIDList: TStringList;
begin
  SaveModifiedString;
  if FileDirty and (MessageDlg
    ('Do you want to save the resource changes?',
      mtConfirmation, [mbYes, mbNo], 0) = mrYes)
  then begin
    { Open an update handle for the file }
    UpdateHandle :=
      BeginUpdateResource (PChar (OpenDialog1.FileName),
        True);
    { Build a list of active string resource IDs }
    StringIDList := TStringList.Create;
    try
      StringIDList.Sorted := True;
      for Idx := 0 to StringResList.Items.Count - 1 do
        StringIDList.Add (IntToStr ((StrToInt
          (StringResList.Items [Idx]) shr 4) + 1));

      BuildUpdateList (StringIDList);
      EndUpdateResource (UpdateHandle, False);
      FileDirty := False;
    finally
      StringIDList.Free;
    end;
  end;
end;

procedure TForm1.Clear;
// ...code cut, full listing on EXE OnLine

procedure TForm1.Memo1Change(Sender: TObject);
// ...code cut, full listing on EXE OnLine

procedure TForm1.FormCloseQuery(Sender: TObject;
  var CanClose: Boolean);
// ...code cut, full listing on EXE OnLine

```

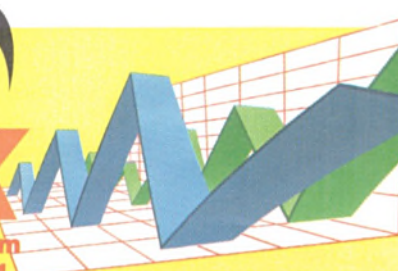
Listing 2 - Resource string editing

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Interpreter = Compiler



Patricia Deardorff

Interpreters and compilers do logically the same thing. They perform the same task with the same level of complexity. As a result, it is possible, using dynamic optimisation techniques such as splitting, to optimise an interpreter into a compiler. I will explain how to do this using a dynamic optimiser that works by applying a series of simple transformations, unaware of the fact that it is converting an interpreter into a compiler.

Both interpreters and compilers take as their input a description of a program (together with inputs for that program) and return the outputs of the program. Whether the program description – the source code – is compiled and run, or interpreted, should have no effect on the results. This is illustrated by Listing 1.

The only difference between a compiler and an interpreter is the physical implementation. Although they do the same thing, they do it in different ways. From outside the compiler or interpreter, it should be impossible to know whether the source code has been compiled or interpreted. This assumption is essential to the process I am about to describe.

As an interpreter is logically the same as a compiler, it should be possible to convert an interpreter into a compiler without affecting the correctness of any programs that depend on the interpreter. (Note that although such a program would physically be a compiler, it would logically be an interpreter and so there would be no way to access the compiled code other than by running it.)

Robert Ennals concludes his series on dynamic optimisation by showing how a suitably cunning dynamic optimiser can convert an interpreter into a compiler.

Operands and operators

Before we convert an interpreter into a compiler, we need to have an interpreter to convert. And before we have an interpreter we need to have a language. Although the principles described here can be applied to any interpreter, for the sake of clarity we will invent a simple language.

It has four variables called A, B, C and D, and they are all integers. A program both takes its inputs and returns its results in these variables. We have simple arithmetic operations: addition (ADD), subtraction (SUB), multiplication (MULT), rounded integer division (DIV), setting one variable to the value of another (COPY), and setting one variable to a constant value (SET). We also have simple flow control statements: always going to a label (GOTO), and going to a label when a specified variable holds the value zero (IFZEROGOTO).

These are documented in Listing 2. Listing 9 shows the source of a very simple interpreter for our language. It works by iterating through


```

source = "C = A + B"
A = 1
B = 2

compileAndRun(source, A, B)->C = 3
interpret(source, A, B)->C = 3

```

Listing 1 – Compiler = interpreter

Instructions are as follows. X and Y represent any of the variables, A, B, C and D

COPY X, Y	Copy the contents of Y to X
ADD X, Y	Add the contents of Y to X
SUB X, Y	Subtract the contents of Y from X
MULT X, Y	Multiply X by Y
DIV X, Y	Divide X by Y – integer division
SET X, constant	Set the value of X to be the specified constant
GOTO label	Goto the line marked with the label named "label"
IFZEROGOTO X, label	Goto the label specified if X is zero
STOP	End the program

Any line may be preceded by a label of the form 'labelname:' that can be a target for a GOTO or IFZEROGOTO.

Listing 2 – A simple language.

This program simply sums the inputs A, B, C and D and leaves the result in A.

```

ADD A, B
ADD A, C
ADD A, D
STOP

```

Listing 3 – A simple program for our interpreter to interpret.

a list of lines in the source code, parsing them, and then performing the relevant instruction. The current line number is held in the variable *i*. After each line has been executed, it sets *i* to the next line to execute.

For the arithmetic instructions, the current line number *i* is incremented by one after each line to cause all lines to be executed in order. For flow control instruction, *i* is set to the point at which to continue execution. This point is found by searching the source code for the line with the correct label. Note that the optimisations we will describe still work if the source is not accessed on a line by line basis through an index variable.

This interpreter runs the source program in a far from optimal way; it has to parse every line every time it is executed. The overhead of parsing each line and deciding what to do is likely to be significantly greater than the overhead of actually doing what needs to be done. All of this calculation is redundant. Provided the source code stays the same, every time an instruction is parsed, the interpreter will do the same thing. By optimising away this overhead we can make this program much faster.

Listing 3 shows a very simple program in our language. When this is interpreted, the interpreter will go through the steps described in Listing 4.1. Statically optimising this to make it faster is very hard. However, dynamically optimising it is very easy, using the very powerful dynamic optimisation trick of dynamic code splitting with respect to a variable.

* indicates something the interpreter has to find out by parsing

- 1: *The first line is an ADD command
- 2: *The first argument of the first line is A
- 3: *The second line of the first line is B
- 4: Add the two numbers
- 5: Set the value of the first arg to the result
- 6: *The next line is line 2.

Note that the vast majority of the time here is not spent adding the two numbers together, but performing redundant calculations

Listing 4.1 – What our interpreter does every time it executes the first line of the program in listing 4.

```
1: Add the two numbers
```

Listing 4.2 – What our interpreter would do if it could assume that the line number was always 1 and make suitable optimisations.

```

DoSomething( 1 )
{
    A += B;
};

DoSomething( 2 )
{
    A += C;
};

DoSomething( 3 )
{
    A += D;
};

DoSomething( 4 )
{
    stop;
};

```

Listing 5 – Variants of the DoSomething() method, generated for different lines.

Split personalities

As long as all lines of code are parsed from the same point, optimisation will be difficult, so the first step in optimising this code is to split it up. Let us start by making the assumption that the source code cannot change. To ensure that the program functions correctly if the source does change, we can attach notification code to any code that can change the source, hence causing us to undo any optimisations that rely on the source not changing.

We can also gain benefits by assuming that the current line number never changes. Although this is clearly not an assumption we can maintain, it is useful to think about the consequences if it was maintainable.

The currently parsed line of code *line* depends on the line number *i*. If we assume that *i* never changes, we can assume that *line* and *cmd* never change, together with everything that depends on them. Whenever *DoSomething* is called for the same line of code twice, much of the computation done will be the same. As we can prove that *cmd* will have the same value we can prove that the same branch in the if/else tree will be taken. We can also prove that *findLineWithLabel* will always return the same line. By continuing our optimising into the *Get* and *Set* methods of the *vars* object, we can prove that for any line of code, the same branch will always be taken when selecting which variable to set. In general, any piece of code that depends only on things that we are assuming to have a constant value can be optimised away.



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ENQUIRY NO. D20


```
void interpret()
{
    int i = 0; // start at first line

    while (TRUE)
    {
        if( HasSpecialisedVersion( i ))
        {
            CallSepecialisedCode( i );
        }else{
            i = DoSomething( i );
        };
    };
};
```

Listing 6 – Check for specialised versions.

```
LoopWhen1:
    A += B;
    goto LoopWhen2;
LoopWhen2:
    A += C;
    goto LoopWhen3;
LoopWhen3:
    A += D;
    goto LoopWhen4;
LoopWhen4:
    stop;
```

Listing 7.1 –We can prove what version of LoopWhen needs to be called next and embed a direct call to the specialised code rather than having to find out where it is every time the code is called.

```
A += B;
A += C;
A += D;
stop;
```

Listing 7.2 –We can now optimise away those calls by arranging the code so it is in order and allowing control to fall through, or by inlining some parts into others.

```
SET B, 1
SET C, 1
loop: IFZEROGOTO A, end
MULT B, A
SUB A, C // decrease A by 1
GOTO loop
end: STOP
```

Note that unlike the earlier example, this example involves flow control.

Listing 8 – A more complicated program in our simple language which calculates the factorial of A and returns it in B. The factorial is defined as (A)(A-1)(A-2)...(1).

Listings 4.1 and 4.2 show that if we could assume that the line being parsed was always the same and optimise accordingly we would be able to remove a lot of overhead. Unfortunately, the line being parsed is not always the same, so we cannot generate code that assumes that it is always the same. However, we can generate several copies of the same function, each representing an optimised routine for executing a specific line. We will refer to this as splitting code with respect to a variable. By optimising away code with provably predictable results, each of these generated functions becomes the same as the code that one would get if one were to compile that line of code.

Here we are generating several physical versions of the same logical code, based on the line being parsed. Note that this is not the only variable we could have split our code with respect to. We could have split with respect to any of the variables that the code depends on. For example, we might have generated different copies of the code for each possible value of one of the variables, but nothing would be gained from doing this. The hardest part of code splitting is working out what to split code with respect to. In general, we get best results when we split with respect to a variable which is used to find other variables, such as a reference to an object or an index in an array. However splitting with respect to other things can be useful, particularly if it is known at call time which specialisation is needed.

Listing 6 shows the code we might get from splitting `DoSomething` with respect to `i`. Note that we can optimise away everything except the actual action.

Optimisation transformations

Although we have generated code for each line, we do not yet have a way to actually find this code and call it.

By default, the optimiser will not generate split code for every line of source, but just for a selected number (perhaps those which have been executed so far). We will have one version of `DoSomething()` that can interpret any line of code, and several versions of `DoSomething` that can only interpret their own line. In order for the specialised versions to be called, calls to `DoSomething()` would be wrapped in a header that checked if a specialised version was available and then called it if it was. If a specialised version was not available, then the header would call the general version of `DoSomething()`. This is demonstrated in listing 7.

This overhead is not required if one can prove what the next line will be. Instead of optimising `DoSomething`, we can optimise the body of the while loop. This is effectively a function that takes `i` as an argument and calls itself with a different value of `i`. Instead of splitting at `DoSomething`, we can split at the loop level. This gives us the advantage that when we are executing specialised code, we can often prove what the next code to be called will be. If we now make the assumption that specialised code will always be in the same place (like all assumptions this can be broken, causing code recompilation) then we can embed direct calls to the other specialised versions of the code. (See Listing 7.1).

We can apply some simple optimisation transformations to get our final compiled code. The only overhead we still have is that of calling the next block of code. This can be removed in several ways. We can arrange code blocks in order and let calls fall through instead of jumping. Or we can inline calls into each other. Note that the optimiser can choose to arrange code in memory however it likes in order to reduce jump overhead. Laying code out in order of increasing value of `i` is the most obvious way, but more complex layouts may be chosen if the optimiser thinks they will be advantageous. The result is shown listing 7.2. We have now produced compiled code.

It's a result

We have just compiled a program using only an interpreter, and a dynamic optimiser that works by applying a series of simple transformations. Not only is this code compiled, but because it is running under a dynamically compiling and dynamically optimising environment, it is dynamically compiled and optimised code. We could even write an interpreter in an interpreted language and end up with highly optimised compiled code.





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ENQUIRY NO. D21

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```

class CInterpreter
{
    // -- The variables --
    CVars vars;
    CSource source;

    void interpret()
    {
        int i = 0; // start at first line

        while (TRUE)
        {
            i = DoSomething( i );
        };

        // Takes the line to execute.
        // Executes the line
        // returns the index of the next line

        int DoSomething( int i )
        {
            CLine line = source.line(i);
            CCmd cmd = line.cmd;

            if( cmd == "GOTO" )
            {
                i = source.findLineWithLabel( line.arg(1) );
            }
            else if( cmd == "IFZEROGOTO" )
            {
                int v = vars.Get( line.arg(1) );
                if( v == 0 )
                {
                    i = source.findLineWithLabel( line.arg(2) );
                };
            }
            else
            {
                if( cmd == "COPY" )
                {
                    int v = vars.Get( line.arg(2) );
                    vars.Set( line.arg(1), v );
                }
                else if( cmd == "ADD" )
                {
                    int first = vars.Get( line.arg(1) );
                    int second = vars.Get( line.arg(2) );
                    int res = first + second;
                    vars.Set( line.arg(1), res );
                }
                else if( cmd == "SUB" )
                {
                    int first = vars.Get( line.arg(1) );
                    int second = vars.Get( line.arg(2) );
                    int res = first - second;
                    vars.Set( line.arg(1), res );
                }
                else if( cmd == "MULT" )
                {
                    int first = vars.Get( line.arg(1) );
                    int second = vars.Get( line.arg(2) );
                    int res = first * second;
                    vars.Set( line.arg(1), res );
                }
                else if( cmd == "DIV" )
                {
                    int first = vars.Get( line.arg(1) );
                    int second = vars.Get( line.arg(2) );
                    int res = first / second;
                    vars.Set( line.arg(1), res );
                }
                else if( cmd == "SET" )
                {
                    int v = Integer.parseInt( line.arg(2) );
                    vars.Set( line.arg(1), v );
                }
                else if( cmd == "STOP" )
                {
                    break;
                }
                else
                {
                    throw CUnknownCommandException;
                };
            }
        };

        i++; // go to next line
    };
};

class CVars
{
    private int A;
    private int B;
    private int C;
    private int D;

    public int Get( String name )
    {
        if( name == "A" )
        {
            return A;
        }
        else if( name == "B" )
        {
            return B;
        }
        else if( name == "C" )
        {
            return C;
        }
        else if( name == "D" )
        {
            return D;
        };
    };

    public void Set( String name, int val )
    {
        if( name == "A" )
        {
            A = val;
        }
        else if( name == "B" )
        {
            B = val;
        }
        else if( name == "C" )
        {
            C = val;
        }
        else if( name == "D" )
        {
            D = val;
        };
    };
};

class CSource
{
    /*
    this is just an array of CLine objects
    for brevity, implementation is omitted
    */

    CLine line( int i );
    // returns line number [i]

    int findChildWithName( String label );
    // returns the line number of the
    // line labelled with [label]
};

class CLine
{
    /*
    for brevity the implementation of this class has
    been omitted, but the methods do the following
    */

    String arg( int i );
    // returns argument number [i].
};

```



Listing 9 – A simple interpreter for our language, written in Java.

It should be stressed that this optimiser did not know it was converting an optimiser into a compiler. All the optimiser did was apply simple rules one after the other to build up a complex optimisation.

This optimisation has very significant implications. If a runtime is available with a suitably cunning dynamic optimiser there are great

advantages to writing an interpreter instead of a compiler. One gets platform independence. One also benefits from the fact that optimisers are significantly easier to write than compilers. Unless you are a very good compiler writer, it is also likely that an interpreter would be faster than a compiler as dynamic optimisers would find it hard to



optimise compiled programs. On top of all this it is likely that future runtimes will simply not allow compilers, so writing an interpreter will be the only way to make your programs run.

Self-modifying code

The sample program we compiled earlier was very simple. Most importantly, it only executed its lines in order. Listing 8 shows a more complex program. This program calculates the factorial of A and returns it in B. Note that we use the instructions `GOTO` and `IFZEROGOTO` for out of order execution of code. These instructions do not make compilation much harder, we just cannot optimise away all of the `goto` statements.

Listing 10.1 shows specialised loop code for each of the lines of this program. Listing 10.2 shows the final optimised code to be run when `Interpret()` is called.

One of the hardest language features to optimise interpreters for is self-modifying code. If code is modified, this requires us to recompile specialised code that depends on the changed source. Things get even harder if the language puts the source in the same address space as the data (eg assembler). In this case, we need to check every access via a pointer to check whether it is modifying code. The most efficient way to do this is to put the code in a protected memory page and update the dependent code when we get a page fault. However, most operating systems do not let you do this, so less efficient methods need to be used.

These same optimisations can be applied to many other programs and gain similarly impressive results. Many common time consum-

```
LoopWhen1:
  B = 1;
  goto LoopWhen2;
LoopWhen2:
  C = 1;
  goto LoopWhen3;
LoopWhen3:
  if( A = 0 ) {
    goto LoopWhen7;
  }else{
    goto LoopWhen4;
  };
LoopWhen4:
  B *= A;
  goto LoopWhen5;
LoopWhen5:
  A -= C;
  goto LoopWhen6;
LoopWhen6:
  goto LoopWhen3;
LoopWhen7:
  stop;
```

Listing 10.1 – Specialised loop code blocks for listing 9.

```
B = 1;
C = 1;
LoopWhen3:
  if( A = 0 )
  {
    goto LoopWhen7;
  };
B *= A;
A -= C;
goto LoopWhen3;
LoopWhen7:
  stop;
```

Listing 10.2 – Excess gotos have been removed.

ing operations involve interpreting something and can be massively sped up through a similar optimisation.

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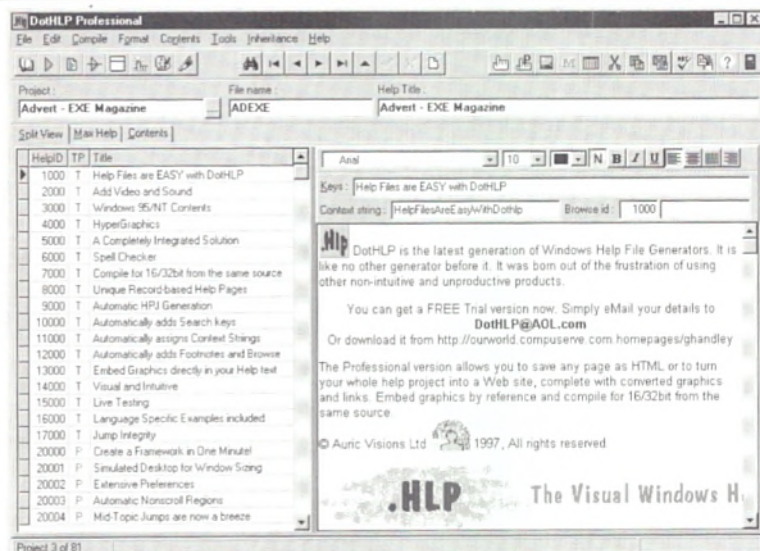
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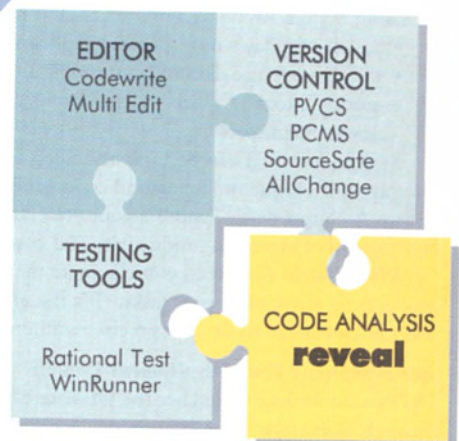
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QUESTIONS

- Q1** Why do programmers celebrate Xmas at Halloween?
- Q2** A prediction of Y2K trouble for Big Blue from a 1992 classic: 'We can predict the date by which the old IBM - IBM the mainframe computing giant - will be dead... On December 31st, 1999, right at midnight, when the ball drops and people are kissing in New York's Times Square, the era of mainframe computing will be over.' Name the author and book.
- Q3** Which of the following are not C programs?
- ```
1 main() {1;2;3;}
2 main() {1,2,3;}
3 main() {1!=2;2!=2;}
4 main() {!42;}
```
- Q4** What is the computing significance of 18<sup>th</sup> January, 2038?
- Q5** Which lines in the following program could be removed without affecting the final value of the variable *x* (your answer must be correct regardless of the initial value of *i*, *c* and *x*)?
- ```
1 while (i<20) {
2   if (c==4) {
3     x = 42;
4     c = 12 ;
5   }
6   i=i+1;
7 }
```
- Q6** 'It was the last day of the 1999th year of our era. The pattering of the rain had long ago announced nightfall; and I was sitting in the company of my wife... I was rapt in thought, pondering in my
- mind some words that had casually issued from the mouth of my youngest Grandson, a most promising young Hexagon of unusual brilliancy (*sic*) and perfect angularity.' What is the book? Who is the narrator?
- Q7** It's the evening of December 31st 1999 (yet again). We are in San Francisco, there's a couple snogging in the Golden Gate park and in a darkened yard there stands a battered old blue police box... Name your Doctor, and who were the lovers?
- Q8** Write a program the only variable declaration of which is for a single integer variable. The program reads in a sequence of positive numbers terminated by a -1 and then prints out the sequence in reverse order.
- Q9** Which product shipped over three months late on 'March 32nd' 1992? How did this save Microsoft's Steve Ballmer from an unpalatable meal?
- Q10** What is next in this sequence? STX, ETX, EOT, ENQ, ACK...
- Q11** When will the HTTP cache scheme fail?
- Q12** How do you find the number of rows in a SQL Server table using SQL without querying the table directly?
- Q13** Which calendar uses a week number ranging from 01 to 53?
- Q14** What is wrong with the following declaration of a nested template?
- ```
vector<pair<int, int>>
Coordinates;
```
- Q15** Who admitted that Java will



- 'run out of dates' and when will this happen?
- Q16** In a C++ and Delphi sense, which is the odd one out of these? try, catch, sizeof, if, class
- Q17** And an easy one for the end. When is the start of the new millenium?
- A17** Since the first millenium started on 0001-01-01 (this is Jan 1<sup>st</sup>, year 1 for those of you not familiar with ISO dates), the new one will start on 2001-01-01.
- A16** All are keywords common to both languages apart from 'run out of dates'.
- A15** James Gosling admitted that Java will 'run out of dates' in the year 292271023.
- A14** You need a space between the two angle brackets ('>' to avoid them being interpreted as a right-shift operator.
- A13** The ISO 8601 calendar which has either 52 or 53 weeks per year except in the year the Gregorian calendar was introduced (which had less than 365 days and less than 52 weeks).
- A12** Look for the ROWS column in the sysindexes table.
- A11** This should happen in 9999.
- A10** BEL. These are the names for ASCII control characters 2 to 7. Remember the time when the full ASCII table was included with every programming book? It still appears in quite a few HTML books.
- A9** OS/2.0, which was supposed to ship by the end of 1991, then before the end of March 1992. Neither deadline was met. Steve Ballmer had said that if IBM

- A8** There may be more than one answer. Here is one (in C). The answer illustrates the way recursion, and the implicit stack involved with scope rules, allows us to have lots of 'instances of a variable'.
- A7** The Doctor was played by Paul McGann, in the 1996 American revival of *Doctor Who*. The episode was notable for many reasons, but especially the scene where the Doc got to kiss his girl assistant right on the lips.
- A6** The book is Edwin Abbott's *Flatland*, written in the 1880s. The hero and narrator is A. Square.
- A5** Only line 4 can be removed. Visual C++ is based on example the C++ class in other operating systems, for extensively used in Unix and and related functions are out of bits and wraps (signed since 1<sup>st</sup> January 1970, runs time\_t, a count of seconds Standard C Library struct
- A4** This is the date when the following it with a semicolon. considered a statement by that an expression is question illustrates the fact
- A3** None. They are all valid. The can't get a date. foreign competition, and still the boys of Silicon Valley
- A2** Robert X Cringely in *Accidental Empires - How*
- A1** Because Oct 31 is Dec 25.

## ANSWERS



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# Webster, Web control & WebViewer

If you want your application to display some **HTML** files but at the same time don't want to write a fully-fledged **Web** browser you could do worse than an **ActiveX** control. Philip Harris goes on a blind date with three **ActiveX Web** browser controls.

**H**TML is rapidly becoming the standard format for storing documents. Apart from its use on the Internet, the accessibility and portability of the format make it an ideal choice for help files and documentation. Most people can produce reasonable results with one of the Web authoring packages that are available, which means that you don't need to buy and learn a separate help authoring tool. You can use the same documents on and offline, and in some cases you may be able to put frequently changing documentation on the Web itself and link to it from the main files. Of course, that assumes your users all have a Web browser installed. If your products are Internet based there's a good chance they will but if not you either have to force users to install a browser they may not want or provide a browser of your own.

Assuming you don't want to spend the next few months writing a Web browser (and the rest of your life trying to keep up with Microsoft and Netscape) and that you're on Windows, your best bet is to go for an ActiveX control.

**Contestant number one – Neil from Oregon**

First up is Webster from Sax Software (<http://www.saxsoft.com>). Webster is available in 16- and 32-bit versions at £90 each, or you can buy both for £145. The 32-bit version of the control needs 2 MB of disk space including the MFC DLLs (which your users may already have). The 16-bit version is smaller at 1.4 MB although you'll need to supply the OLE DLLs if needed.

The first thing you notice about Webster is that it's a little bit rough around the edges. The installation program installs five icons, one linked to a text file containing the licence agreement, one telling you where to get technical support and three to various areas of the Sax Web site. Clicking on these loads your current browser; this is odd considering that the manual lists linking to a company Web site for updated documentation as the first use for Webster.

More importantly, there's no help and no sample files. In fact, there's no sign that the control even exists. Hunting around in the installation directory, I found a promising looking Samples directory. Inside was a simple Visual Basic Web browser created using the control and a few lines of code. However, for some reason the program wouldn't allow me to load Web pages from disk, although I could go online okay.

A shaky start for our first candidate. Things did improve though; a quick trip to the Sax Web site got me a later version of the software which installed a few more icons and a working version of the sample program. Still no help file but Webster does come with a well written manual (although some examples of how to use the control in Visual C++ would have been nice).

Webster is actually ludicrously simple to use. The hardest part was finding where Microsoft had hidden the component gallery in Visual C++ 5.0. Once you've done that you can add the control to your project and Visual C++ will generate an appropriate MFC class for you. You'll then find a Webster icon in the resource editor just like a standard



David Humphries @ Monster

control. Adding the browser to a dialog is just a matter of clicking and dragging. If you're using Visual Basic things are even easier; just add the control to your palette and away you go.

Webster includes its own toolbar and status line and all the code needed to surf the Web. So, once you've added the control to your window or dialog, you've built a browser (see Figure 1). All the standard functions are there, including printing, a history list, and a 'Go Home' button. In most cases though, you'll want to customise the control to fit your needs. As well as providing properties for the standard HTML attributes (the colour of links, heading fonts etc), Webster lets you turn the toolbar and status line off, and provides methods and events to provide the same functionality. Webster also implements Web proxy support and caching, with controls for the number of pages to cache and the size of the cache



Figure 1 – Webster.



used for images. There are hooks for simple filtering of content, so you can block pages containing naughty words, for example.

How does Webster survive out on the Web? Webster supports HTML 3.0 including tables, but you won't find any of the newer features. There's none of the browser specific tags, no frames, and of course no Java. Graphic support is reasonable although GIF support is patchy in places with the odd image not displayed at all. All in all, Webster is fine for standard HTML that you control, but if you want to build your own browser to compete with Microsoft then Webster isn't the way.

### Contestant number two – Bob from Redmond

If Microsoft's Web browser component appeared on Blind Date it would be the sort of contestant that stands up, sings, dances, and balances Cilla on their head. It would also need a bigger stool.

The Microsoft Web browser component is 32-bit only and is provided with Visual C++ and Visual Basic, there's even a bit of documentation if you can find it in among the rest. Using the control is simply a case of adding the component to your project and then clicking and dragging on to your dialog. However, the Microsoft component doesn't provide any toolbars, you'll need to create those yourself. Nor is there any direct control over fonts, colours, or caching in the way that there is with Webster. The methods available are primarily limited to basic navigation and setting the size of the control.

You can provide your users with the option to change these values though, by opening the Internet settings dialog. From there users can adjust the font, colour and cache settings just as they would if they were using Internet Explorer. And they are, because Microsoft's Web browser control is just the browser component from Internet Explorer. As a result Internet support is near perfect, anything Internet Explorer can do, you can do. (See Figure 2.)

This power comes at a price though. Microsoft has decided that the only way you can distribute the browser control is by distributing Internet Explorer with your own application. The problem is that Internet Explorer is huge, adding a massive overhead to your distribution. Of course, some people would rather Internet Explorer didn't come anywhere near their system so unless you know your customers have Internet Explorer installed you risk alienating part of your market.

### Contestant number three – Kevin from Kansas

Last up is WebViewer from Visual Components (<http://www.visual-comp.com>). Like Webster, the control is available in both 16- and 32-bit versions (£195 each). One sample program is provided, in Visual Basic again, and you'll need to use Visual Basic itself to run it because there's no compiled version. There is a very good help file though, with step-by-step instructions for building a simple browser in Visual Basic, Visual C++ (dialog, form view, and SDI/MDI applications), and PowerBuilder. (See Figure 3.)

If you don't have Visual Basic then a Visual C++ test program is easy to put together. WebViewer provides a toolbar and status line just like Webster. And the similarities don't end there. Take a look at the wrapper class Visual C++ generates for the control and you'll find all the methods and events that Webster supports. Look at the WebViewer OCX control itself and it's virtually the same size as Webster. Is this a corporate conspiracy? A case of industrial espionage?

A search of the Web provided the answer in the form of Home Page Software (<http://www.homepagesw.com>). Home Page has developed WebTrek, a 16- and 32-bit Web browser control. At \$495 it's more expensive than both WebViewer and Sax's Webster but that includes one year's worth of updates. You can also license the source to Home Page's control and it would appear that this is what both Sax and



Figure 2 – IEBrowser.

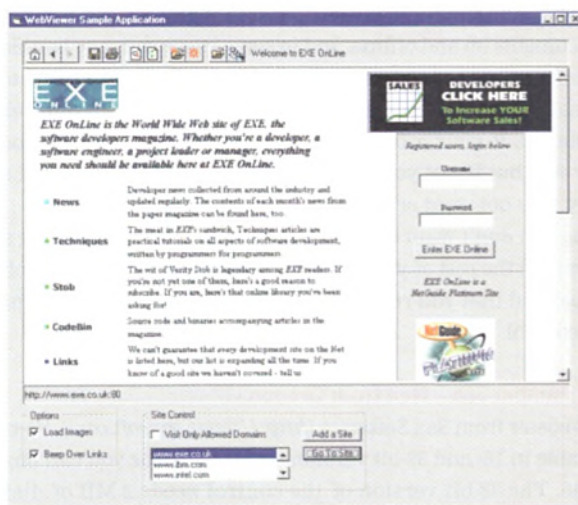


Figure 3 – WebViewer

Visual Components have done, although I was unable to get confirmation from either company in time for this article.

WebViewer is more expensive though, so what do you get for the extra money? The answer appears to be nothing. The presentation of WebViewer is slightly better and the inclusion of Visual C++ specific instructions will be useful if you've not used ActiveX controls before. Neither company appears to have modified the source for the control though.

### The choice is yours

Which control should you choose? Contestant number one, slightly scruffy and underpowered but small and flexible? Or contestant number two, the powerful but considerably overweight Microsoft browser control? Or contestant number three, the more expensive twin brother of Contestant number one?

If you want full HTML support there's only one choice, the Microsoft browser control. You'll just have to put up with having Internet Explorer tag along with your application. If you want to reach 16-bit users or you don't want to force to people to install Explorer then Webster is your best bet. You'll need to stick to fairly simple HTML though.

*Philip Harris is Director of Microtrope Ltd, a software company developing Windows products. He can be contacted on 01295 252002 or by email at [piharris@microtrope.com](mailto:pjharris@microtrope.com).*





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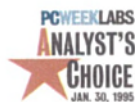
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NO LIMITS



# NuTcracker

Porting software from Unix to NT will not be easy. Peter

Collinson reviews NuTcracker, a new product that may help you pull it off.

See more and more people with two screens on their desks: one for Unix and one for Windows. I am sure that you should only need one.

A small number of products allow you to access an NT system from your Unix X Window based workstation, for example, NTRIGUE from Insignia Solutions. An answer to the opposite problem, that of getting access to Unix from an NT machine, is solved by OpenNT which I looked at in July (*Can NT pass as Posix*). OpenNT replaces, or perhaps it would be fairer to say, significantly upgrades, the standard Posix subsystem for NT that is supplied by Microsoft. In its latest releases, OpenNT supports sockets and that has opened the door for it to support a local X server running on the NT machine. At present, OpenNT is a good end-user solution, giving you viable access to Unix from a Windows NT machine. The X server allows you to run terminal and graphical applications remotely on Unix while getting access to NT applications on your local machine.

Another problem that's fast emerging is the desire to port Unix applications to Windows NT. I am sure that there are many people across the world beavering away at this task. Managers wake up one bright morning, come into work and pronounce that the products should move to NT. Well, there are undoubtedly good business reasons for the move, or for at least supporting NT as an additional application platform. However, the decision will open a very large can of very slippery worms.

If your programming room is full of Unix staff, then management has a conversion problem that may not be initially apparent. A program is a program, right? Well no, a program runs in an environment and the native Windows Win32 environment is an alien world to a Unix programmer. Training someone to enter that world is not easy. OK, you can send people on those highly priced training courses that are run by many organisations. Undoubtedly the staff will learn something in those five days, but it won't turn them into Windows programmers.

If I went on such a course, I guess I'd want to walk out with a general view of the philosophy behind programming for Windows. Most importantly, I'd want some sort of handle into the private language that Microsoft uses to document its world. Understanding the language is crucial because much Microsoft documentation resides on CD based help systems. To investigate a problem you need to know what keyword to use to find the information you are seeking. In my experience, Microsoft keywords don't spring readily into the Unix trained brain. I have spent a considerable amount of time searching for the right keyword to unlock the small piece of information that I needed to progress some task or other.

All this assumes that the staff is willing to learn about the one Microsoft way. There are many who hate Windows and will be rather happy if they never have to see or use anything generated by Gates et al. And there are many who hate Unix too! When I get flame email from both camps, I know I've managed to pursue the right line in these articles.

Then, I suppose, you could employ some Windows experienced staff to port your product. There are the usual new-employee risks in this. Will the new people be any good? How long will it take to train them to understand the existing Unix based code? Will they be Unix haters who will never be able to understand the reasons for doing things in the way that they have evolved? Also, it will probably split your programmers into two distinct camps with different backgrounds. Ideally, you need some way of moving your product and your programmers from one world to the other without too much pain.

## NuTcracker

Well, one product which tries to position itself in the centre of this whole mess is NuTcracker. The main aim of the NuTcracker suite is that you should be able to take an existing Unix application, copy the files to Windows NT, compile the program, and run it. Your Unix program is linked with a DLL which provides conversion support between the Unix programming world and the Win32 environment.

Graphical applications are a problem – there is no clean mapping between the X Window system and Win32 – so NuTcracker provides X libraries that will talk to an X server running on the local Windows NT machine.

At the end of the day, you will have a binary that will run on Windows NT under Win32. You will need to ship the NUTC DLL, and if the product uses a GUI, your end user will need to have access to a local X server running on the NT machine. Of course, you pay for each DLL and X server that you ship, but you must offset this cost against the price you would have to pay to port your entire product range from the Unix environment to Win32 (and don't forget to add in the cost of lost revenue for the time involved).

An early design decision for NuTcracker was to run the applications on the Win32 subsystem inside the NT machine, and not write a new Posix subsystem. The rationale was simple. Applications running on Windows NT talk to a main subsystem which in turn passes messages in and out of the NT micro-kernel. There are good communication routes along this path, but subsystem to subsystem communication is less good. Applications running under the Posix subsystem are essentially locked in a box, constrained by this lack of communication. It's always going to be hard to get access to what might be considered standard Windows features, like OLE or DCOM, from the Posix subsystem.





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## Where to find things

The NuTcracker package is from DataFocus and you'll find its Web site at <http://www.datafocus.com>. Scientific Computers distribute NuTcracker in the UK, and its web site is <http://www.scl.com>. The X archive site, with a bunch of free tools and programs, is at <http://ftp.x.org>. The `xcal` program is available in Unix source form from <ftp://ftp.hillside.co.uk/xcal>, you'll need both `uncompress` and `tar` to unpack it.

Given this, let's think about the program that is being ported. Undoubtedly, it will start life as a straight Unix port, but there will soon be calls to incorporate standard Windows functionality. Can I embed your application in my spreadsheet? Also, Windows does many things differently. For example, it has access control lists (ACLs) on files. Standard Unix (or Posix) doesn't support ACLs. Mapping Unix file access control onto that which Windows NT supports is possible, but you can do better. Programs will inevitably migrate to use these native features of the operating system, and you want to allow and promote this migration. I am sure that people in the Unix software business who write applications that run on several different Unix platforms have already had to tackle this kind of issue when dealing with the various flavours of Unix that exist.

By running on top of the Win32 subsystem, NuTcracker permits you to add in Win32 specific routine calls, tailoring your application to the native machine environment.

### Installation

NuTcracker comes in two flavours, 'with' and 'without' X support. I've been looking at the version with X support, release number 3.1. The package is bundled with a complete set of MKS Toolkit Posix programs and the SCO XVision Eclipse X server. The package comes in a large box containing a CD, and six large books. Three books are from DataFocus: the *Installation Guide and Porting Guide*, the *Programmer's Reference for the Library and Curses*, and the *Programmer's Reference manual for System Calls*. There are two books documenting the MKS Toolkit and one for the X server. It's good to have real printed documentation.

You plug the CD into your drive and it autostarts, loading the NuTcracker package and the MKS Toolkit. I spent some time wondering where the X server was before discovering that there are some extra loading options from the CD. You have the choice of loading one of three X servers.

I found the installation part of the *Installation and Porting Guide* a little too intense for a beginner. There is a need for a Roadmap document that gives you a brief description of the options you have when you install this quite complex set of programs. Also, the installation is more than a little naughty; you can remove the SCO XVision server and the MKS Toolkit cleanly from your disk, but there is no uninstall for the NuTcracker package. Moaning about not being able to remove things is not just a problem for reviewers. I always want to be able to get things off my system, if only to ensure that I can do a clean reinstall of a vanilla package. After hacking the obvious files from the system by hand, I now find that one part the installation sequence dies when unpacking something or other (very probably on top of some file in the Windows system directory that I failed to delete). I am told that DataFocus is well aware of this problem and plans to ship an uninstaller in the next major release.

Once you have it installed, you can take a look around. The MKS toolkit provides a very solid set of Unix (or rather Posix) command line utilities, including a version of Korn Shell that seems to do all that it should. There's a full set of what we like to call the standard Unix utilities, including `vi` and my old friend `ed`.

The toolkit does the right thing with filenames too. The NTFS file system actually has full Posix semantics, including case independent naming of files. People are rarely aware that it's the Win32 layer which ignores the case in filenames. Files are created with their case taken from the string presented by the calling program, but are presented to the user as initially capitalised strings by the GUI desktop. If you create a file called `MAKEFILE`, you will always see `Makefile` when you look at it from Explorer; and can access it by typing `makefile` or `MAKEFILE`. However, the underlying NTFS file system makes it possible to create two files in the same directory with names that differ only in capitalisation, say `Makefile` and `makefile` even though Win32 applications don't make use of this ability. Strictly, case independence is not a Posix standard feature, but the MKS toolkit for NuTcracker operates in a case independent manner, meaning that you can navigate the file system in lower case, irrespective of the actual case of directories and files.

The shell also makes some non-Posix compromises when looking for executable files. If you type a command name into the shell, like `ls`, then the shell will also look for `ls.exe` as well as `ls`. You don't need to have a file called `ls` on the system especially to support the shell. This means that you can access the standard NT commands, so you can use `ATTRIB` rather than `chmod`. This is deeply helpful when you are using TCP/IP on the network; programs like `PING` and `FTP` that are standard in the normal command shell also operate like Unix commands in the MKS environment.

As I said, I installed the SCO XVision Eclipse server. It installed simply and I soon had X sessions running into my Unix machines. A wizard, called the Unix Wizard, is used to create little profile files. These files seem to be stored centrally by default and not in any particular user profile, so it's not clear whether the system works cleanly on an NT machine used by several people. I find it a little curious that a shortcut to the Unix wizard is not placed in the standard menu for XVision; you need to go searching for it in the directory where the program suite was installed.

You can run the XVision Eclipse server in two visual modes. The first places X applications on the regular Windows desktop, so there's an implied window manager. The second mode runs X inside a single window, so you are expected to run a window manager. I prefer the former.

While messing with the server, I tried its XDM support. This seemed to function, although the hosts were not too happy unless I ran the server in a single window. I suspect that they were trying to load a window manager, and were not coping too well when they found one running. Sun's Solaris 2.6 setup was spectacularly unhappy, and the XDM server on the Sparc died. The problem is likely to be a configuration issue.

Getting the packages installed is not hard. I suppose that I have some complaints, but they are not too major. You really can have a Unix-like working environment up and running on you NT machine in about 10 to 20 minutes.

### Porting programs

The primary purpose of this package is to port Unix programs. To compile them, you are expected to have a version of Microsoft Visual







C++ installed. You can run the compilation system in visual mode or reach for the familiar command line driven utilities that you know and love (or alternatively have come to hate). There's a `cc` command to compile programs and a version of `make` that can use the `makefile` that you will find when you copy in the source. Actually, there is considerable flexibility in your environment when you start working on programs. This is good because it allows you to get on with the job.

When you start thinking about porting programs, the *Installation and Porting Guide* becomes very useful. This gives a step by step guide of the changes that you are likely to need to make to the source in order to port it. There's considerable information in this section of the documentation and you are advised to read it.

I tried my very very old `yacc` and `lex` exercise that creates a small calculator. Of course, the first problem is that there is no `yacc` and `lex`. This program compiled out of the box with the initial version of NuTcracker that I had tried some time last year, so I was somewhat nonplussed. It turns out that DataFocus continues to supply versions of various useful programs that emanated from Berkeley or GNU in source form but no longer treats them as supported programs. Your first task is to compile them.

Having done that, I typed `make` for my calculator and had a working program in a very short time. Well, it was not quite working as expected. It's the type of program that you type things into, making it perform some calculation and print the result. It was generating the correct results, but was not printing anything until I typed Control-D to close the input file. It felt like a buffering problem initially.

On closer inspection, it seems that the `lex` scanner uses the `read` system call to read a block of data, and this was not behaving as expected for terminal input. Unix applications know that a terminal input stream will return from the `read` system call when return is pressed. Replacing the call to `read` by a call to the `fgets` stdio library routine made all the difference.

Incidentally, to discover this problem I used the debugger built into Visual C++; there are clear instructions in the documentation telling you how to set things up for the NuTcracker libraries. I don't think that this problem is a show-stopper. It's a porting issue, and I'll guess that there are not many command line programs being ported to Windows NT that might expect this type of input to work. What's more interesting is whether the X support works.

I looked around my source tree and came across my X based calendar program, `xcal`. I wrote this many years ago, but still use it on a daily basis to organise my life. It's actually a complex program from the X standpoint, but not too huge; it's around 6000 lines of C. (The program uses the Athena widget set, the original set of demo widgets supplied with the X11 release.) Actually, I had no great expectations of porting `xcal` because the NuTcracker documentation only claims to support Motif.

However, I noticed that the `Xaw` library was loaded when I installed the NuTcracker package, so it seemed worth a try. I copied the files, and typed `xmkmf`. This is a standard wrapper to the `imake` program that takes your `imakefile` describing the source files for the program and creates a `Makefile` tailored for the local compilation environment. This seemed to go well, so I typed `make`. The `make` program failed, saying that it didn't know how to make my program. It took me a short while to realise that I needed to be making `xcal.exe` and not

just `xcal`. After that, things went swimmingly. Initially, there were a few compilation warnings from the program and it also failed to link because, at present, the `mmap` system call is not supported (it will be in the next release I am told). But after changing an `ifdef`, I soon had a fully working version of `xcal` running on Windows NT.

Well, having had such a resounding success, I looked around for some programs that use the Motif widget set. I pulled some from <ftp://ftp.x.org> and had similar success with porting them. I did spend too much time trying to find where the X application default files were stored; they are in the NuTcracker install tree.

When you install NuTcracker you can load two flavours of the Motif widget set: `wintif` is from IXI Visionware and provides a Motif compatible library with a Windows look and feel. Well, that's what the manual says. From the description, I expected to compile a Motif program and have it merge seamlessly into the mess of Windows applications on my screen, this was not to be. The look is not too close to my NT 4.0, but probably could be with a small amount of tailoring choosing the correct fonts and setting colours. I haven't examined this too closely, I will admit.

However, all in all, the package is impressive. I really had expected to fight hard to port the various programs and I just didn't have to. It's important to say that these programs are not necessarily Posix programs, they are Unix programs that compile and run happily on a great number of platforms. There is no need to double port your code, once into Posix and then onto the NT platform. All the programs that I tried compiled easily, sometimes with a few minor changes, but none that were insurmountable.

The programs all ran as expected. I do suspect that the area of end-of-line handling from your application needs to be looked at carefully. As you know, Windows ends its lines with Carriage Return/Line Feed pairs; and Unix just uses a single Line Feed. However, most C programs use `\n` to mean end of line, which is Unix style really. The problem is normally avoided on Windows by ensuring that a text output stream is opened as such, giving special flags to the `fopen` routine call. I don't think that it's actually possible for a package like NuTcracker to detect and anticipate these difficulties.

### Instantly productive

It's almost impossible to test all the features that are provided by a package like NuTcracker, all you can do is dip in, try a few things and make an assessment. I haven't managed to look at porting a server onto Windows NT and I am sure that this is a great area of interest for many people. The package documentation does talk in great detail about servers, and provides the glue necessary to make a server interact properly with the system. There's a demo copy of `inetd` that you can investigate and install. Incidentally, there are some case studies on the DataFocus Web site (follow the *Success Stories* link from its front page). Some of the studies talk about serious servers comprising large numbers of lines of code.

There are many things about the package that I haven't managed to mention here. However, I found the package easy and appealing to use. As a Unix programmer, you are instantly at home and can be doing productive work rather than spending time on the learning curve trying to get the basics of your environment together. Of course, there are a few rough edges, and it's necessary to talk about them, but I don't feel that the rough edges in this package are very major. ■

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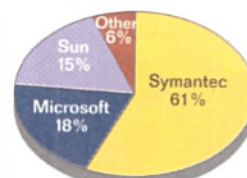


A close-up photograph of a hand holding a small, glowing, orange-yellow sphere. Bright, warm light rays radiate outwards from the sphere, creating a dramatic, sunburst effect against a dark background. The hand is positioned in the lower right, with fingers gently gripping the sphere. The overall mood is one of hope, inspiration, and divine light.

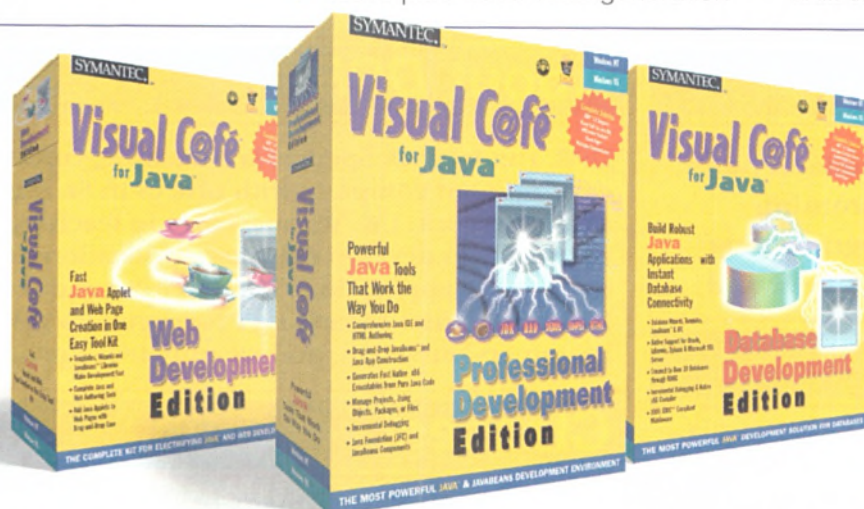


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# Sun's new Swing set

Tom Guinther takes a look at the Swing components architecture within Java Foundation Classes (JFC), a collection of classes designed to enhance visual applications written in Java.



Sun's newest offering for Java developers comes in the form of a 'Swing Set', or more officially, the Java Foundation Classes (JFC). The three main components are *Swing*, AWT, and Java2D.

Swing, version .50/.51, is available at the Developers Connection on the JavaSoft Web site (it is the final preview release prior to the official beta of the product) and JavaSoft expects to release Swing and JFC by the end of the year. This version works with the JDK 1.1.2 and up, but the final release is intended to be an integral part of JDK 1.2. One important note: this .50/.51 version of Swing does not include the source code for the components. This is a temporary problem that will be addressed with the first beta release.

## Swing design goals

Before you commit to any technology you have to ask yourself: why? What are the design goals? What problems are being solved? What are the advantages of this approach versus another? In the case of Swing my initial concern was that Sun avoided producing another AWT. From my perspective, 'AWT Design' is an oxymoron. That is, like 'Military Intelligence', two contradictory words you would never expect to see together. Although the JDK 1.1 event model helped radically improve the overall design of Java and AWT, I have always felt that certain aspects of AWT were ill conceived and that everyone would be better off if they were quickly discarded.

It seems apparent that the Swing architecture has been thought out to a degree that AWT never was. One organisation which probably deserves initial credit is Netscape, the creator of the Internet Foundation Classes (IFC). IFC is the original basis for Swing, and Netscape has been a co-developer. In its current form Swing is very different from IFC but the roots, although buried, still show through from time to time.

According to the Swing overview provided with the documentation, the primary design goals are to provide a unified, comprehensive, set of components with a 'pluggable' look and feel, that is 100% pure Java, and lightweight.

*Unified* is intended to mean that Swing and AWT work seamlessly together. Since Swing is built on top of AWT (among other things) a seamless implementation would seem to be required. Also, Swing is intended to provide 100% pure Java versions of all AWT controls. That is, the standard controls such as Button and List will have Swing equivalents and will not require 'peer' widgets to be provided by the operating system. Converting your AWT code to use Swing components is expected to be a trivial process involving name changes (and the JDK 1.1 event model).

*Comprehensive* means that every common user-interface widget or component has a 100% pure Java implementation that supports the new pluggable look and feel model. As well as being 'feature rich', Swing components are designed to be easy to use, and extensible.

*Components* refer to how Swing is based on the Java Bean design

model. The Java Bean model provides component properties, event-based communication, and object serialization. Java Beans also serve as a general model for lightweight components. All Swing components are Java Beans compliant.

*100% pure Java* and *lightweight* refer to the fact that the full implementation of all Swing components is written in pure Java and does not require native, 'peer' widgets to be provided by the host operating system. This helps to insure that all components look and behave the same, regardless of the host platform.

*Pluggable Look & Feel* refers to the ability to dynamically specify the look and feel of an application or even individual controls. I refer to this as the 'Dr. Jekyll and Mr. Hyde' feature. Your application, at the touch of a button, can transform itself into something completely different. Whether the result of that transformation creates a monster, or not, primarily rests on your shoulders. You can go crazy with custom look and feels, or you can stick to the standard look and feels provided with Swing. Those look and feels are, 'Basic' (Windows 95), or 'Rose', a JavaSoft specific one similar to Solaris.

## Distinct identity

Are you horrified by the following quote also extracted from the Swing overview documentation: '...we expect that application houses and corporations will start creating their own L&F modules to give their products a distinct identity'? Don't get me wrong, I think it's cool to allow the end-user to choose a preferred interface, but do we really need to return to this type of chaos? Flexibility and individual expression are things I hold dear, but I clearly remember when each product looked and worked differently, and they are not pleasant memories. It was confusing to say the least.

This is obviously a feature Sun thinks will be a big public-relations win because they talk about it incessantly. They are so over-focused on it as to obscure the more fundamental aspects of the architecture and completely overshadow the importance of the other design goals.



Figure 1 – The Basic look and feel.



Figure 2 – The Rose look and feel.



```

public class SimpleExample extends JPanel
{
 static String basic = new String("Basic");
 static String rose = new String("Rose");

 JButton button = new JButton("Hello, world");
 JRadioButton basicButton = new JRadioButton(basic);
 JRadioButton roseButton = new JRadioButton(rose);

 // Group the radio buttons.
 ButtonGroup group = new ButtonGroup();
 group.add(basicButton);
 group.add(roseButton);

 // Register a listener for the radio buttons.
 RadioListener myListener = new RadioListener();
 roseButton.addActionListener(myListener);
 basicButton.addActionListener(myListener);

 /** An ActionListener that listens to radio buttons. */
 class RadioListener implements ActionListener
 {

 public void actionPerformed(ActionEvent e)
 {
 String lnfName = null;

 // which radio button was clicked on?
 if (e.getActionCommand() == rose) {
 lnfName = "com.sun.java.swing.rose.RoseLookAndFeel";
 }
 else {
 lnfName = "com.sun.java.swing.basic.BasicLookAndFeel";
 }
 try {
 // change the look and feel
 UIManager.setLookAndFeel(lnfName);
 // force a redraw
 SwingUtilities.updateComponentTreeUI(frame);
 frame.pack();
 }
 catch (Exception exc) {
 System.err.println("could not load LookAndFeel: "
 + lnfName);
 }
 }
 }
}

```

Listing 1 – Dynamic look and feel.

In defence of the Swing design, it should be added that not having this flexibility would result in needing to make platform specific trade-offs that would surely upset the Windows, Solaris, or other GUI contingents that exist. There really is no other solution for cross platform development; 'pluggable look and feel' is a must!

### Underlying swing

The Swing component architecture is based upon the Model-View-Controller (MVC) architecture originally championed by Smalltalk. As every GUI library is based on MVC, or some closely related cousin, this should come as no surprise. The Swing MVC design includes what the documentation refers to as '...a small modification in the classic MVC design'. The View and Controller are combined into one component, known as a *delegate*. This is a common improvement on classical MVC because it solves many of the complex design problems required by a complete separation of the View and Controller. When you combine two of three major components into one piece you should not refer to it as a '... a small modification'. Regardless, understanding the MVC model is not a pre-requisite for Swing programming.

While *delegate* is used to describe the merging of the View/Controller (V/C), its look-and-feel specific implementation is referred to as a *ComponentUI*. Swing components delegate V/C specific functionality, such as rendering and sizing, to the *ComponentUI*. In case you missed it, a *ComponentUI* is look-and-feel specific so every component provides an implementation of *ComponentUI* for each look-and-feel it supports.

Every Swing component extends the class *JComponent*, which is a sub-class of *java.awt.Container*. Each component has a *UI* property that can be read and written from *getUI()* and *setUI()* respectively. The value of the *UI* property is a *ComponentUI*. Typically, when a Swing component is created, it will obtain a *LookAndFeel* from the *UIManager*, and then, using the *LookAndFeel*, create a look and feel specific *ComponentUI*, setting it via the *setUI()* method.

Of course, every Swing component has a model part too (the 'M' in M-VC). This describes the non-view specific aspects of the component. The model is associated with the component using the *setModel()* method, and can be queried using *getModel()*.

### Using Swing components

The Swing preview includes a variety of sample code that illustrates the general architecture and use of Swing components in Java applications. The Simple example (*SimpleExample.java*) is a good illustration of how to dynamically change the pluggable look and feel.

*SimpleExample* creates a window with three buttons. One is a standard push-button ('Hello, world'), and two radio buttons ('Basic' and 'Rose'). Depending on which radio button is selected, the window redraws itself and the buttons, using the specified look-and-feel. Basic refers to *BasicLookAndFeel*, and Rose to *RoseLookAndFeel*. See Figures 1 and 2.

The code in Listing 1 has been abbreviated to illustrate the pluggable look and feel code. The most interesting part is in the *RadioListener* inner class that listens for an *ActionEvent* to be sent from one of the radio buttons. When an *ActionEvent* is received the appropriate look and feel name is provided to the *UIManager.setLookAndFeel()* method, which will change the installed look and feel for the entire application.

### The Swing set demo

One thing I haven't yet covered is the number of UI components the Swing set includes. Not only is every UI component you ever wanted included in Swing, the underlying richness of each components feature set far exceeds my expectations. Here is an abbreviated list of components: *BorderFactory*, *JButton*, *JCheckBox*, *JRadioButton*, *JComboBox*, *Icon*, *ImageIcon*, *JLabel*, *JLayeredPane*, *JInternalFrame*, *JList*, *JMenu*, *JMenuBar*, *JMenuItem*, *JPopupMenu*, *JProgressBar*, *JViewport*, *JScrollPane*, *JScrollBar*, *JSplitPane*, *JTabbedPane*, *Springs*, *Struts*, *JTable*, *JTextArea*, *JTextComponent*, *JTextField*, *JToolBar*, and *JTree*. Also of note: common dialogs, JDBC support, a drag and drop API, and *JHTMLPane*, which is a basic component for displaying simple HTML documents. To get a feel for all these controls and more, all you have to do is run the provided *SwingSet* sample application.

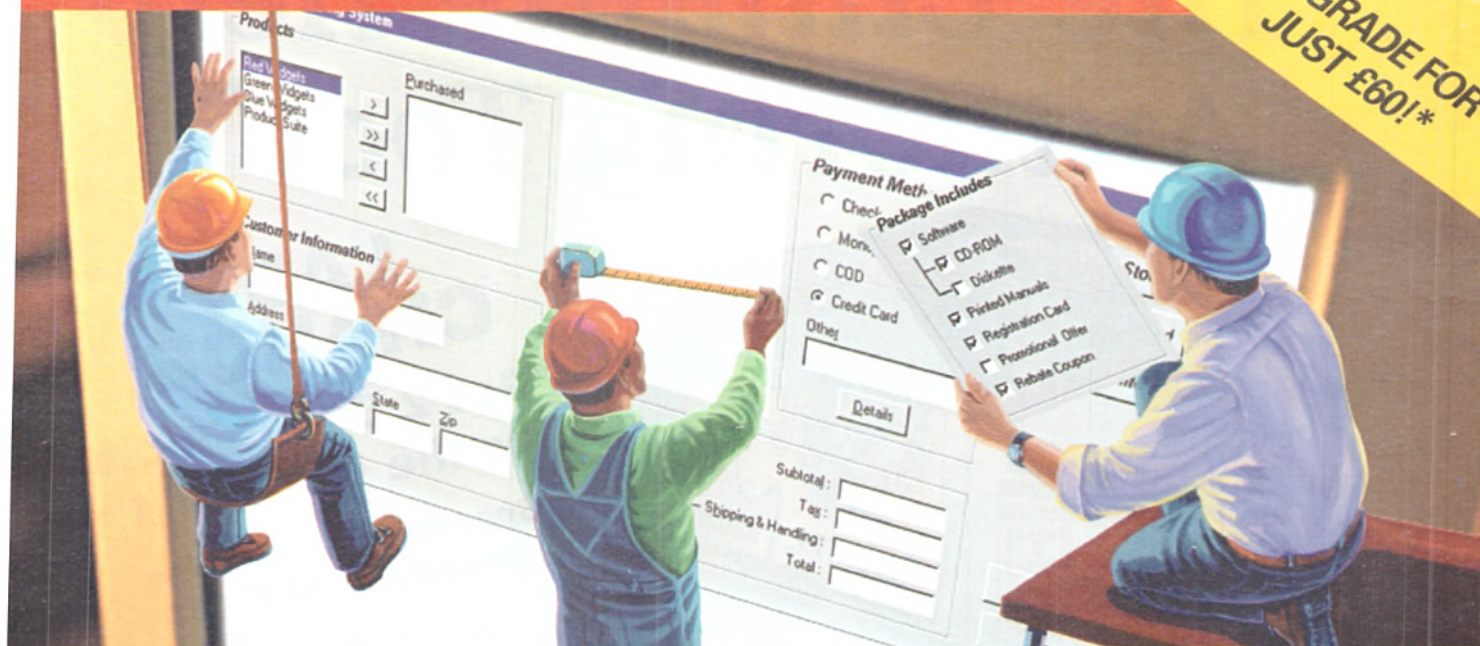
When I first ran the demo I was internally cringing, expecting performance to be an extremely limiting factor, and I expected the 'pre-release' to show a lot of cracks. I was pleasantly surprised (although it took a few seconds to get everything loaded). The performance is more than acceptable, with most tasks and components showing little or no delay to input. There were a few minor redraw problems but I didn't encounter any major problems during the exercise.

In its current form it is difficult to gauge exactly how well the architecture will stand up against other offerings but, from what I have seen, I think it will clearly stand on its own two feet. ■

*Tom Guinther works for Vireo, a company developing device drivers kits. He can be reached via email at tomg@vireo.com.*



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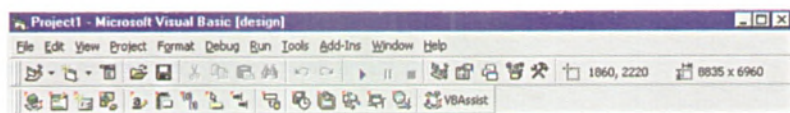
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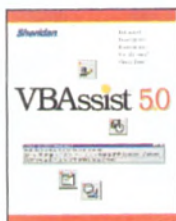
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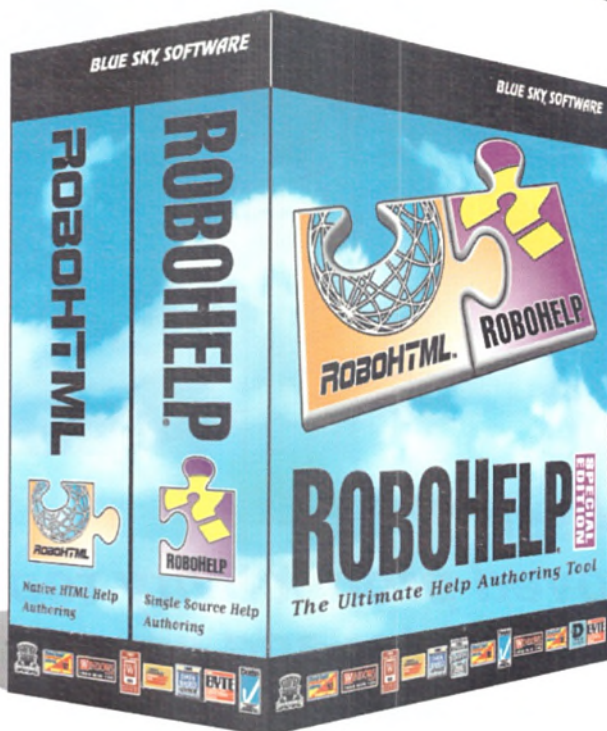


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# Template for memory management

Dynamic allocation? It's all part of the service with C++ templates. Francis Glassborow looks at higher level alternatives to malloc and free.

A few weeks ago I had an email advocating the use of `malloc()` in C++ because the programmer wanted to use `realloc()`. I will not argue that if you are going to use the latter you will need to use the former. The problem is in assuming that `realloc()` is necessarily the right C++ solution to a problem. Of course, there are specialist low-level problems where C's low-level technology may be exactly what is needed.

The problem most programmers want to tackle is dynamically changing the size of an array during its existence. If you need to do this in C, `realloc()` allows the possibility of some 'magic' to get better performance than by rolling your own version. If you start doing this kind of thing in C you better know what you are doing because the compiler is going to trust you to avoid possible dangling pointers, etc.

C++ is a different language with a new set of tools. Forget about `new` and `delete` for the moment – they are low-level tools for the component builder and have little place at application level except for creating single objects. Let us look at the alternatives that C++ provides.

## The power of genericity

Firstly, there is the non-obvious facility provided by the template class `basic_string<>`. Most programmers think of strings as being something to do with characters but the template actually supports a greater degree of genericity. There is nothing to stop you from having strings of `int` or `double` or... Well, what is the limit? It took some time before the penny dropped even in the minds of those who were working on the template; you can have a string of any simple fixed size value type. In other words a plain old C data type (called a POD by the experts).

Once you realise this, you also realise you may not need `realloc()` because a string instance provides much of what you will probably need. You do not need to track your dynamic memory because string types do that for you. When your string object goes out of scope, either because of the normal flow of execution or because an exception has been thrown through it, the dynamic memory will be released.

Looking at the various template parameters of `basic_string<>` might be a little too scary for you but not to worry; C++ provides a couple of other templates that have similar advantages but which may be less daunting, if only because they look more like what you expect. Secondly, we have `vector<>`. This template behaves much like an array and is a sensible choice when you are not going to be doing many size changes. Like `realloc()`, it will copy the existing data if growth requires relocation. It works just about as efficiently as a raw C-style dynamic array with the added bonus that the memory management is done for you.

The problem which C never tackles is that of providing a dynamic array-like type that guarantees not to change its address. With care and understanding you can provide such a type for yourself in C by

adding some extra layers of indirection but I have never seen a C programmer do so. You never need to do so in C++ because the `deque<>` (pronounced deck) template does it for you. These objects can grow at both ends by adding extra blocks of (non-contiguous) memory. The index operator (`[]`), dereference operator (`*`), etc. have all been overloaded so that a `deque<>` behaves like an array as far as the user is concerned. But you get two things for the cost of the extra hidden complexity: objects stay where you put them and you can add extras before the start (using negative indices) as well as after the end.

C++ has replaced the sledge-hammer of `realloc()` and dynamic arrays with a selection of more highly tuned alternatives from which you can choose the one that best meets your needs. Of course if you delve deep inside the low-level implementations you will find uses of `new` and `delete`. You may even find uses of `malloc()` and `free()`. As an application programmer, this should not be your concern. C has an exhortation: 'trust the programmer'. C++ should have a similar one: 'trust the other programmer'. Experience, however, may lead us to question the merit of both. If we are to become true engineers, we must become worthy of being trusted by our colleagues as well as trusting them.

There is certainly no justification for a program leaking memory because of poor memory management of collections of objects.



## Dynamic single objects

That leaves us the problem of dynamic single objects. C has very little use for these. If you think about it, you can see why. They are useful for creating nodes for lists and one or two other specialist data uses but that is about it. C++ needs dynamic creation on a much larger scale. There would be little benefit from polymorphism if we could not create the exact type we wanted when we wanted it. This means that C++ relies extensively on dynamically created single objects.

Good class hierarchy designers hide this away behind surrogates, proxies, or whatever you choose to call the objects that handle polymorphic types. Poorer designers leave much of the guts hanging out for the application programmer to tinker with. Even then, you should not have to worry about memory management. A suitable smart pointer template should do the work for you.

I write 'should' because the history of the provision of such a template in the Standard C++ library is a sorry tale. Originally `auto_ptr<>` was intended to meet the UK's requirement that there should be such a template but successive rounds of people with bright ideas tinkering have resulted in a type that too easily breaks your code (at run time). Strictly speaking, the current form does what was intended. Unfortunately, it can easily be abused and seem to do the things that you want only to blow up somewhere during the execution of your program. If you only use it for what was intended, it works, but...



I am going to stop there because next week – too late for this issue – the UK is having one final attempt to fix the problems. It has taken several weeks of email exchanges for everyone to understand exactly what others are trying to achieve and exactly how dangerous the current solution is. We even had one genuine C++ expert declare that he always used `auto_ptr<>` in a particular way and it would work OK. But he was blown out of the water by another expert simply pointing out that a good and legitimate optimisation of a standard algorithm would result in his code breaking at run time. Expert number one agreed and now has to fix his production code. It is easy to get fixated on a view. Next time I will let you know how we got on.

### Hot topic

Calendars, dates, and associated calculations are among this year's hot topics. You might be interested in looking at *Calendrical Calculations* (0 521 56474 3, £16.95). The authors take a detailed look at calendars that are in current use (plus an excursion into the Mayan ones). There are some real surprises and some problems that most of us probably never think about. How do you handle anniversaries in calendars that have complete extra months periodically (usually in a complicated 19 year cycle)?

I should warn you that the authors use Lisp for expressing algorithms but, if you can cope with that or can skip such detail, the actual text puts the Y2K problem in a new light.

### Last month's problem

Can the following program terminate early as a result of an assert failure?

```
void fn(T);
void gn(T const &);
int main() {
 T t;
 T tclone(t);
 assert(t == tclone); // A
 fn(t);
 assert(t == tclone); // B
 gn(t);
 assert(t == tclone); // C
 return 0;
}
```

Assume that type `T` has a copy constructor that produces an exact copy and that it has an `operator ==` that returns true if, and only if, the left-hand side and right-hand side are identical. In other words the expression `(t == tclone)` in line A returns true. If you are a C programmer, ask yourself if you expect any differences between passing by value and passing by pointer to `const` type.

The second assert (line B) is concerned with determining if passing by value could result in a change to the original even when the copy constructor produces an exact copy. Note that I wrote 'could', not 'should'.

Suppose that your copy constructor tracks how many times an instance has been copied in such a way that the immediate copy inherits the updated copy-count. Under these circumstances the copying of `t` to pass its value to `fn()` changes the original. Pretty weird stuff, but be careful because some programmers do provide some weird semantics and copying sometimes does change the original.

Before the C specialists imagine they are safe, consider a `struct` that has a pointer member, something like:

```
struct Trap {
 int value;
 Trap * link;
```

```
};
void fn(struct Trap t){
 (t.link->value)++;
}
int main(){
 struct Trap malignant;
 malignant.value = 0;
 malignant.link = &malignant;
 fn(malignant);
 return 0;
}
```

Of course, such code is pathological and we have to trust programmers not to write it. But I have seen more than one example of a `struct` instance containing a pointer to itself. Because of aliasing, there are many cases where the compiler cannot know that a pointer member of a `struct` does not point to itself. Indeed, isn't that exactly what you need for an empty circular list?

The third case is clearer cut. Passing a parameter by `const` & only limits the called function to using `const` member functions on that parameter. There is no reason to suppose that the object has not been changed. It may have a `mutable` member or the called function may have cast away the `const`. More to the point, the `const` protection only protects the shallow data. For example, if class `T` objects have a pointer to a dynamically provided buffer the `const` qualification inhibits relocating the buffer but it says nothing about changes to the contents of the buffer.

Do these cases matter? Yes, because the first one highlights how important it is to stick to expected semantics and the second one makes it clear that the compiler can not rely on cached data remaining valid after a return from a function call, even if the function has only `const` & parameters. You may know that nothing can be changed but the compiler does not and must act accordingly. Anything else would be a dangerous optimisation.

### This month's problem

Look carefully at the following code and consider why it should not work (many current compilers will be quite happy with it even though they should not be).

```
struct X {
 int i;
 X & operator = (X &);
 X(X &);
};

X fn(X x){
 return x;
}

int main(){
 X x, z;
 x.i=5;
 X y(fn(x));
 z = fn(x);
 return 0;
}
```

*Association of C/C++ Users subscriptions: individual £15, student £7.50, corporate £80, Overload & C++ SIG £30 (including ACCU membership). For further information and application forms write to Francis Glassborow, 64 Southfield Road, Oxford, OX4 1PA, call 01865 246490 or email [francis@robinton.demon.co.uk](mailto:francis@robinton.demon.co.uk)*





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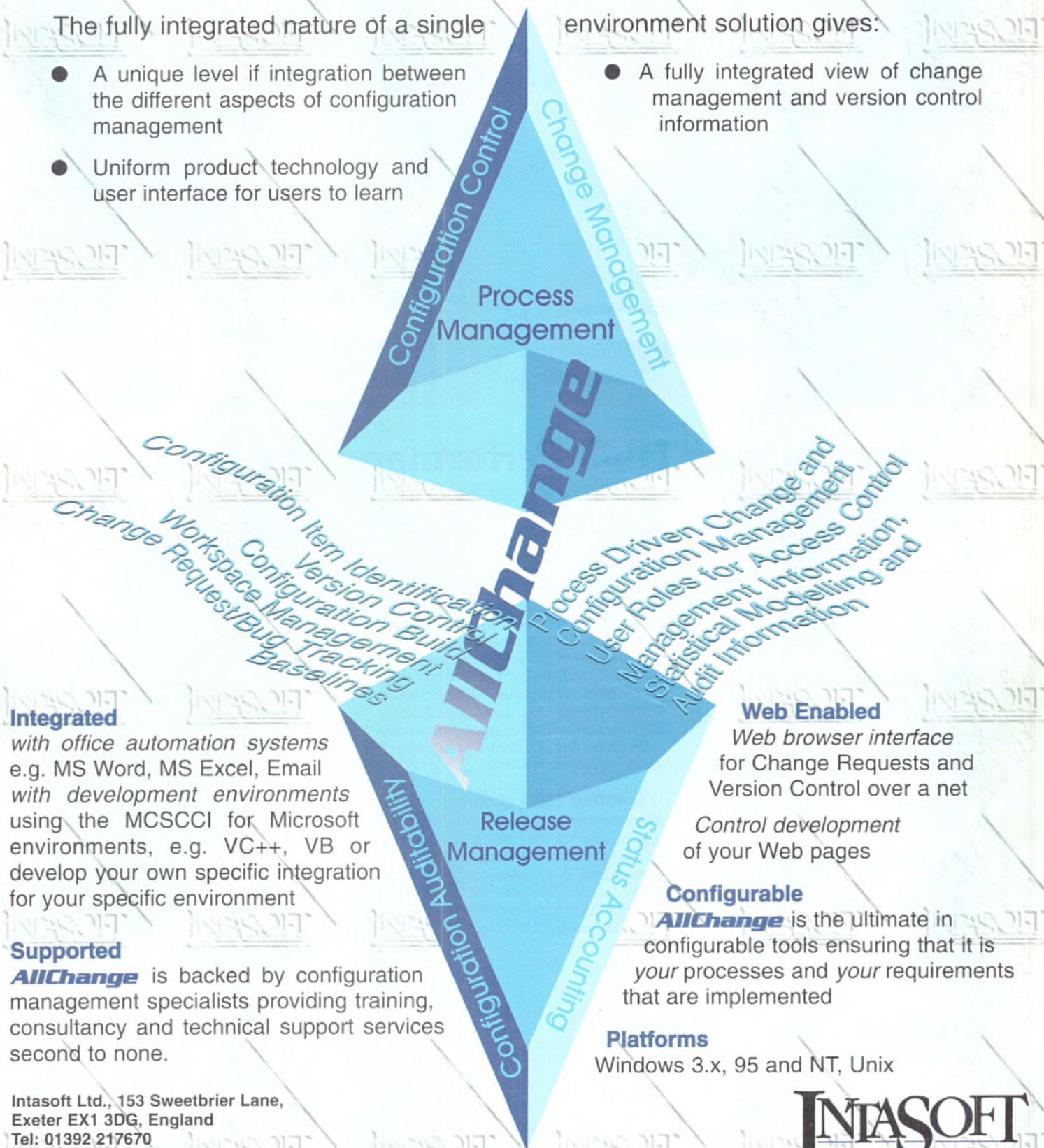
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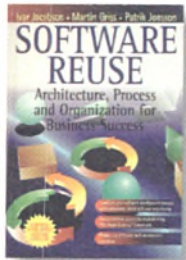
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## Software Reuse: Architecture, Process and Organisation for Business Success

Reviewed by Gavin Smyth



This book proposes a software development practice concentrating on reuse, not just at code or library level but over the whole process of software production, from analysis onwards. It's said that most of software development is the application of common sense, but books such as this are valuable in emphasising the fact and filling in the missing parts. The major sections cover: an object-oriented architecture style, emphasising reuse; the processes and roles involved in producing software to this architecture; and advice on (re)organising a business into a form which facilitates these processes. Although the authors state that object-oriented development, particularly related to software reuse, is the way of the future, they do not maintain that it is easy. They describe a framework which their experience suggests will ease the transition to a reuse oriented company. The book claims to be of use to just

about anyone involved in software production but it will be of most benefit to managers or leaders of large projects. There are interesting chapters on managing reuse teams and estimating costs, the latter including a modification of Boehm's work *Software Engineering Economics* as well as more practical rules of thumb.

The feel of the book is very academic; the language is very precise and deliberate and the treatment of the subject very detailed. This means that all jargon is clearly defined but it makes for very dry reading and a lot of repetition. For example, the authors split large scale application development into the three areas of component system engineering, application system engineering, and application family engineering. They then devote an entire chapter to processes involved in each area while the three are fundamentally the same (ie to develop software) with only a change in emphasis. However, in common with academic books this one does have a very comprehensive set of references, making it relatively easy to find out more about any particular aspect of the subject.

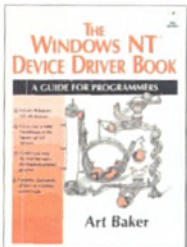
*Software Reuse* is a thoroughly up to date book, mentioning Java and ActiveX (though I was surprised that Ada barely gets a mention). Perhaps this is because it is also very PC and Windows biased, but that probably reflects modern development in the business world anyway. The real world examples, unfortunately, are rather vague and discussion of pitfalls is rather sparse. This book, like many software development process descriptions, tries too hard to sell the concepts of the process without highlighting the traps to avoid.

✓ **Verdict:** Recommended only to people overseeing development.

|                   |                                                                                    |
|-------------------|------------------------------------------------------------------------------------|
| <b>Title:</b>     | <i>Software Reuse: Architecture, Process and Organisation for Business Success</i> |
| <b>Author:</b>    | Ivar Jacobson, Martin Griss & Patrik Jonsson                                       |
| <b>Publisher:</b> | ACM Press (Addison Wesley Longman)                                                 |
| <b>ISBN:</b>      | 0-201-92476-5                                                                      |
| <b>Price:</b>     | £29.95                                                                             |
| <b>Pages:</b>     | 480                                                                                |

## The Windows NT Device Driver Book 'A Guide for Programmers'

Reviewed by Chris Cant



There was only one book in the computer section of my local bookshop that seemed to deal with NT device drivers. Taking the plunge, I was happy to find that *The Windows NT*

*Device Driver Book* was aimed at programmers and, being recent, covered NT 4.0.

If you need to write an NT driver, you will need Microsoft's NT Device Driver Kit that comes with MSDN level 2 (or better). Although the kit has lots of source code and full documentation, its presentation leaves something to be desired.

Writing NT device drivers does take a bit of homework, so there's nothing like a good book to help you through it. *The Windows NT Device Driver Book* takes things in the right order. It advises you to learn about your hardware electronics and architecture first before plunging into the necessary gruesome NT detail.

Taking a big gulp, you learn about the basics of kernel-mode I/O processing and all the data structures you will have to contend

with. Slowly a parallel port driver takes shape. First it just loads and unloads itself. Then it picks up information about hardware that NT has already detected, and allocates it as necessary. Driver I/O dispatch routines are written, and then finally you do some interrupt-based data transfers. Time-outs and timer-based drivers are covered, and the use of DMA. Device error logging and system threads are then explained. Higher-level drivers are described briefly.

Misplaced at the end, the book has very useful chapters on building, installing, and testing drivers. If you want to understand that NT Blue Screen of Death then look no further as a useful appendix gives bugcheck codes and their likely interpretations. Explanations of the development process are clear and include details of tools and techniques that are not necessarily obvious to the new driver writer.

The author seems to be familiar with many different types of hardware and driver but most of the examples are based on using the parallel port. Several techniques for these transfers are given. There are also some code examples for the serial port.

On the down side, the first working example was supposed to send a line of text out my parallel port to a printer. This interrupt-driven driver did not seem to work; I did not get round to finding out why.

Also, the book should have described how to fit into the NT driver structure. For example, if writing a driver to access the parallel port, you should really fit into the NT driver hierarchy, ie your driver should use the existing NT *parport* arbitrator driver to gain access to a parallel port while you need it. The example drivers of the book simply grab the parallel port for the entire NT session.

That said, the book more than lived up to its early promise and worked well as a tutorial and a reference.

✓ **Verdict:** Recommended

|                   |                                                                    |
|-------------------|--------------------------------------------------------------------|
| <b>Title:</b>     | <i>The Windows NT Device Driver Book 'A Guide for Programmers'</i> |
| <b>Author:</b>    | Art Baker                                                          |
| <b>Publisher:</b> | Prentice Hall                                                      |
| <b>ISBN:</b>      | 0-13-184474-1                                                      |
| <b>Price:</b>     | £29.99                                                             |
| <b>Pages:</b>     | 522 (disk of source code)                                          |

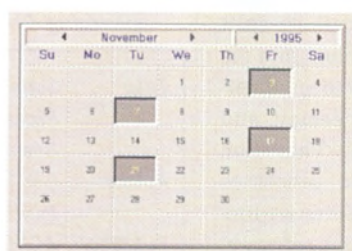


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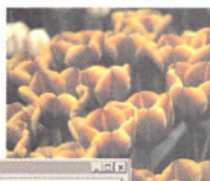
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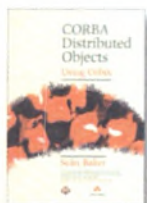
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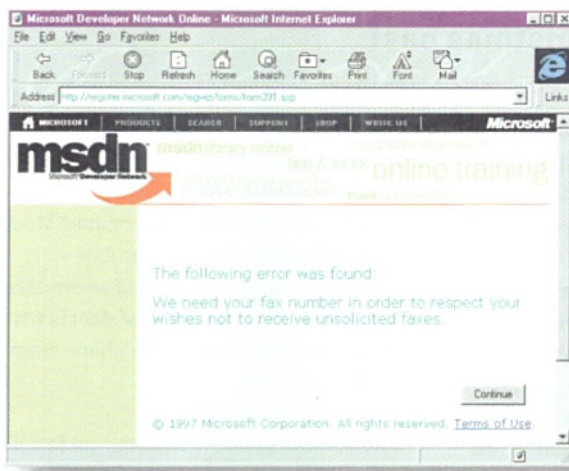
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# Wishlist

**E**XE reader Matt Harvey sent us this screenshot! He received this 'insanely funny error message while attempting to sign up to Microsoft's Developer Network Online'. Enough on Microsoft, Ctrl-Break would appreciate receiving funny error messages generated by other software houses...



# Yet another Usenet meme

**Ctrl-Break** received the following customer support story culled from Usenet. **Never trust hardware people!**

*An end user rings customer support to report that his computer is faulty.*

**Customer support:** 'What is the problem?'

**End user:** 'There is smoke coming out of the power supply.'

**Customer support:** 'You will need a new power supply.'

**End user:** 'No, I don't! I just need to change the startup files!'

**Customer support:** 'The power supply is faulty. You'll need to replace it.'

**End user:** 'No way! Someone told me that I just needed to change the startup and it will fix the problem! All I need is for you to tell me the command.'

*10 minutes later, the end user is still adamant that he is right. The customer support engineer is frustrated...*

**Customer support:** 'Sorry, Sir. We don't normally tell our customers this, but there is an undocumented DOS command that will fix the problem.'

**End user:** 'I knew it!'

**Customer support:** 'Just add the line `LOAD NOSMOKE.COM` at the end of the `CONFIG.SYS`. Let me know how it goes.'

*10 minutes later.*

**End user:** 'It didn't work. The power supply



is still smoking.'

**Customer support:** 'Well, what version of DOS are you using?'

**End user:** 'MS-DOS 6.22.'

**Customer support:** 'That's your problem there. That version of DOS didn't come with NOSMOKE. Contact Microsoft and ask them for a patch that will give you the file. Let me know how it goes.'

*1 hour later.*

**End user:** 'I need a new power supply.'

**Customer support:** 'How did you come to that conclusion?'

**End user:** 'Well, I rang Microsoft and told him all about what you said, and he started asking questions about the make of power supply.'

**Customer support:** 'Then what did he say?'

**End user:** 'He told me that my power supply isn't compatible with NOSMOKE.'

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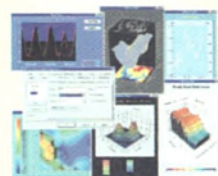
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# A Christmas carol

Ms Stob is haunted by the ghost of Christmas past.

I wake up on ring two, as one does when woken from sleep by the phone, and continue to lie on my back, summoning the will to open my eyelids. At ring seven, I manage it, and at ring eight-and-one-half, I have pawed enough gunk out of my eye sockets to read a green '5:13' from the alarm clock.

When they want to show a hangover in *Asterix*, they draw the character with a bubble over his head with a log being sawn in half. The bubble above my head contains a fibreglass 1970s-yellow Japanese car being cut up by a chainsaw gang. Covered in sweat, a frightful pain in the centre of my skull, photophobia, my saliva glands apparently having put in about half an hour's production of oil waste before packing it in completely. All seasoned with an ambient hint of nausea.

Wade through own discarded clothes and over crunchy yet sharply penetrating bits of plastic to the bathroom, ditch toothpaste and toothbrush in basin, fill the toothpaste tumbler brimful with Listerine, gulp Listerine, remember halfway through gulping Listerine that Listerine is non-gulpable, attempt to ungulp Listerine but instead manage to inhale about half a mouthful, fall to the floor kicking and struggling and coughing. After thirty seconds regain use of airway. With great effort, sit down on toilet seat and pant, helpless.

Bathroom sprayed liberally all over now like the inside of the back of John Travolta's and that black chap's car in *Pulp Fiction*, only with Listerine instead of errm, you know. Nausea advances a notch. Still, if I do throw up, at least I

won't die from Listerine poisoning. There's a comfort Verity.

What the hell have I been drinking? Must have been port. Recognise symptoms. Only port does this to me: liquid paracetamol unfortunately from the anti-matter universe. Good grief, you'd think I was old enough to...

Hello.

Phone still ringing.

This must be about ring 37. It is either a really determined pervert, the looney who leaves orders for Pizza deliveries at all hours, double glazing or dear relative in clog-popping peril. Blunder into hall and put out reluctant hand to pick up receiver. But phone sees me coming and stops ringing just in time.

Pro'lly just the Pizza man, fancying an early brekka. Actually, I'd sort of like to have a little word with the Pizza man. But of course I am never there when he rings – always find his message on the answering machine: one medium Hawaiian with stuffed crust, as quick as poss. I'll stuff his crust yet.

Hold on: his message. Why am I barking at five in the morning when I am a dog owner? Where's my trusty answering machine? Brief

tactile exploration discovers corpse of answering machine and multiple fragments on floor. Rather as though someone had knocked over little table and then blundered drunkenly across contents. Who could have committed this dreadful crime? Must remember to call in Miss Marple on this one, later in the day.

Am suffering strong sense of second boot dropping syndrome, so I sweep an area of carpet clear of debris with my hand, and sit down on the hall floor. Sure enough the phone rings within a few seconds, and I pick it up at once.

'Hello? Hello Verity?'

The voice is male and awake and familiar and clipped-Germanic-foreign and horribly, horribly enthusiastic – like a puppy. I try out my voice.

'Ooooozat?'

'Hello Verity, it is me, Patrick. I am sorry, am I waking you up?'

'S five inna morning, Whajerfink?'

'No no, here in Rotterdam it is nearly half past six.'

Ah. Now I know who this is. This is Patrick, husband of my old friend Fiona. She married a native of The Netherlands and, well, went Dutch.

'Hey Verity, I am having a problem with my computer. He will not play the new car game that I am buying for Christmas.'

'Hey Verity, don't say that rude thing. Please help me, for the kids' sakes.'

There's only one kid in Fion's household, and I'm talk-

ing to him. Patrick knows I know this. Damn. You've got to help somebody with a sense of humour – it's The Law.

'The problem is he gives a message which says' – some Triple Dutch – 'which means "the steerer is not correctly in place."''

'Ah, so you haven't got a driver loaded.' (I admit it, I've given Patrick tech support before.)

Ninety minutes later, I have Patrick zooming around his virtual track with CD-ROM access restored and IRQ and I/O port (incoming and outside harbour) conflicts resolved and stereo sound enabled, and, as I put down the phone, I admit it, I do feel much better – triumphantly James Herriotish. Good morning Mr Farnon, yes we did have an early call from Maastricht Farm, no, no need to bother Tristan, I sorted it myself.

Outside the flat, London is beginning the day in sci-fi disaster silence: there is no background hiss of cars and lorries on the wet motorway, no comforting rumble clatter and whine of tube trains as they cross the bridge into the station, and no snow falling snow on snow, snow on snow on snow.

It is Christmas morning.





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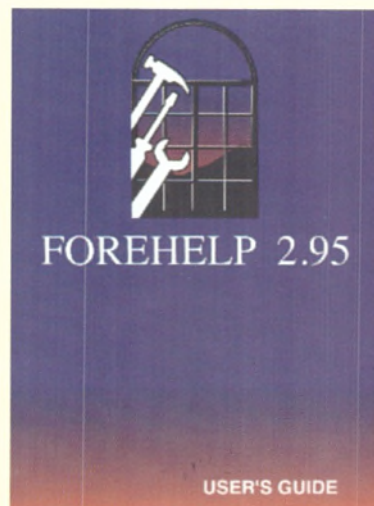
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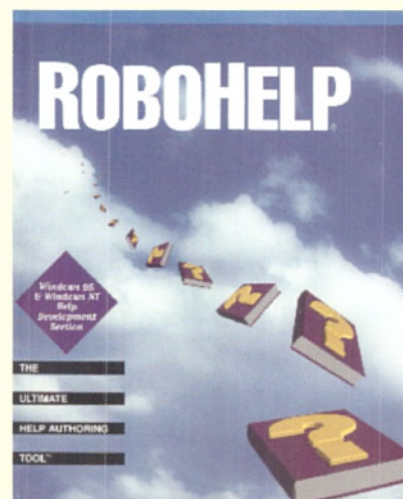
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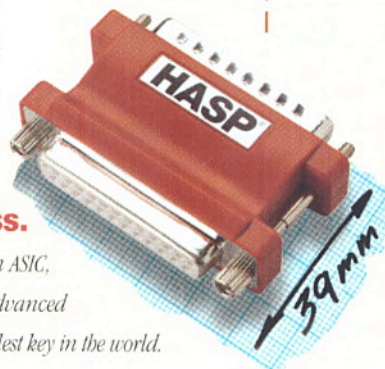


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