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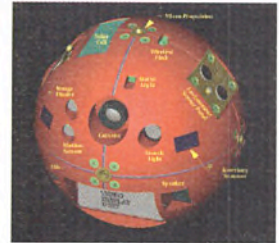
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Of syllables and syllabi

Programming languages have always been a topic close to the heart of developers. Heated debates, even quasi-religious (flame) wars, have raged over which language is 'better'. There are many arguments, for example, which language to use for teaching computer science. How many languages should a 'good' developer know, and which ones, are other difficult issues.

The learning of natural languages does not generate such debates, but it still raises some issues. Obviously, kids learn the language of the country in which they live. But what should be the rule when one or both parents are foreign? Should the local language be the only one spoken? Should parents speak to their kids only in their own mother tongue and, if so, what language should the parents use between themselves? And what criteria should be used to select the foreign languages taught at school; other European languages because the countries are close by? Chinese or Spanish or Russian because they're spoken by so many people in the world? Japanese because it might make sense for future business opportunities?

There are several important differences between programming and natural languages. The latter have evolved over long periods of time and their foremost goal is to facilitate communication between humans. Trying to create a natural language from scratch, as with Esperanto, has resulted in failure. Programming languages, designed to communicate with machines, have a history of, at most, fifty years. A lot of code has been written in most of these languages but can that, of

itself, be considered something of a success? Especially when you consider that most of the code can no longer even be read. There's a rumour that the data of the first space missions is no longer accessible, but we can still read old parchments. Another difference is that programming languages tend to be learnt when older. (Alex Telford has covered some other difficulties with languages in his EXE article in July 1999.)

Based on the short history of programming languages and what can be drawn from the history of natural languages, there's a strong argument for languages to be able to grow over time. This means that languages

concepts implemented were in the core. (One trend among language specialists I have noticed at recent conferences, which was very clear at the JaCC conference in April, is a change of focus from the direct comparisons of language features to the comparisons of idioms. The discussion has moved to a meta-level. One example of this shift is represented by Alan Griffith's article in EXE June 1999 on how to translate idioms across C++ and Java.)

This brings me to the central issue of how to teach programming and the importance of the choice of language(s) for this task. For

them, manages to increase computer penetration several fold, both languages and the teaching of them will have to change pretty soon. The need for complex system software will always be there but 'users' will increasingly want to customise their own devices. For this they will need to understand how the whole software works, to at least some degree. Programming will have to be much more forgiving. Also software upgrades will have to get better at preserving user enhancements.

It would help if there was some common ground of discussion for both experts and novices. One way could be a single language that is simple enough to learn (for novices) but expressive enough (for experts), providing a common communication medium. Guido van Rossum has written a funding proposal along these lines using Python as a starting point (www.python.org/doc/essays/cp4e.html). His proposal is targeted at teaching programming to non-Computer Science undergraduates. As Rossum points out, more work needs to be done, not only on the language but also on the development environment, and on program analysis, comprehension, and visualisation.

Computer languages have flourished in the past fifty years. Many different paths have been explored. With the likely forthcoming dramatic increase in the number of people using programmable devices (can we even call all of them computers?), it is time to devise programming languages better suited to humans and good teaching programmes. ■

David Mery



What should be taught are the basic concepts and idioms not the limitations of one language.

should allow for user-extensions, such as new vocabulary and new rules, to be added in a way that makes them indistinguishable from the primitives implemented by the language's creators. Guy L. Steele Jr. wrote a quite funny and convincing paper on how this applies to Java (Growing a language, cm.bell-labs.com/cm/cs/who/wadler/steele-oopsla98.ps).

The reasoning is that to express all the needs that all the developers may have today, a small language is no longer adequate. On the other hand learning a large language can take a very long time. Ideally, the core should be relatively small but there should be a mechanism for extension via some form of libraries that should be accessible in a transparent manner, as if the

instance, the very simple concept of recursion is trivial to explain in Lisp (it was very well taught to me at University). Once this concept is understood, iteration is viewed as a simple case of tail recursion. If you start with Basic (as I did before University) then the language forces you to have a very iterative view of all algorithms. To shoehorn these algorithms into languages such as Basic or Pascal adds unnecessary complexity. What should be taught are the basic concepts and idioms not the limitations of one language.

Up until now, humans have always had to adapt to computers. If all the work done on information appliances, wireless information devices, or whatever you want to call

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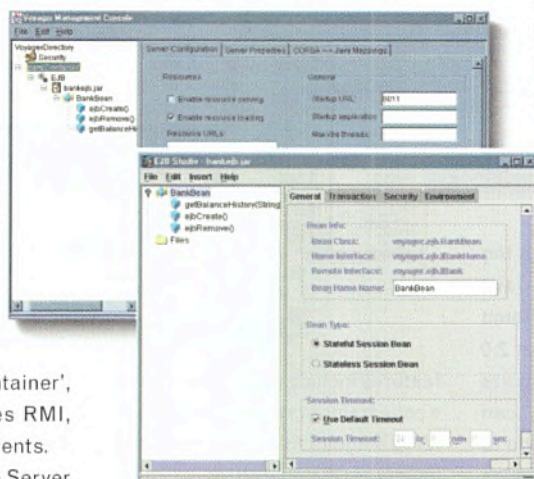
The Voyage from ObjectSpace

ObjectSpace has updated its (100% Pure Java) Voyager Application Server to version 3.1. It's an EJB (Enterprise JavaBeans) development environment for application programmers and EJB-component builders. It enables the development of scalable, distributed applications through its directory service replication, load-balancing, and connection management. This involves the use of Voyager ORB Professional, which has also been updated and is part of the Voyager ORB plus Services family. Employing a 'universal container', the Server accommodates RMI, Corba, and COM-based clients.

In addition to EJBs, the Server supports enterprise Java APIs such as JDBC, JNDI (Java Naming and Directory Interface), and JTA (Java Transaction API). New features for 3.1 include a DCOM Bridge to make remote DCOM objects transparently accessible, support for accessing of XML documents as Java objects, TCP con-

nection management, and the Load-balancing Directory Service.

Addressing issues of enterprise-scale development, Voyager Application Server 3.1 uses a secure and persistent implementation of JNDI



to store configuration information in a centralised directory. Multiple servers can store their configuration data in this directory, and each server can be administered remotely from within the Voyager graphical environment, via the Voyager Management Console (pictured).

Voyager includes EJB Studio (also pictured), a GUI-driven management tool for the packaging of EJB components. The GUI is intended to save the developer from having to master low-level EJB configuration formats. You have to specify design-level properties of components and the EJB Studio should handle the rest.

The Voyager Application Server is part of the Voyager product family for distributed computing. This includes Voyager ORB plus Services, which has similarly been updated to version 3.1 – it comprises the 100% Pure Java Voyager ORB Professional, Voyager Transactions, and Voyager Security.

A 30-day evaluation copy of Voyager products can be downloaded from the Web. Specific pricing and configuration information is available from PtS.

www.pts.com/europe/voyager.html

IBM's **DB2 Everywhere** is an **RDBMS** with a footprint of around 100 KB. Following agreements with **Palm** Computing and Puma Technology, the system is designed to help DB2 Universal Database developers create applications for handheld devices. DB2 Everywhere will be freely available from the Web. www.software.ibm.com

As well as enhanced documentation and some bug fixes, **ProDelphi 6.6**, the shareware Delphi source code **profiler**, sees the addition of a history function to allow the comparison of method **run times**. Priced at \$50, a free-ware version can be downloaded from the Web.

www.hp.europe.de/prodelphi/

Software AG has updated its **Natural** development environment and 4GL to version 4. As well as a component browser and an OO class editor for component-based development, there is an Explorer-style GUI, extended support of **ActiveX** controls, support for BLOBs, and simplified localisation of applications.

www.softwareag.com

Ultimate Diagram, from Dundas, provides an **MFC**-based framework for the creation of diagramming, **workflow**, and object-relationship applications. It requires MSVC 5.0 or higher. The Standard Edition costs £279 and the Enterprise Edition £549.

www.componentsource.com

Linkbot Enterprise 1.0 is described by Tetranet Software as a 'next generation **e-testing** solution'. It is a database-driven, **web-site** management system. Pricing starts at \$3,995, but a free 30-day evaluation copy is available from the Web.

www.tetranetsoftware.com

Synchronising HoTMetal Pro 6.0

Version 6.0 of **HoTMetal Pro**, SoftQuad's web authoring tool, features enhanced **FTP** capabilities, automated, synchronised site updates, and remote file editing. Aimed at both professional developers and new **HTML** users, it comes bundled with a clip art library of over 5,000 images, backgrounds, and animated **GIFs**, and the **PhotoImpact** image tool suite from **Ulead Systems**. **WS_FTP Pro 6.0** and **IE 5.0** and **Communicator 5.0** are also included.

Version 6.0's integrated **FTP** capabilities allow the easier configuration and management of multiple websites across multiple servers. Files can be uploaded, downloaded, renamed, copied, deleted, or dragged and dropped straight into **HTML** pages for editing.

A new synchronised publishing feature allows you to update web pages via drag and drop. All links are maintained automatically. When ready to publish, **HoTMetal Pro** performs a comparison of local and remote files and automatically publishes the latest versions.

Version 6.0 sees improved error handling, with a log generated of all errors encountered in files. For enhanced customisation, scripting support is provided by a choice of scripting engines: **JavaScript**, **VBScript**, **Perl**, and **Python**. An **Attribute Inspector (AI)** has been included in the Source editing view. It presents a complete list of all legal attributes for each **HTML** element.

For Windows 9x and NT 4.0, pricing starts from £99.

www.softquad.co.uk

Servlet debugger

Java developers creating servlets for the Web are the target for the **Enhydra Servlet Debugger** from **Lutris Technologies**. A servlet itself, it can run in any servlet environment, including **Apache JServ** from **Apache Software**. No modifications to your servlet are required; using a special URL, requests are made to the debugger and then forwarded on to the target servlet. The debugger keeps a queue of requests and responses, recording the details, and a trace is logged of every call made to the servlet API. As well as **Apache**, **Netscape Enterprise Server** and **Microsoft IIS** are supported.

The debugger is available by itself or as part of **Enhydra 2.1**, a **Java/XML** application server. The debugger is freely available for download.

www.enhydra.org

A Rational RoseLink by any other name

IP*Works 4.0 is a set of **TCP/IP** programming components and tools. Version 4.0 sees six new **ActiveX** controls (bringing the total to 22): **SNMP**, **LDAP**, **IMAP**, **MIME**, **MX**, and **SNPP**. It costs £179 from ComponentSource. www.componentsource.com

Priced at \$50, Vervet Logic's **XML Pro v2.0** is an XML editor that allows you to query, transform, and map **XML** bi-directionally with e-commerce apps, databases, and legacy systems. Additionally, **Intraware** has launched an *Everything XML* web page, designed to be a one-stop resource for analysis and info about XML.

www.intraware.com/xml/

ER/Studio 3.5 is a data modelling application for logical and physical database design and construction. Version 3.5 supports views as distinct database object types, can import/export data models, and can import SQL files to create data models. It costs £2,219. www.embarcadero.co.uk

The Enterprise Computer **Telephony** Forum (ECTF) has announced the release of S.410, a **Java** implementation of the ECTF services API and architecture. A cooperative effort with Sun, it is being released as the media package for the Java Telephony API (**JTAPI**) 1.3. You can download the complete S.410 spec from the Web. www.ectf.org

The **Oracle8i Appliance** is a pre-configured, pre-installed **Internet-enabled database** server that's designed to eliminate the need for a separate operating system. Targeted at applications to be deployed by ISVs, core operating system functions are embedded into the server.

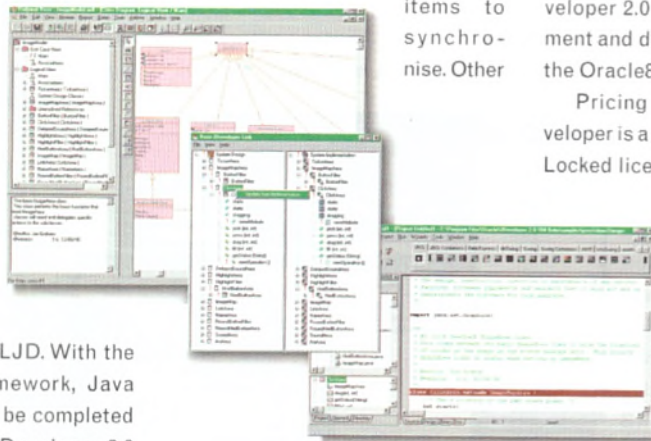
www.oracle.com/appliance/

An integration between Rational Rose and Oracle JDeveloper 2.0, called **RoseLink for JDeveloper (RLJD)**, has been developed by Ensemble Systems.

The idea is that developers benefit from designing OO software by using Rational Rose 98i and then generating a 'markerless' code framework for an application using RLJD. With the already-coded framework, Java applications should be completed rapidly within the JDeveloper 2.0 environment. The system supports iterative development: it can reverse-engineer existing code to produce up to date software design models in Rational Rose.

The user-interface for RLJD builds a side-by-side representation of the Rose model and the JDe-

veloper application. It highlights any unsynchronised model or code items, and it gives you a choice of items to synchronise. Other



features include support for Java 2, a code framework preview, and editor dialogues to modify non-UML Java-specific properties.

Rational Rose 98i provides UML-based modelling for designing component-based applications. The Unified Modelling Language is for

specifying, visualising, constructing, and documenting the elements of a software system. Oracle JDeveloper 2.0 supports the development and deployment of Java with the Oracle8i database.

Pricing for RoseLink for JDeveloper is as follows: \$955 per Node-Locked licence (installed for each individual user) and \$1,910 per Floating licence (defining the number of concurrent users).

Other Ensemble products include Rose Word Link, Rose Delphi Link, Rose JBuilder Link, Rose Visual Café Link, and RoseLink for VisualAge Smalltalk.

A fully functional 30-day time-limited version of RoseLink for JDeveloper can be downloaded from the Web.

www.ensemble-systems.com

A bootstrap for appliances

To bootstrap the development of Internet appliances, Integrated Systems Inc. (ISI) is offering a hardware and software reference design free of charge. The **WebPDA** platform is based on the Mitsubishi M32R/D microprocessor (32-bit RISC CPU with 2 MB DRAM on-chip) and ISI's real-time OS pSOSystem.

The design reference incorporates Sun's pJava V1.1, PointBase's Java database, Espial's email and PIM applications, and ANT's browser and email. On the hardware side, it includes design services from ISI's Doctor Design subsidiary.

Reference designs commonly take the form of application notes found in the catalogues from the electronic chip manufacturers. However, they tend to reveal simple designs where the main intention is just to show how to use the chips. Designs as comprehensive as the **WebPDA** can encourage companies with some special needs, but little or no experience of how to design such a product, to get in on the act.

Anyone wanting to get started in developing an Internet appliance can license the complete reference design free, hence shortening time to market and reducing initial costs. Once products are built, though, royalties have to be paid.

For an additional cost, variations on the design are possible. For instance, although the reference design is based on **IPV4**, ISI does have an **IPV6** stack – it seems a minor change to implement **IPV6** as well if required.

By the time you read this, two other reference designs should have been announced. It is likely that one will be x86-based and the other will focus on networking.

www.isi.com

Visio 2000

Visio is releasing its Visio 2000 platform in stages. The Standard edition (SE), the base product, and the Technical edition, for engineers, are available now. The Pro and Enterprise editions (more targeted at developers) are slated for mid November. The engine has been completely rewritten, which brings increased speed as well as improved ease of use.

Visio 2000 SE does offer more to developers even if it doesn't include all the shapes, such as UML diagramming, available in other editions. Visio 2000 is VBA 6.0 compatible.

Changes to Visio's ShapeSheet give more control over individual shapes; changes to the object model make fine-grained control easier. New automation objects include the Hyperlinks and the MasterShortCut objects. Group behaviour of shapes has been enhanced.

Visio 2000 SE retails at £139, Technical and Pro are £279, and Enterprise will be £695.

www.visio.com

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Pending Validation	34	73	
Closed or Other	144	246	
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Project: Manager Core, Mail Enab			
Defect Statistics	Priority1		
Open Defects	1		
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Closed or Other	12		
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Visualising CA

A report from the CA World conference.

Embedded Solutions Ltd (ESL), a spin-off joint venture with Oxford University, was set up to develop and exploit Handel-C, a radical approach to co-design.

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BUILD YOUR WEB APPLICATIONS FASTER

Orchestrating an embedded revolution?

It's not often that we write about hardware in EXE. We are, after all, a software developer's magazine. But recently we got a preview of a new technology which threatens to blur the line between hardware and software permanently.

Embedded Solutions Ltd (ESL), a spin-off joint venture with Oxford University, was set up to develop and exploit Handel-C, a radical approach to co-design (see *Co-design: where hardware and software meet*, EXE, December 1995). The aim of Handel-C is to bring the flexibility and reconfigurability of software to hardware, using Field-Programmable Gate Array (FPGA) technology. FPGAs contain large numbers of gates - as found in microprocessors and RAM chips - whose logical arrangement can be reprogrammed on the fly. In effect, it's possible to write and rewrite different circuits onto the FPGA at will.

Handel-C itself is a subset of C that is tailored to doing the job of writing hardware. Programs in Handel-C translate *directly* into circuitry on the FPGA. A device using an FPGA doesn't need a microprocessor, or support chips. Functions like driving a display or taking input can be performed by hardware written onto the FPGA itself. ESL uses a demo board consisting of an FPGA and DRAM chip, with some connectors

Notes

We're sure that you'll be hearing a lot more about FPGAs - and Handel-C - in future. Meanwhile, you can get your hands on a Handel-C toolkit for £3,500 per seat from ESL direct.

[Web site >>](#)

Internet

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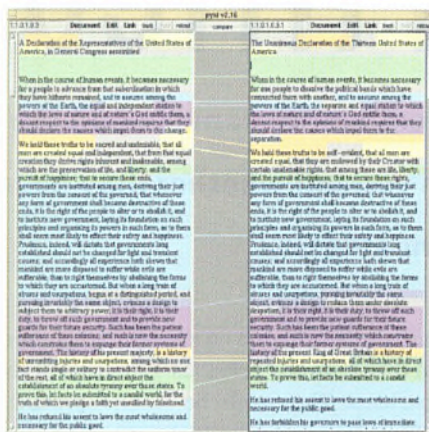
Xanadu – the pleasure dome is open

It was only last month that *Soapflakes* bemoaned the neglect of hypertext. Well, the father of the term back in the 60s and an original pioneer of the web-like ideals behind it, Ted Nelson, has stepped into the spotlight once again with Xanadu. The code previously known as Xanadu 88.1 and 92.1 has been released on the Web at <http://udanax.xanadu.com> as Open Source under the names Udanax Green and Udanax Gold (two implementations of the server, developed in C and Smalltalk respectively). Points of interest will be the use of bi-directional linking, the write-once architecture that records every change to every document across an infinitely grow-

able address space, and the use of 'tumbler addresses' to manage and relate those changes.

This is the first public release of the software developed by the Xanadu Operating Company, originally set up in 1979, whose board of directors have voted to become udanax.com. The Udanax Green back-end and a new 'pyxi' Python front end have been demonstrated at the O'Reilly Open Source Conference in California.

The example, from Udanax Green, shows Udanax hypertext tracking the evolution of docu-



ments. The 'transpointing window' allows for two versions to be displayed side-by-side and the connections identified.

www.udanax.xanadu.com

As the result of an agreement between Gemplus and Symantec, **Java** developers will be able to design and build Java Card applets for SIM cards in a familiar environment. As well as **GemXplore CASE**, a SIM software development environment, Gemplus has two new SIM development plug-ins: Object Designer, which incorporates **Visual Café 3.0 Professional**, and Advanced Development Tools. www.gemplus.com

Hi Spy, from PHD Computer Consultants, is a **text search** tool for those producing CD-ROM **web-sites**. Replacing a search engine that's normally available via a web server, a Java applet runs directly from the CD in the user's browser. Licences start from \$750. www.phdcc.com

The integration of Polyhedra's real-time database with the **OS/2** is aimed at systems that involve both large **database** usage and **real-time** performance. The OS/2 Polyhedra system can be used to set up a hot standby pair of databases, within a distributed system. The integration is available on the PowerPC processor family. www.polyhedra.com

Software AG's middleware, **EntireX**, is to provide full support for the use of XML. **Software AG** asserts that EntireX will not only transport data in **XML** format, but will also apply the XML standard to internal control information for EntireX data objects. www.softwareag.com

Databases from the front-end

Two upgraded controls from Apex Software concern the development of database front-end applications: True DataControl 6.0 and DBInput Pro 6.0.

Replacing True DBWizard 5.0, True DataControl 6.0 is an ActiveX control to supplant the standard Microsoft ADO data control in VB 6, providing data control at both design and runtime. For rapid development, it eliminates manual coding by allowing you to specify data relationships, logic, and all UI features in a non-procedural way. The control enforces these guidelines at runtime and can combine them with procedural code. As well as standard database functions, it supports the use of ad-hoc queries, and find and bookmark dialogs. The control also removes a limitation of standard VB data sources by permitting the use of parameters in an underlying SQL statement at design-time. And expressions can be assigned to parameters.

True DataControl 6.0 can be used within VB 6.0, IE 4.0 and 5.0, VC++ 6.0, and in any Microsoft development environment that can bind to an ADO/OLE DB data source.

Moving on to the second database-related control, True DBInput 6.0 is a collection of eight data-aware ActiveX input controls and five objects designed for MS Visual Studio database front-end application development. It is designed to extend or replace VB's text, calendar, mask, edit box, and frame controls.

Among the eight controls are two new ones: TDBCcalendar and TDBCcontainer 3D. TDBCcalendar displays up to 12 months of date information and provides international character support, enhanced calendar displays, and holiday settings. TDBCcontainer 3D applies three-dimensional effects to controls inside containers. The five ActiveX objects in DBInput Pro 6.0 have been developed for financial applications.

Other features of DBInput Pro include support for IE and other ActiveX-compatible browsers, character filtering, international character and format support, OLE drag and drop, the use of spin buttons, the tailoring of background colours and 3D text effects, and password masking.

True DBInput Pro 6.0 works with VB 5.0 or 6.0 and Visual Studio 5.0 and 6.0 with support for ActiveX Data Objects (ADO) 2.0, Data Access Objects (DAO), and Remote Data Objects (RDO).

Available from Contemporary, True DataControl 6.0 and True DBInput Pro each cost £220.

www.contemporary.co.uk

Books received this month

Publisher	Title	Author	ISBN	RRP
Cambridge University Press	Enterprise Java computing...	Goving Seshadri	0-521-65712-1	£24.95
Cambridge University Press	Java for the Cobol programmer	E. R. Doke & B. C. Hardgrave	0-521-65892-6	£27.95
Morgan Kaufmann	Linux clearly explained	Bryan Pfaffenberger	0-12-553169-9	£32.95
SSC	The artists' guide to the Gimp	Michael J. Hammel	1-57831-011-3	\$39.95
Morgan Kaufmann	Thin clients clearly explained	J. T. Sinclair & M. Merkow	0-12-645535-X	£29.95

All certified

When you can't even remember the names of all the skills your employees need, how can you tell whether they have them? Jules is training himself to be sympathetic.

The way programmers talk, you'd think they like being in a field that turns over its skills base every two years – they use words like 'exciting' and 'cutting edge of technology' even though another programming manual can hardly be described as exciting and most of this churn isn't technological at all, it's commercial. But then, when all their old skills become redundant, and they have to learn a whole set of new ones, all they do is complain. Who is going to pay for all these new skills? Where can I get the least damnfool cutesy American book about them so I can bluff my way through the next interview for my own job?

If you think you've got it hard, spare a thought for the managers and personnel people. Managers have been told that you have to do something three times before you can get a feel for budget estimates, but here they're in a field where the core technology seems to change three times before the first version is finished, and the only way to complete is to hire a whole bunch of new people, retrain the old ones if there's any money left, and hope the project doesn't crash and burn in the meantime.

How are they to decide whom to hire? Easy, hire the people with the new skills. How do you find out if they've got the new skills? Easy, ask them for previous experience at the interview. Ah, but no! These days, with the APIs spiraling

out of control, there's no chance that they have any previous experience. They might be bluffing. Do you realise that there are, among our number, programmers so dishonest that they would apply for a job for which they have no experience whatever, and then learn, on the job, at the expense of the project? Shocking, but true.

There's no way that any manager with an eye towards their job security would dream of hiring a programmer who had just read a book or two, and practised in their own time. Why, our programmers could do that, and since they haven't, it proves it's not worth doing. No, the only way to find out whether these programmers are any good is to ask them for their qualifications.

There's a whole bunch of certification schemes; Microsoft has its MCSD qualifications, Novell and Sun have their own as well. These qualifications, like most non-work experience, measure nothing very clear and certainly nothing worth measuring (and nothing related to the ability to perform a real-world job under pressure), but these wastes of time are not the subject of this month's complaint. It's the squillions of smaller companies who are offering training in everything from how to start your computer to how to achieve critical mass in ASP.

Please don't misunderstand, I have nothing against training, and nothing even against

training companies. Most of them seem to be offering good products. No, what concerns me is how the result of that training – the certificate – is interpreted. Assuming the material covered is both accurate and useful (which, unless the trainer has on-the-job experience, is doubtful), exactly how much skill is it possible to acquire in a day, or a week, or however long the course lasts? You might have a certificate, but in most cases the certificate signals little more than that you might possibly know what most of the things are called in the index to the help system. Learning something as complex as Word macro programming in a week is utterly unrealistic, no matter how talented the tutors.

But, to the managers who are faced with the task of hiring people, certificates are a godsend. If an applicant has a certificate, he's qualified, and the manager has exercised due diligence in hiring him. If the applicant has no certificate, he's unqualified, and it doesn't matter what he thinks he knows, because nobody – not the manager, their existing team, or anyone else in the firm – can tell whether the candidate is bluffing or not.

Of course, it doesn't occur to the manager to wonder whether the certificate issuer knows anything about the subject either. There's loads of training bodies and certificate issuers, and many of the training courses don't have an exam, so the certificate only says that the

holder might have seen the material, not that he understands it, nor even that he didn't sleep through it.

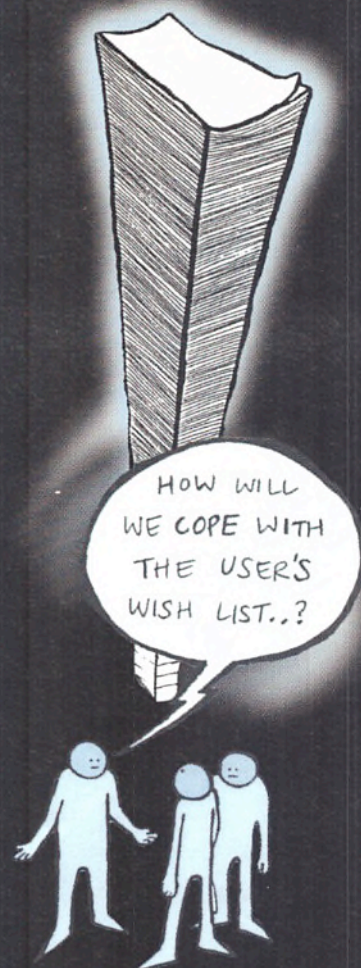
In response to this mad state of affairs, two things are happening. First, trainers are producing courses (at not trivial expense) for all manner of subjects, knowing that the more certificates a job applicant has, the more chance he has of impressing the boss. Second, people who need certification for their existing knowledge and don't want to pay the going rates (which, to document a realistically extensive basket of skills, are outrageous) are either writing their own certificates, or getting their mates to write them. Since anyone can set up a training company, these 'bogus' certificates could be quite as valid as any others. Possibly more alarmingly, they may represent a similar degree of achievement.

At the end of the day, all a manager wants to know is whether the applicant can do the job. If the chap does what's required of him, does it matter whether he's learning as he goes along, reading a book, or attending every course going? If he's doing the job, he's doing it. If he's not doing it, it's very easy to fire a new recruit. But even in these days of fearsomely eroded job security, managers don't feel able to fire the incompetent, and consequently programmers (both contract and permanent) are having to pay through the nose for training they generally don't need and can't use, which is offered by training companies who are providing unnecessarily expensive courses in what they know is a captive market.

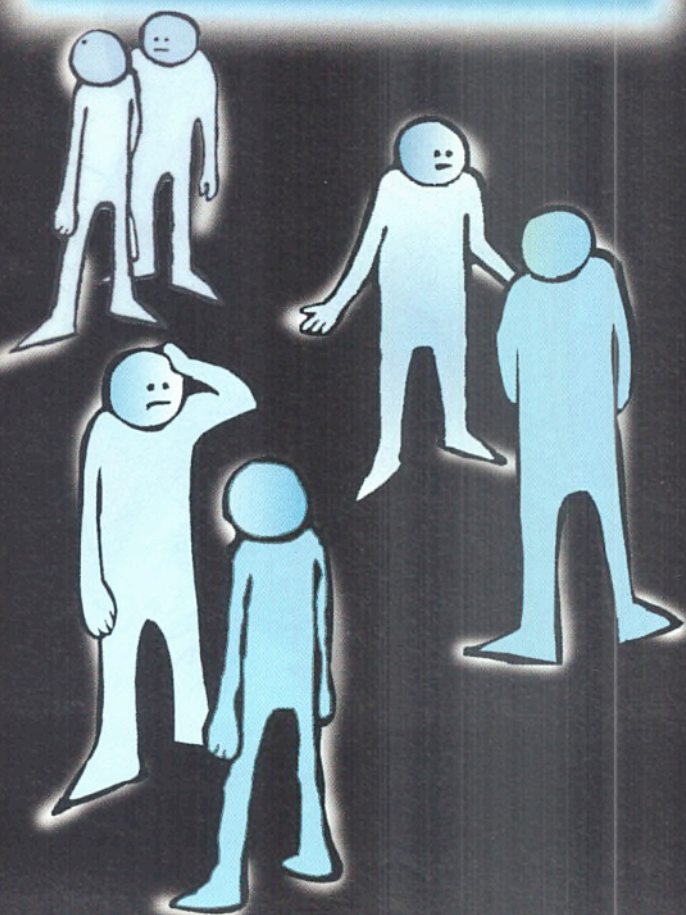
I blame the management. ■

Jules is a programmer, writer, hardware designer ... hang on ... nope, he can only afford to be a programmer. You can contact him on 01707 662698, or at mayhem@jules.cix.co.uk.





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ISO-compliant VC++

Dear Sir,

Many programmers find Microsoft VC++ a generally robust and effective product, which seems to improve with each new release. For these people, and new VC++ users, it is important that compliance with the ISO C++ standard is made a top priority with the next release of VC++.

From a programmer's point of view, there are many benefits to be had from a standards-compliant VC++ release:

- The ability to use third-party books, documentation, and idioms, and to take part in conversations with other C++ programmers.
- It makes it easier to use Windows as a base for developing programs that may be used on other platforms, or with mixed platforms.
- The new standard seems to be 'wise and good'. It is worth incorporating on its own merits. For example, partial template specialisation has emerged as a crucial mechanism for using templates effectively and the C++ language is not complete without it.
- Compliance benefits new C++ programmers learning the language (the basis of Microsoft's future income stream from the product). Currently, there is a lot of confusion among learner and early-experience C++ programmers about the standard as encountered in textbooks, example code, and answers to questions, and the results of trying to run that code on the non-compliant VC++ compiler (eg check out the postings to independent VC++/MFC support sites such as <http://www.codeguru.com>). In the past, the ISO C++ standard has been a moving tar-



get, and VC++ could not really be expected to match it. That has changed with the ratification of the new standard; today, a 'top drawer quality' compiler must support it 100%. There is of course nothing wrong with VC++ incorporating proprietary extensions to the libraries and language itself, but the 'core' of the language must be ISO C++ compliant.

Obviously, there is the issue of backwards compatibility – existing VC++ code may 'break' some of the new standards (such as the `for` scope rule). The existing VC++ code base therefore requires an *option* of permitting non-compliant syntax. Backwards compatibility is not a reason to ignore the ISO standard when writing new code modules.

Hopefully, the Visual C++ development team will treat ISO standards compliance as a matter of urgency with the next release of the product.

N. Landmark
nic@cix.compulink.co.uk

I feel this is a very important issue and would welcome further comments from readers about the degree of compatibility you expect, or feel you have the right to expect, from C++ development tools. There are validation tests out there to certify, or otherwise, compliance to the C++ Standard, but how many products are measuring up? Or will even show an intention of measuring up? Will compliance, with all the costs of development for the vendor that implies, be rewarded with increased custom? Or will other factors override this issue at

We welcome short letters on any subject relevant to software development. Please write to: The Editor, EXE Magazine, St. Giles House, 50 Poland Street, London W1V 4AX, or email editorial@exe.co.uk

purchase time, effectively rewarding the tardy (feature-rich/compliance-poor) tool builder? – Ed.

Ivory towers

Dear Sir,

In your July edition Alex Telford discusses the explosive subject of language design and why languages always seem to have clinkers in them (*Self-selection of the species?* EXE, July 1999). Personally, I doubt very much whether this has much to do with intelligence either of the designers or of the programmers.

In my (arrogant) opinion it has everything to do with design objectives. After twenty-four years of programming I have concluded that you can divide programming languages loosely into two groups, those designed by people who intended to use them for some definite task and those designed to be cast down from ivory towers, as pearls before swine, to prove their designers' ineffable superiority.

The canonical example of the former is C (not C++) and the classic example of the latter is Pascal.

Of course both approaches have strengths and weaknesses but give me the user-designed languages every time because, even if they don't do my job very well, at least I know that they evolved to do something well. But then I learned my programming processing real world data and only started colliding with computer scientists later.

I learned not to like computer science.

Thomas Groves
 Kennington, Kent

Swinging the lead

Dear Sir,

I loved the *Mayhem* article (*Swinging the lead*, August 1999). I think Jules has given credit to us. One thing I would like to add is that for us overseas people, it can be a lonely existence, especially if you don't speak the lingo. I've gone from regular bi-daily beer garden evenings in Munich (without doubt the best time of my life) to, 'as a consultant you may not attend our company bbq' in Belgium. (Not saying it's country related, company policy perhaps.)

I think those with smaller salaries tend to forget that quality of life isn't always income related, but I'm damned if I'm giving up my private aeroplane yet and coming back to the UK. I think there is a lot of jealousy around also. I don't believe it when I hear the often stated, 'I've never met a good contractor' – they do exist. I've also noticed that many 'disorganised' companies utilise contractors.

There is a lot of failure in the computer business, bad planning, culture gaps, etc... Contractors make excellent targets for blame – they aren't there to answer back.

If you are planning another *Mayhem* on a similar theme, I think there is plenty of room (and current misunderstandings) about good/bad accountants and the ways to minimise one's tax. Don't ask me, I'm still learning, but I do know that my training has cost £6,000+ in the last 6 months.

Kevin Yeandel
kev.y@justicemail.com

Sealed with a kiss

That's keep it simple, stupid. Taking a cue from *The Elements of Programming Style*, Peter Collinson offers ten aphorisms for the autumn.

My dictionary tells me that an *aphorism* is a short pithy phrase or maxim. Sometimes, having a short mantra to sum up a situation can help. In the US, when driving a hire car, I keep repeating 'the driver drives in the middle of the road'. The phrase ensures that I don't become part of a head-on collision when turning left, and helps when I'm driving in places where I am uncertain of position, such as car parks.

I've been wondering recently about how to characterise ideas of good programming. What are the rules by which programs should be written? A slim volume called *The Elements of Programming Style* by Kernighan and Plauger (McGraw Hill, ISBN 0-07-034207-5) that I rediscovered on my bookshelf provoked some of these thoughts. This book was originally written in the early seventies and revised into a second edition in 1978. It was aimed at Fortran and PL/1 programmers, and written for programmers working in a completely different computing world.

The book is stuffed with aphorisms, most of which remain surprisingly fresh today. I find that thinking of statements that characterise what is good (or bad) helps to make you think about the topic. Here are my ten favourite aphorisms.

Keep it simple, stupid

Simplicity is important because it generates clarity of code. Clarity is important because other people will need to read and maintain your code. Actually, one of those other people is you, but you will be displaced in time. I find that I always forget code that I've written after I've finished the development cycle of writing and debugging. Putting code into production means 'all bugs are now features' and I erase all memory of how the code works. Some time later when a feature turns out to be undesirable, I am forced to look at some strange code written by some other idiot, who was really a younger instance of me.

Writing simple code is actually defensive programming, and will help that 'future you' understand what the 'present you' was attempting to do. It's a real must to avoid using this week's neat trick. All languages have neat tricks, smart syntactic shortcuts that do something in a mysterious way that's fun to use when you are 'in the know'. Sadly, in future, you may have forgotten what you know now. Neat tricks fade with time. They need to be avoided, or if they are really the only way to do something, they need to be placed into a routine that can be commented with the full gory details explaining the syntax.

Some languages contain 'write-once, read never' syntax, like regular expressions in Perl, and it's good practice to recognise these constructs and take time to document them at the time of writing. Perl has a special method of allowing you to place comments inside regular expressions. There's good mileage in using it.

Simplicity is important when choosing algorithms too. Convoluted algorithms can be hard to recognise because you are often too close to the code, and by the time you have it working, you understand the complexity. The code just doesn't seem complicated because you have mastered it. Human inertia also sets in. Once you have created something complex, it's not easy to contemplate throwing all that work away in favour of something smaller, clearer, and hopefully simpler. I think that you need experience to help you judge how complex some specific design is likely to be, so that all the extra work is not done in the first place. The big question – 'Is there a simpler way?' – needs to be uppermost in the mind at the design stage.

When choosing data storage, it's a good idea to pick on one form of data structure and stick with it for the entire program. For example, if you want to use linked lists, then don't mix singly linked lists with doubly linked lists. Pick a data representation, and write or acquire a set of access routines that perform primitive operations on that structure. Make sure that you cannot bypass the access routines, if you are tempted to do that then your primitive set of operations are incorrect. Should the need arise, you can then replace the access code with some more complex routines later.

Simplicity is not aided by over commenting. Never comment syntax:

```
j++; /* add 1 to j */
```

This helps no one; hopefully, they can read the code themselves.

I tend to comment each routine with brief statement saying what the routine does, and what it returns. I don't tend to insert inline comments, except where there is something that's counter-intuitive or something that might be taken as 'over coding':

```
if (p == NULL) { /* defensive check */
```

Looking at my code, I do tend to add comments that are thinking noises as I am creating it:

```
/*
 * we now have all the data loaded into
 * the table, scan through and process it
 */
```

All programmers need KISS to be tattooed on the fingers of both hands.

Make programs read from top to bottom

When I started programming, you banged your cards into the system and out came a chunk of printer paper. On the last sheet were the results, or more likely the error messages from the compiler. You tended then to look backwards in the fan of paper for the program so you could fix it. When programming in Algol, routines had to be defined before they were used and it didn't matter too much because you were working backwards through a wodge of paper.

When I switched to using online systems in the late-70s, I was programming in C, and you tended to write programs so that the main



part was at the start of the file followed by supporting routines in order of use. At the end of the file, you placed the basic support routines. Early C didn't check routine arguments, so you didn't need to have forward declaration using function prototypes to ensure that the checking worked.

This ordering makes sense when using editors. It displays the program in 'top down' format, so it's clear what is happening. Related routines are grouped together, so you should be able to read downwards and find how things work. These days, if I am writing a suite of programs, I'll hive off the support routines into a separate library, but I keep related routines in one file. For example, all the routines that relate to memory management will be together. At the start of such a file, I tend to write comments that document the routines, so you don't have to go very far to find out what routines do, how to call them, and what they return.

C now checks function arguments, insisting on function prototypes, and this is done so that you can deal with your program in a top down fashion. I personally find it disconcerting when I run across programs that are written 'upside-down'.

Program for the need to know

When you look at someone else's code with a view to changing it (and remember, that someone else can be you), then you really don't want to have to understand how it all works before you make the change. The code needs to be written with the 'need to know' in mind. After all, this is what happens with library routines. We rarely know nor care how library routines work, we just call them.

To make a change to an unfamiliar program, you'll need to scan all the code to understand how it hangs together. You shouldn't need to know how it all works. Identifying the code that needs changing should be simple when the program consists of well-documented interfaces to modules, whether those modules are routines or classes. When you make a change, beware of adding new code that creates complexity. For example, there's often a temptation to bend old code to new ends, which can often significantly add to the overall complexity.

The need to know extends to the side effects of code too. Routines with side effects should be avoided or at least, their side effects should

be clearly commented. For years, I've avoided using global data because global variables are one of the most used ways of obtaining a side effect from a routine. I'll tend to pass things that routines need as parameters.

If a routine has all external data passed into it by parameters, then when you look at the code you can see what variables the routine is using. Parameterising routines also makes them easier to test. They become self-contained entities that require no global state.

Make routines do one thing well

Comprehensible programs consist of sets of small routines each performing one simple task. The task should be able to be encapsulated in a simple comment line or two. Routines should always hide some part of the operation from the rest of the code, providing a toolkit that makes the rest of the code simpler.

There's often a great temptation to place several sets of operations into one routine. It's very common to see routines sprinkled with print statements, as the data is processed and the output generated. It's sometimes much easier to create code like this, inter-mixing complex processing and output. However, this coding style leads to complexity, making it very hard to change safely. The most common change to any program is an alteration to its output format, and sometimes you will need to change only one or two characters in a format string, but finding those characters can be hard. Worse, the characters often occur in several places, where the result is computed under different conditions.

Things are much clearer if the program calculates the results or some coherent part of the results in one well-defined routine and prints its answers using another dedicated output routine. Initial coding may be slightly lengthier, because of the need to store partial results. But when the program is mature, having been hacked by several pairs of hands, it will hopefully be considerably less messed up with conditionals and `#ifdefs` as each programmer makes their own defensive change to the code.

Of course, getting more than one result from a routine can be complex. Traditional programming languages don't allow you to say:

```
(key, value) = doit(stptr);
linefmt(key, value);
```

Where the routine `doit` processes the string pointed to by `stptr` and returns two values that are then passed into the output routine. In principle, the above code works in Perl, although you'd have to add some dollars before the variable names to tell Perl their types.

Things are a little harder in C. Maybe you would pass pointers to `key` and `value` into `doit`:

```
doit(stptr, &key, &value);
```

Maybe you would define a structure that holds the results and pass that back.

Separate control and execution

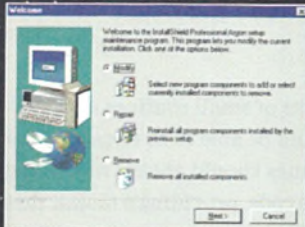
Lots of coding uses a loop of some form to scan sets of data and process them one at a time. I nearly always place the loop in one routine, and call other routines from inside the loop to do the work of processing one instance of the data. Actually, I also use this technique at the start of a program. If my program decodes arguments and then processes several files, then the `main` section just decodes the arguments and creates a processing loop, calling a routine (often called `process`) to do the work of the program on each of the input files.

In general, separating control from execution adds greatly to program clarity. It allows the entire loop to be seen and understood. It's



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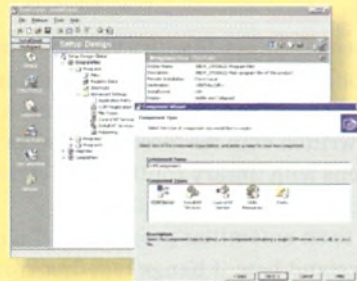
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part of the need to know principle; when looking at how the loop works, you don't really care what processing is being done on the data. It also allows the separate testing of the processing code on a single instance of the data that's being looped over, and this can be a win when using a debugger.

It can also simplify control of the loop for error testing. The processing routines are induced to return a value on success or any errors, and the value can be tested to see what happened.

Of course, I don't do this if the processing that's required in the loop is only a few lines, but separating control of actions from the actions themselves makes the code considerably more comprehensible.

Use meaningful names

I guess that this one should go without saying, but I find that names continue to be a problem when I look at other people's code. Names in early programming languages were restricted in length, really to allow their compilers to build symbol tables more easily. The restriction has been lifted in most languages, and names have often become too long. There are two main schools of thought, the underliners (`a_long_name`) and the capitalisers (`aLongName`). I tend towards being an underliner, because this was how the original Unix system was created. I expect that the choice of name type is a religious issue. The main thing is that when changing someone else's code, you should go with the flow.

Fundamentally, as long as the name conveys meaning about what the variable represents, then I am happy. Some people believe that names should indicate their type, so you don't have to find the definition of a name to discover what it's supposed to do. I am not too convinced by the need for this if the code is written in small chunks – the declaration of a name should be within screen scrolling distance of the code that uses it.

Some companies have programming standards for names. However, rules will need quality control. Aeons ago, when I was a student, I remember working as a programmer for a major bank in central London that had a standard for Cobol names. This is needed. The namespace is flat. The standard was to use a letter to indicate the division that the variable was declared, a number to make it unique, all followed by something to make it meaningful. The meaningful bit tended to get dropped, and the code was littered with temporary working variables called `W3458` and the like. These were untouchable, because no one really knew what they did.

Don't constrain by size

Most early programs on Unix were written to fit into the 32 KB-word data space afforded by the PDP-11. Initially, Unix systems swapped programs in and out of memory, and programs needed to be completely resident to run. Most early DOS programs were constrained by the dreadful segmented architecture supported by the Intel chips. The PDP-11 designers had more excuse than the Intel chip designers, who surely knew that the majority of programs that would be written for the architecture would be in a high-level language (and that language would probably be C).

Anyway, the early Unix programmers tended to burn fixed length sizes into their code. Buffers are often `BUFSIZ` bytes long (a constant in `stdio.h`, 1 KB on early systems and often 8 KB now). Arrays of structures were statically compiled into the program, because it was easy, and because it was known that you couldn't get any more memory. And because the system swapped whole programs in and out, it was not good to have the program grow too much. When a program grew in size, it would possibly be necessary to swap it out and then

The code was
littered with
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`W3458` and the like.



These were untouchable, because no one
really knew what they did.

bring it back in again with its new size so that it would be positioned correctly in memory. It was more efficient to stake a claim to some maximum limit at program load time.

On Unix, most of the restrictions placed on programs because of fixed length structures have gone away with time, since all Unix systems now have paged virtual memory. The buffer size limits tend to remain; many programs still assume that a complete text line will fit into `BUFSIZ` bytes. Many GNU programs don't make this assumption, and can deal with arbitrarily long text lines.

All of the production programs I have written for the last 10 years or so have dynamically allocated the memory space used for structure storage. If I want to read 1,000 lines into memory, I'll do that a line at a time, reading each line into a variable length string, and storing a pointer to the string in a variable length array of pointers. For efficiency, I'll probably allocate the pointer array in chunks of lines. Sometimes I'll map the original file into memory using the `mmap` system call.

Dynamic allocation makes considerable sense, since in the final analysis the program is then constrained only by the limits that the kernel has established for user code. And programs tend to fail more cleanly. People didn't expect to run out of memory when they compiled in static 'immense' data structures. This expectation was always incorrect, and often tables overflowed giving rise to unpredictable effects.

Test, test, and test again

Testing is something that I tend to do as I go along with most of the programs that I write. I'll write a bit, then test a bit. This is a reasonably good strategy for eliminating the stupid bugs that creep in due to typos and muddled thinking.

What's interesting when testing is what happens at the boundary conditions. Will a program terminate gracefully if it has no data? Will a routine fail gracefully when it runs out of memory?

On a recent largish project I was engaged in, I supplied all the library routines in their separate files with a `main` section that was compiled in using a test build (`#ifdef STANDALONE`). I then created some tests in the `main` section to check that the module behaved sensibly. Not only does this technique allow testing of each module of the program, but it also provides for regression testing if the program fails for some reason and the code needs changing. It's worth spending time to get this going. It saves oodles of time later when things are altered. It was helpful when I moved the code from Unix to the Windows NT platform; by then I was happy that my code was okay, but was less happy that the Windows equivalent system routines would work as I expected. They did (mostly).

I also like to single-step through code using a debugger and check that it's behaving sensibly. This is a good way to check that pointers are not broken and strings hold correct values, etc.



People don't seem to worry too much about making things run more quickly. Sadly, it's this

attitude that produces systems that make you wait; all those inefficiencies add up.

Make it work, then optimise

When I started programming, machine cycles were relatively scarce and making code run quickly was very important. Especially when the code was going to be used in some part of the system that was time-critical or was going to be used *many* times. I suppose that cycles are not so scarce today, and are certainly considerably shorter than they were. People don't seem to worry too much about making things run more quickly. Sadly, it's this attitude that produces systems that make you wait; all those inefficiencies add up.

Personally, I still like to worry a little about execution speed. It's a habit that dies hard. However, I haven't profiled a program for

some time. I think that once a program is working, there's mileage in looking at the general code clarity and adding or changing things that will help you to understand what is happening when you return to change it.

If anything can go wrong, it will

Finally, my code is always defensive. I always test results from routines that apparently never fail. I rarely use an `if` without an `else`. I always have a default in a `switch` statement. I tend to check that pointers are non-null. The list goes on. I confess that I am sometimes at a loss about how to report these errors – I tend to make the program die with some error message. The first routine I write in any new program is:

```
void error(char *fmt, ...)
```

and the second is:

```
void fatal(char *fmt, ...)
```

which calls `error` and dies.

Sometimes these checks are never triggered for the lifetime of the program. Sometimes odd things happen, and you are glad they are there. On the whole, changes in the general environment that alter the known basics of the world trigger odd things. Programs always live much longer than you think that they will, so defensive programming is probably a good thing. ■

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The dockside of loading packages

Why should you ever want to explicitly load and unload Delphi or C++Builder packages? Dave Jewell presents a variety of cases, which include rolling your own IDE experts.

Perhaps one of the most frequently asked Delphi/C++Builder programming questions I've ever heard is, "How can I dynamically load and unload packages from within my own program?" At first, this seems like a rather weird question to ask. After all, if you've written your application to use packages, then everything just ...uhh... happens. You decide what components and forms you want to put in a package (usually in order to share them with other programs in a suite of proprietary applications), create your DPL or BPL file, and off you go. One of the great things about Borland's implementation of VCL packages is that your application source code looks exactly the same whether you're using packages or not. It cunningly eliminated all the `LoadLibrary` and `GetProcAddress` nonsense that most Windows programmers have to put up with, making the use of packaged code completely transparent to the application programmer. You can even use variables that have been exported from a runtime package in a completely natural manner.

On the fly application enhancement

This being the case, why should you ever want to explicitly load and unload packages? Why not let the runtime library take care of everything? Actually, there are plenty of interesting reasons for doing this sort of thing. You might, for example, want to release a shareware application that has its functionality restricted in some way. Registered users could download an additional package from a website (hint: put the package in an encrypted ZIP file and email the password to the users!) which, when placed into the same directory as the shareware program, would make additional functionality available. From an anti-cracking point of view, this is a more secure proposition than including *all* the functionality of an application into the freely downloadable EXE file, and then using passwords or timeouts to limit that functionality. If those extra features aren't physically there, the cracker can hardly patch things to make them available!

Another good reason for explicitly loading packages is to allow you, the programmer, to create package twiddling utilities and IDE experts that wouldn't otherwise be possible. For the last few years, I've become increasingly less enthusiastic about the Delphi/C++Builder component palette. It works fine until you've got more than a dozen pages on the palette, after which your productivity goes down as you find yourself spending all your time needlessly searching through all the available pages for some specific component. How about writing a replacement component palette for the IDE? Perhaps this sounds a little unrealistic

right now, but when you look at the amazing things that the recently introduced CodeRush 4 does to the Delphi 4 IDE (see <http://www.eagle-software.com> for more details) perhaps it's not so far-fetched.

Loading your own packages

In this article, I'm going to look at several different scenarios that cover the loading and unloading of packages with known 'contents', packages with unknown contents, packages that contain forms, and packages that contain design-time and runtime components. I'll start off by looking at a very simple scenario whereby an application wants to load and invoke a specific form in a known package.

(Note: Unless otherwise stated, the various sample programs discussed in this article were all built with Delphi 3. However, you should be able to use these same techniques with C++Builder without any problems. Moreover, you must ensure that the 'Use Run-time packages' option is turned on. Things won't work unless you use this option.)

Take a look at Figure 1. This shows a small demo program, `ex1.exe` (the leftmost of the two forms), that has invoked an external form contained within a small external package, `extra.dpl`. The extra functionality in question corresponds to the form on the right – it simply paints random blue lines all over the form. In this particular case, the extra benefit to the user is pretty minimal (though it's more entertaining than a lot of TV commercials!), but of course, that's not really the point. The important thing is the way in which the application loads and invokes the code contained within the package.

I'll look at the 'packaged form' first, the code for which is given in Listing 1 (to save space, I've stripped out the usual form declaration stuff at the front of the file). As you can see, there's really nothing special going on here, with the exception of the call to `RegisterClass` as part of the unit's initialization clause; everything else is plain-vanilla stuff. This call to `RegisterClass` is actually crucial because of what we're doing. Normally, whenever a new form is loaded, the Delphi runtime library calls `RegisterClass` to register the form's class in the list of classes maintained within the `ClassList` variable (see `classes.pas` for more information). However, when the form is external to the application, and when the package is explicitly loaded in the way I'm discussing here, you have to make sure that `RegisterClass` gets called. We'll see exactly why this is necessary later.

Listing 2 is considerably more interesting. This is the source code to the application that actually loads the package and makes use of it.



Everything happens in the Load button's `OnClick` event handler where you'll notice that the first thing I do is check for the presence of the wanted DPL file. If you were using external DPL or BPL files to give extra functionality to a program, you wouldn't want the user to go through some complex setup process. The simplest option is simply to check for the presence of the package file in the same directory as the application itself.

Once I've verified the existence of the package, I call the `LoadPackage` routine, which loads the package, maps it into the address space of the calling process, and verifies that there are no duplicated units shared between the application and package. At the same time, the `LoadPackage` routine invokes another routine called `Initialize`, which is exported by the package. This has the effect of calling the initialization clauses of all the units that are contained within the package. And of course, this is a very important point: it means that – in the case of Listing 1 – the `RegisterClass` routine will be called at this point, adding `TExtraForm` to the list of registered classes.

Because this has just happened, the application program can then immediately call `GetClass`, passing it the name of the wanted form class. This retrieves a `TComponentClass` pointer, which is a reference to the class, not a reference to an instantiated object. Finally, the form is created by invoking the `Create` method of the class. Once you've got a live form, you can make it visible, call `ShowModal` to execute it as a modal dialog, and basically do all the usual stuff that one does with a Delphi form!

Cleaning up is a somewhat more complex process. In fact, part of the code in the `FormDestroy` routine (Listing 2) has been shamelessly plagiarised from the `UnRegisterModuleClasses` routine (see `classes.pas`). It uses the `APIVirtualQuery` routine to scan all components in the application, searching for components that have been implemented in the loaded package, rather than in the host application. If any such component is found, then it's deleted. This is very important because the 'guest form' might, for example, contain one or more custom components whose implementation is contained within the loaded package. If the package were unloaded while those components were still active, deeply bad things would happen when it came time for those components to call their own overloaded destructors, or, for that matter, any other methods whose code is located in a package that ain't there any more! This initial step isn't strictly necessary in the case of this simple example program, but would be very important with a more complex example.

Once this preliminary cleanup step has been done, the code then calls the aforementioned `UnRegisterModuleClasses` routine in `classes.pas`. This reverses the effect of the earlier `RegisterClass` call, and the package can then be safely unloaded at this point. The complete source code and executables are included in the file `example1.zip`, which you can find within the ZIP file relating to this article on EXE OnLine, and also in the EXE conference on Cix.

Although I placed this package unloading code inside the `FormDestroy` handler of the host program, I don't want to give the impression that a package can only be unloaded when the host program exits – that's not true. In fact, the package can be unloaded at any time – you could just as easily have a Load and an Unload button on the main form. I've also included another, slightly tweaked, example to illustrate this in the file `example2.zip`. Notice that this code checks (from the `FormDestroy` handler) that the package has been unloaded, and if it hasn't been, it makes darn sure that it is! As pointed out earlier, this is essential if you don't want to end up with a GPF.

If you play around with the second example, you'll notice an unfortunate shortcoming of this simple approach. If you load multiple instances of the packaged form, and then click the Unload button, you'll find that not only do all the active forms get unloaded, but it then becomes impossible to load them again. If you wanted to implement multiple instances properly, a better solution would be to implement some sort of reference counting scheme so that – for example – the low-level `LoadLibrary` and `FreeLibrary` routines only get called when necessary.

Getting a handle on the ClassList

So far, I've only looked at the case where the application already knows what forms are present in the external package. In terms of adding extra functionality to applications you've written, this is likely to be all that's needed. However, it would also be instructive to explore the situation where an application is presented with a package that contains one or more unknown forms. How can an application program-matically determine what forms are contained within a package?

The simple answer here would be to use the `EnumResourceNames` API routine to enumerate all the resources in the package of type `RT_RCDATA`. For each resource found, you could check the first four bytes to see if they're equal to `FileSignature`, as defined in the `classes.pas` file. If so, then you know that you're dealing with a form resource. However, there's a problem with this approach; a particular package might contain (say) five form resources, but only three of them are meant to be invoked externally, the other two being for internal use within the package. How does one discriminate between the two? The short answer is that one doesn't, at least not using this approach.

A better technique would be to rely upon the fact that the classes of externally callable forms must be registered using `RegisterClass` as I've already described. If you could somehow 'hook' into the `RegisterClass` routine, then it would be possible to 'watch' which classes were being registered as a result of the call to `LoadPackage`. Unfortunately, this approach won't work either because the `ClassList` variable (defined within `classes.pas`) is only defined in the implementation part of the unit. Moreover, the various routines that operate on this `TList` object do not allow us to enumerate its contents, making it impossible to determine what has been added to the list by a call to `LoadPackage`. Time to call for Captain Hackomatic...

As my entry for 'Delphi Hack of the Millennium Award', I present the code in Listing 3. As the name suggests, this routine, `GetClassList`, uses some rather dirty trickery to track down the hidden `ClassList` variable, within the `CLASSES` unit, returning a pointer to the object. Although you will no doubt recoil in horror at this code (I recoiled too, but I just could-



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```

unit ExtraFunctionality;

{ ... usual stuff stripped for the sake of brevity ... }

procedure TExtraForm.OKButtonClick (Sender: TObject);
begin
  Close;
end;

procedure TExtraForm.Timer1Timer(Sender: TObject);
begin
  with PaintBox do Canvas.LineTo (Random (Width) ,
                                   Random (Height));
end;

procedure TExtraForm.FormCreate(Sender: TObject);
begin
  PaintBox.Canvas.Pen.Color := clBlue;
  PaintBox.Canvas.Pen.Width := 4;
end;

initialization
  RegisterClass (TExtraForm);
end.

```

Listing 1 – The 'packaged form'.

```

unit Ex1App;

interface

uses
  Windows, SysUtils, Classes, Forms, StdCtrls, Controls;

type
  TMainForm = class(TForm)
    LoadBtn: TButton;
    procedure LoadBtnClick (Sender: TObject);
    procedure FormDestroy(Sender: TObject);
  private
    { Private declarations }
    hMod: HModule;
  public
    { Public declarations }
  end;

var
  MainForm: TMainForm;

implementation

($R *.DFM)

const
  PackageName = 'Extra.dpl';
  FormName    = 'TExtraForm';

procedure TMainForm.LoadBtnClick (Sender: TObject);
var
  Form: TCustomForm;
  FormClass: TComponentClass;
begin
  if FileExists (PackageName) then begin
    hMod := LoadPackage (PackageName);
    FormClass := TComponentClass (GetClass (FormName));
    if FormClass <> Nil then begin
      Form := TCustomForm (FormClass.Create (Application));
      Form.Visible := True;
    end;
  end;
end;

procedure TMainForm.FormDestroy (Sender: TObject);
var
  Idx: Integer;
  M: TMemoryBasicInformation;
begin
  if hMod <> 0 then begin
    for Idx := Application.ComponentCount - 1 downto 0 do
    begin
      VirtualQuery (GetClass (Application.Components
                             [Idx].ClassName), M, sizeof (M));
      if HModule (M.AllocationBase) = hMod then
        Application.Components [Idx].Free;
    end;

    UnRegisterModuleClasses (hMod);
    UnLoadPackage (hMod);
    hMod := 0;
  end;
end;

end.

```

Listing 2 – Loading the package and making use of it.

n't help myself...) I should point out that I've tested it with Delphi 3, Delphi 4, and with a late beta of Delphi 5, and it works fine in all cases. Moreover, the code is written in such a way that it will return a pointer to the class list irrespective of whether or not you build your program with run-time packages, meaning that this little routine will be useful in situations other than the package-loading scenarios discussed in this article.

Putting all this together, take a look at Figure 2, which shows version 3 of our package-loading demo program. Clicking the Load button will fill the list-box with the names of all the classes (hopefully, form classes!) registered by the external package. Once you've done that, you can then double-click the class name of your choice in the list-box, and the corresponding form will be created. Just to illustrate the point, I've added another demo form to the *extra.dpl* package, this time sporting thin green lines instead of thick blue ones – absolutely no expense spared here, you know!

When you click the Unload button, all the objects and classes supplied by the external package will be released, and the list-box will be updated to reflect the point. Listing 4 is a partial listing of the code that's involved here. As you can see, clicking the Load button calls *LoadPackage* as discussed previously, but this time merely invokes *UpdateClassList* to show the class names registered by the package. Within *UpdateClassList*, I use the *ClassList* variable (same name as the private variable within the *CLASSES* unit, and initialised in the *FormCreate* routine) to iterate through the list of registered classes, finding all the classes that belong to the package and adding them to the list-box. (Once more, I use the *VirtualQuery* trick to determine 'ownership' of a particular class.) Finally, the *ListBox1DbClick* routine is invoked when a class name is double-clicked, using the class reference to create an instance of the class as described earlier.

Needless to say, there are many other issues to be considered when extending the functionality of an application in this way. How does the program extension obtain configuration information from the application, and how does it pass data back to the host program? This is a subject that I don't plan to cover here, but you could do worse than follow Borland's example in the design of the *libintf.pas* module. You may know that *LIBINTF* contains a number of different interfaces, each of which is implemented as a descendant of *TInterface*. Both the host and the extension package see a unit that defines an abstract programming interface, and the host application provides a concrete implementation of this interface that is usable by the add-in package. Another solution is to use COM, as Borland has done in more recent versions of its Open Tools API.

Accessing packaged components

This is all great fun of course, but what makes packages *really* interesting is the ability to load up an arbitrary package and access and use the components contained therein. If you think about it, this is exactly what the Delphi IDE does when presented with a new package. In the remainder of this article, I'll discuss some of the techniques used by the IDE and show how you can access packages in the same manner.

But first, a word about runtime versus design-time packages. As you are no doubt aware, Delphi gives you the option of creating packages that can be used at design-time from within the IDE and runtime-only packages that cannot be used within the IDE. The whole point of a runtime package is that it provides a mechanism for deploying one or more components (as part of your application) in such a way that the component can't be 'hijacked' by other software developers and used in their own applications without actually having to pay for them.

Unfortunately, the distinction between runtime packages and design-time packages has been implemented in a relatively weak

manner – it's really just a matter of setting a couple of bits in the PACKAGEINFO resource that's created as part of the package file. Moreover, it's only the IDE that actively enforces the distinction between the two different types of package. In other words, when you try and load a runtime-only package in the IDE, Delphi will stop you from doing so, but there's absolutely nothing to prevent you from loading and manipulating a design-time-only package from some other application. I mention this here because – inevitably – the techniques I'm describing will allow some folks to do ...umm... creative things with the components in a design-time-only package. I want to stress that this isn't my intention, and the code presented here is intended to further the development of legitimate IDE add-in experts and the like.

```
function GetClassList: TList;
var
  pb: PByte;
  Idx: Integer;
  pl: PLongint absolute pb;
begin
  ( Abandon hope, all ye who enter here.... )
  Result := Nil;
  pb := @Classes.GetClass;
  if pb^ = 255 then begin
    // Built with runtime packages, so need to indirect via
    jumpable!
    Inc (pb, 2); pl := Pointer (pl^); pl := Pointer (pl^);
  end;
  for Idx := 0 to 20 do begin
    if pb^ = $A1 then begin
      Inc (pb); pl := Pointer (pl^);
      Result := Pointer (pl^); Exit;
    end;
    Inc (pb);
  end;
end;
```

Listing 3 – 'Delphi Hack of the Millennium'.

```
procedure TMainForm.UpdateClassList;
var
  Idx: Integer;
  KlassName: String;
  Klass: TPersistentClass;
  M: TMemoryBasicInformation;
begin
  ListBox1.Clear;
  for Idx := 0 to ClassList.Count - 1 do begin
    Klass := ClassList [Idx]; KlassName := Klass.ClassName;
    VirtualQuery (Klass, M, sizeof (M));
    if HModule (M.AllocationBase) = hMod then
      ListBox1.Items.Add (KlassName);
  end;
end;

procedure TMainForm.LoadBtnClick(Sender: TObject);
begin
  if FileExists (PackageName) then begin
    hMod := LoadPackage (PackageName);
    if hMod <> 0 then UpdateClassList;
  end;
end;

procedure TMainForm.FormCreate(Sender: TObject);
begin
  ClassList := GetClassList;
end;

procedure TMainForm.ListBox1DbClick(Sender: TObject);
var
  Form: TCustomForm;
  FormClass: TComponentClass;
begin
  with ListBox1 do if ItemIndex <> -1 then begin
    FormClass := TComponentClass (
      GetClass (Items [ItemIndex]));
    if FormClass <> Nil then begin
      Form := TCustomForm (FormClass.Create (Application));
      Form.Visible := True;
    end;
  end;
end;
```

Listing 4 – Version 3 of our package-loading demo.

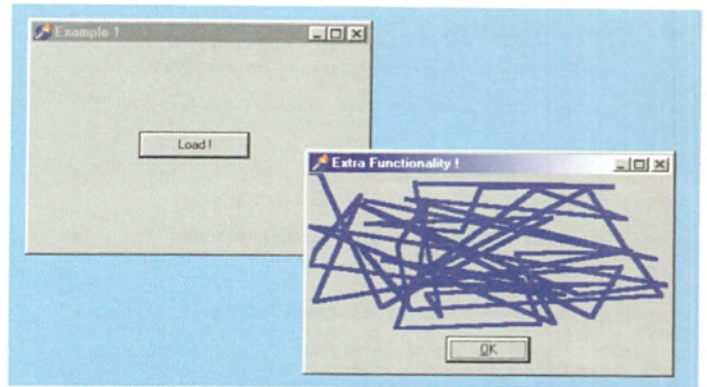


Figure 1 – Here's a simple demonstration of how you can use packages to add extra functionality (though in this case, not much!) to an application through the use of packages. The 'scribble' form is in a separate package, apart from the main application.

Having said that, I obviously needed a 'sacrificial' package to play with – preferably one containing an assortment of components – and I decided to use the excellent IPWorks package (<http://www.devsoft.com>) for the purpose of my fiendish experiments. Sorry, guys, but it's nothing personal. Obviously, you will want to experiment with whatever packages you've got to hand...

First, take a look at Figure 3. This shows my little 'Package Inspector' utility in operation. On the left is a list-box that shows all the units that have been found within the package. To the right of that is a list of class names corresponding to all the Delphi components that are registered by this particular package. Finally, the image on the right shows the palette bitmap (if any) that corresponds to the currently selected component in the second list-box.

Listing 5 shows an (abbreviated) listing of the code that's required to do this. As ever, full source code is included on EXE OnLine and on Cix, this example being located in the example4.zip archive. The package is loaded in the usual way by making a call to LoadPackage within the FormCreate event handler. Once this is done, the first priority is to determine which units are contained within the package. In the past, I've referred to the PACKAGEINFO resource (part of the DPL or BPL file) that encapsulates which units have been used to create the package. In principle, one could explicitly load this package and parse it on a byte-by-byte basis. However, a much neater idea is to let the VCL library take the strain by making use of a routine called GetPackageInfo, located within the SYSUTILS unit. This GetPackageInfo takes a standard API-level module handle (returned from the call to LoadPackage), together with a pointer to an enumeration routine, and enumerates both the units contained within the package and the additional packages that are required by the package being examined. (In this simple demo program, I haven't concerned myself with the case where a package requires one or more other packages. The IDE, however, essentially builds a tree of dependencies for each package.)

For each contained unit, or required package, the MyPackageInfoProc routine is called, using the NameType argument to discriminate between the two cases. If it's a contained unit, then the name of the unit is added to the Contains list-box.

Time to register an interest...

Okay, so you know what units are contained within a package. But what registered components are contained inside those units? The answer is none! At least, there won't be any registered components until you've registered them! You may remember that when I first mentioned the LoadPackage routine, I stated that this routine auto-



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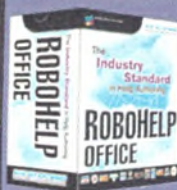
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matically called the initialization clauses of all the units contained in the package being loaded. However, there's still the question of the `Register` routine, which must be present in each unit that wants to register one or more reusable components.

From the perspective of a component writer, you've probably written dozens of `Register` routines, placing the needed call to `RegisterComponents` inside each one. Maybe you haven't worried too much about what it is that gets to call the `Register` routine, and when it happens? The fact is that there's nothing magical about the `Register` routine; someone, somewhere has to write the code to explicitly call it! When your package is loaded inside the IDE, code within the IDE searches each contained unit within the new package, looking for `Register` routines. If it finds one, then it calls it. It's as simple as that.

Okay, I lied; it's not *quite* that simple. When you build a package with Delphi 3, each of the various `Register` routines within each unit ends up as an entry that's exported from the DLL. So far so good. But the actual name of this exported routine actually looks something like this:

```
MyUnit.Register@51F89FF7
```

This might look like somebody's email address (well, Microsoft Word certainly thought it was, when I typed it in a moment ago) but it isn't. The first part of the exported name corresponds to the name of the

unit (in this case, `MyUnit`) followed by a period, the name of the `Register` procedure itself, and then a certain amount of gobbledegook that is used internally by Delphi to perform version checking. Although this looks like a random number, it's totally deterministic, provided that you're using the Delphi 3 compiler.

With this in mind, you should be able to understand what's happen-

ing inside the `FormCreate` routine in Listing 5. Having loaded the wanted package, the code steps through each of the units found within the package, generating a registration procedure name in the form shown above. It then uses the familiar `GetProcAddress` routine to retrieve the address of this procedure and executes it in order to register any components that may be contained within that unit.

Unfortunately, there's another little wrinkle here. In Delphi 4 and Delphi 5, Borland wanted to improve package compatibility with C++Builder. Accordingly, it changed these all-important exported `Register` routines to use the same name-mangling conventions that would be generated by a C++ compiler. Thus, the `MyUnit.Register` example above changes to become:

```
@MyUnit@Register$qqrv
```

Once again, this tells us that `Register` belongs to `MyUnit`, as you'd expect. I haven't catered for this C++ name-mangled version of the routine in my code, but the changes required are trivial. On the



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

type
  TForm1 = class(TForm)
    Contains: TListBox;
    Label1: TLabel;
    RegClassList: TListBox;
    Label2: TLabel;
    Panel1: TPanel;
    Image1: TImage;
    Label3: TLabel;
    procedure FormCreate(Sender: TObject);
    procedure FormDestroy(Sender: TObject);
    procedure RegClassListClick(Sender: TObject);
  private
    { Private declarations }
    hMod: HModule;
    ClassList: TList;
  public
    { Public declarations }
  end;

var
  Form1: TForm1;

implementation

{$R *.DFM}

procedure MyPackageInfoProc (const Name: string;
  NameType: TNameType; Flags: Byte; Param: Pointer);
var
  Self: TForm1 absolute Param;
begin
  if NameType = ntContainsUnit then
    Self.Contains.Items.Add (Name);
end;

procedure MyRegisterComponentsProc (const Page: string;
  ComponentClasses: array of TComponentClass);
var
  Idx: Integer;
begin
  for Idx := Low (ComponentClasses) to High (ComponentClasses)
  do
    Form1.RegClassList.Items.AddObject (
      ComponentClasses [Idx].ClassName,
      TObject (ComponentClasses [Idx]));
end;

procedure TForm1.FormCreate(Sender: TObject);
var
  Idx: Integer;
  RegProc: Procedure;
  RegisterProcName: String;
begin
  ClassList := GetClassList;

  // First, "subclass" the RegisterComponents procedure
  @RegisterComponentsProc := @MyRegisterComponentsProc;

  // Now, load the package we're interested in
  hMod := LoadPackage ('ipworks.dpl');
  if hMod <> 0 then begin
    Contains.Clear;
    GetPackageInfo (hMod, Self, Idx, MyPackageInfoProc);
  end;

  // Now, try and register each unit we've found
  for Idx := 0 to Contains.Items.Count - 1 do begin
    RegisterProcName := Contains.Items [Idx] +
      '.Register@51F89FF7';
    @RegProc := GetProcAddress (hMod, PChar (RegisterProcName));
    if Assigned (RegProc) then RegProc;
  end;
end;

procedure TForm1.RegClassListClick(Sender: TObject);
var
  Bmp: TBitmap;
  ResName: String;
begin
  with RegClassList do if ItemIndex <> -1 then begin
    ResName := TComponentClass (
      RegClassList.Items.Objects [ItemIndex]).ClassName;
    Bmp := TBitmap.Create;
    try
      Bmp.LoadFromResourceName (hMod, ResName);
    except
      Bmp.Width := 28; Bmp.Height := 28;
      Bmp.Canvas.Brush.Color := clBtnFace;
      Bmp.Canvas.FillRect (Rect (0, 0, Bmp.Width,
        Bmp.Height));
    end;
    Image1.Picture.Assign (Bmp);
    finally
      Bmp.Free;
    end;
  end;
end;
end.
```

Listing 5—A little 'Package Inspector'.

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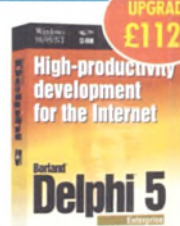


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assumption that you want to load Delphi and C++Builder packages without regard to version, the best bet would be to generate the old-style procedure name, calling `GetProcAddress` to see if it's there. If it isn't, then try the more recent, name-mangled form.

At this point, you know what units are in the package, and you also know how to register the components contained therein. But there's one final piece of the jigsaw remaining. Specifically, you don't know what components are contained within each unit. Here again, there's a simple trick that you can use.

Hooking the `RegisterComponents` routine

If you delve once more into the depths of the `CLASSES` unit, you might be surprised to discover that the `RegisterComponents` routine doesn't actually have any 'guts' to it. More specifically, it simply calls through a procedure hook called `RegisterComponentsProc`. What's going on here, and where is the code that actually performs component registration? The answer of course, is that it's inside the IDE. Normally, only the IDE needs to register components. Consequently, the IDE sets up the `RegisterComponentsProc` pointer to refer to the 'real' component registration routine within itself. This routine takes care of maintaining an internal data structure that the IDE uses to keep track of all the different components. If you were to try calling `RegisterComponents` within an ordinary application, you'd simply end up raising an `EComponentError` exception, as you can see from the source to the `RegisterComponents` routine.

From our perspective, we're trying to be a 'mini-IDE'. I want to know what components are registered by each unit, and so I need to come up with a 'real' implementation of the `RegisterComponents` routine to replace what's inside the IDE. Again, you can see how this is done by referring to Listing 5. When the `FormCreate` routine is executed, it simply sets the `RegisterComponentsProc` variable to point at `MyRegisterComponentsProc`. Within this routine, I iterate through all the supplied components, adding the name of each component to the `RegClassList` list-box along with a pointer to the actual type. Instead of saving a type pointer in the `Objects` array of the list-box, I could just as easily save the associated page name of the component palette. Because we don't actually have a palette, I've ignored this parameter!

Of course, using the `RegisterComponents` hook in this way only allows us to build a list of *all* the components contained within the



Figure 2 – Using some nefarious techniques to get hold of the internal class list, it's easy to build a list of all the registered forms contained within a package. Here, the package contains two separate forms, each of which can be instantiated by clicking its entry in the application list-box.

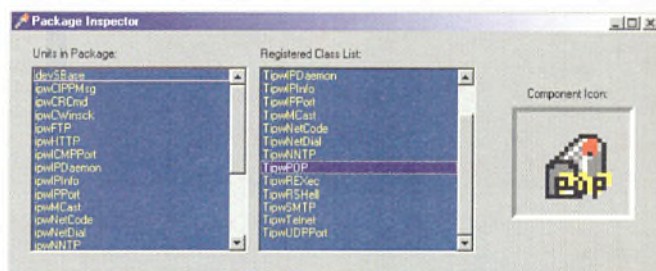


Figure 3 – Extending the techniques further, you can interrogate an unknown package to determine what units and components it contains, get the bitmap handle for each registered component, and of course create instances of those components in the usual way.

package. If you wanted to build a list of the components associated with each unit, that's pretty simple to do but requires a little more work. Within the `for` loop that calls the registration procedure for each unit, you'd simply set up some global variable immediately before calling the unit registration procedure. This variable might, for example be a string naming the current unit, and would be examined from within the `RegisterComponents` hook routine, allowing the enclosing unit name to be determined.

(Note: For the technically curious, this is pretty much what happens within the actual IDE. Firstly, a new object of type `TRegModule` is created, and then, within the call to `RegisterComponents`, any registered classes are added to that instance of `TRegModule`. When the next unit is registered, a new instance of `TRegModule` is created, and so on.)

For the sake of completeness, my little demo program also retrieves the bitmap associated with the currently selected component. This is very easy to do because component bitmaps are always stored in the package with the same name as the associated component. Thus, a component called `TSuperListBox` would have an `rt_Bitmap` resource of the same name. Once you've created a `TBitmap` object, you can simply retrieve the bitmap through a single call to the `LoadFromResourceName` method.

The magic of an IDE

In this article, I've discussed how to use packages to add functionality to your own applications, described a monumental hack that allows you to get at the private class list within the `CLASSES` unit, and spent some time looking at how the IDE works its magic when accessing the contents of design-time packages. It's important to appreciate that what is design-time for you the programmer, is runtime from the IDE's perspective. To put it another way, the techniques used in this article could potentially be refined to the point where you could use design-time packages and components within your application, just as if they were fully fledged runtime packages. I hope you won't do that because, for one thing that would be rather naughty and – more importantly – I might get the blame! Rather, I hope that this article will give you some ideas for writing new and exciting Delphi/C++Builder add-ins of your own and – who knows – maybe even a replacement IDE!

Dave Jewell is a freelance consultant, programmer, and technical author specialising in low-level systems programming under Windows and DOS. He is the author of 'Instant Delphi' published by Wrox Press. You can contact Dave as djewell@cix.compulink.co.uk. **EXE ONLINE**

The value of embedded development

Embedded operating systems promise a rich seam for development. But where exactly is Microsoft going with Windows CE and NT Embedded?

Ian Murphy gives an overview of the market.

The use of embedded operating systems is almost as old as the use of computer controlled equipment yet it is only in the last four years that we have begun to see a consumerist approach to embedded devices. The traditional embedded device is something like a telephony switch that would contain a complete copy of an operating system rather than the cut down versions that we see today. The use of the term embedded was meant to indicate that you could not directly access the operating system: you needed to attach another device using a serial link or a network workstation.

Over the last few years we have seen an explosion of devices using embedded operating systems, and as well as the telephony and manufacturing markets, we have seen them enter the IT market. Typical devices here are in the security market with the growth of hardware firewalls that are beginning to replace many of the current software firewall solutions. For this class of product, it is important that the operating system is locked away from any access other than a strictly controlled set of applications using a secure connection.

Yet if you were to trawl through the press over the last year alone you might be surprised at the amount of attention that is being paid to the consumer market and embedded operating systems. There are several vendors and groups involved in this field, which shows an extremely healthy market with a lot of potential for developers and software houses of all sizes. Unfortunately, a lot of healthy competition does not indicate compatibility and the challenge for developers is deciding which of the vendors or consortia to back as the market takes off.

The relatively recent interest of Microsoft in this field, with Windows CE and NT Embedded, has raised the general level of attention, but some other companies from the traditional IT marketplace have already done a lot of work.

PalmOS

At present, the leader of this market is 3Com with its Palm offerings (formerly called PalmPilot). At the Windows CE Developer's Conference in Denver this year, a number of Microsoft people were admitting, openly, that 3Com had done to them as they had done to IBM during

the early PC operating system wars. 3Com set out to create a single reference platform and then built the operating system around it. They made developer kits readily available and encouraged developers to work with them. You simply need to go to <http://www.palm.com> and download the SDK of your choice. Support for developers extends to public training courses written and supported by 3Com, although getting places on these courses can be difficult due to demand.

Microsoft has also conceded that the number of applications for PalmOS far outstrips those available for the Windows CE platform (I will look at the primary reason for this later). The result is a market with an extremely large amount of readily available software. To hear Microsoft trashing this market in Denver by constantly repeating the mantra that many of these were shareware utilities that didn't really add up to much was extremely amusing. It appears that Microsoft has forgotten how often it has purchased the rights to utilities in order to incorporate them in its own software over the years.

Perhaps the biggest drawback for the Palm has been that development of the hardware platform has lagged behind that for CE devices. Products such as the Cassiopeia E-105 with high-performance graphics, 32 MB RAM, and video and audio playback leave the Palm looking a little dated. Yet there is an increasing number of games being developed for this platform and 3Com is determined not to allow itself to be bullied out of a market that it has done more than most to establish. All of this, however, presupposes that people are more concerned with seeing the platform as a grown-up's Game Boy rather than as a business platform. When you look at the Palm family from the latter perspective, it has been accepted by a large number of corporate buyers who see it as being ideal for business applications where a notebook would be overkill.

EPOC

Another player in this market is Symbian with the EPOC operating system. Key players in this consortium are Matsushita via Panasonic, Ericsson, Motorola, Nokia, and Psion. Because of its make-up, Symbian is very telephony focused. And as the key to the success of these devices is the 'use anywhere' argument, combining the telephony and



data in a single device simplifies the whole scenario, for both the user and the developer. During the design phase for EPOC a lot of attention was paid to the issue of platform compatibility. Whenever you have a range of different vendors developing their own hardware and using their preferred chipsets, you need to build an infrastructure to separate the application layer from the hardware.

Compare this to 3Com achieving its success by having a single reference platform and you can see the problems facing Symbian. As a result of careful planning, the operating system ships on classes of devices irrespective of the vendor of the device. At this level, the code is binary compatible across the board. The only time you will need to look at making changes is when you move, for example, from a Smart Phone to a Communicator. Each class has its own particular user interface components to support devices such as the screen. In this case, you would need to make changes to your code but you would then be able, once again, to enjoy code compatibility across different vendors.

There is little doubt that being seen as the key telephony solution is likely to enhance the appeal of EPOC and recently there have been several deals struck with telephony vendors in the Far East, such as Japan's NTT. This particular deal ensures that EPOC will have support for the next generation of telephony services in Japan. And with Ericsson and Nokia leading the way within Europe and the US on the issue of a single integrated telephony platform, EPOC developers are being presented with a huge market. Support for those developers, just as with 3Com, comes in the form of both freely available SDKs and access to significant technical information. Courses are run on a regular basis and are often fully booked months in advance.

The significance of the telephony platform has been given a boost with Microsoft announcing its support for mobile telephony systems (both for Windows 2000 and NT Embedded) despite earlier indicating that it thought the telephone a niche market for embedded solutions. This was further emphasised when Microsoft acquired UK software house STNC and gained access to its experience and knowledge of EPOC – it is an opportunity for Microsoft to extend its micro browser to another platform.

Elate

The Tao Group, has an embedded operating system called Elate, which is carving out a different path from its competitors. Tao works very closely with a number of OEMs, who create the reference platforms, and chipset vendors, who do the porting of Elate with technical assistance from Tao. Yet instead of simply flooding chipset and platform

vendors with another operating system, Tao have built an operating system that will standalone as well as sit on top of all the major operating systems, particularly Windows CE.

There are two key components for the Tao Group in achieving this: the Elate J-Engine and the Virtual Processor environment. The J-Engine is fully Personal Java-compliant and instead of using an interpreter it runs code natively, massively improving performance. Whether you like or dislike Java, it is here to stay and increasingly educational establishments are using it as a replacement for other languages in their computer science and software development courses. The Virtual Processor environment means that people who prefer to use C or C++ can compile their code to the VP assembly language and it will then run on any implementation of Elate.

Tao is marketing Elate for devices such as set-top boxes and digital televisions. However, it sees the need for digital cameras and other more common consumer electronic devices, such as CD players and Mini-Discs, to use an embedded operating system. Combine this with the ability to put Elate on top of Windows CE and then run the same Java application on every device and potentially you have a killer environment. Tao's clean room implementation of a high-speed Java engine gives them an edge compared to most other Sun-based implementations. With a sub-2 MB footprint, this provides size and speed in the same package.

At present, Elate has all of its key resources working with vendors to provide a range of devices for the market, although it is already running training courses at its premises near Reading, USA, and Asia. SDK availability will be announced in the near future and it is hoped that Tao will follow the lead of Symbian and 3Com by allowing free downloads of the SDK.

Windows NT Embedded

This finally brings us to Microsoft, which is shipping two different embedded solutions: NT Embedded (NT/E) and Windows CE.

Windows NT Embedded has a totally different approach. It is designed to allow you to create a highly optimised, single-application Windows NT 4.0 Server platform. When you install Windows NT, you often get a large number of components that are not required and which, in some cases, may actually provide other people with the opportunity to breach your security.

Microsoft has produced an SDK and a graphical platform builder (based on technology licensed from VenturCom) that does a validation check before attempting to build your platform. This is extremely important due to the way that Windows NT interdependencies operate. Unfortunately, this same technology has yet to filter through to the Windows CE platform builder, although it is to be hoped that by the time version 4 appears Microsoft will implement it. Three key features of NT Embedded are that the operating system can be reduced to a footprint of around 14 MB, it doesn't need a paging file on the boot device, and the operating system can be installed and run from a CD. This last point will catch the attention of corporate IT departments because it offers an exciting possibility to protect yourself from virus attacks at the operating system level.

There are three key areas for NT Embedded in its early adoption. The first is in the network firewall space. With the potential to remove unwanted components, it will provide OEMs with an interesting proposition. This is a perfect example of where the ability to run the operating system from a CD is of great interest. As mentioned, a read-only operating system cannot be modified and is therefore ideal for this purpose. The second area is likely to be in the telephony market, although this may really have to wait until the Windows 2000 version ships with the new built-in IP extensions. The third is inside vertical

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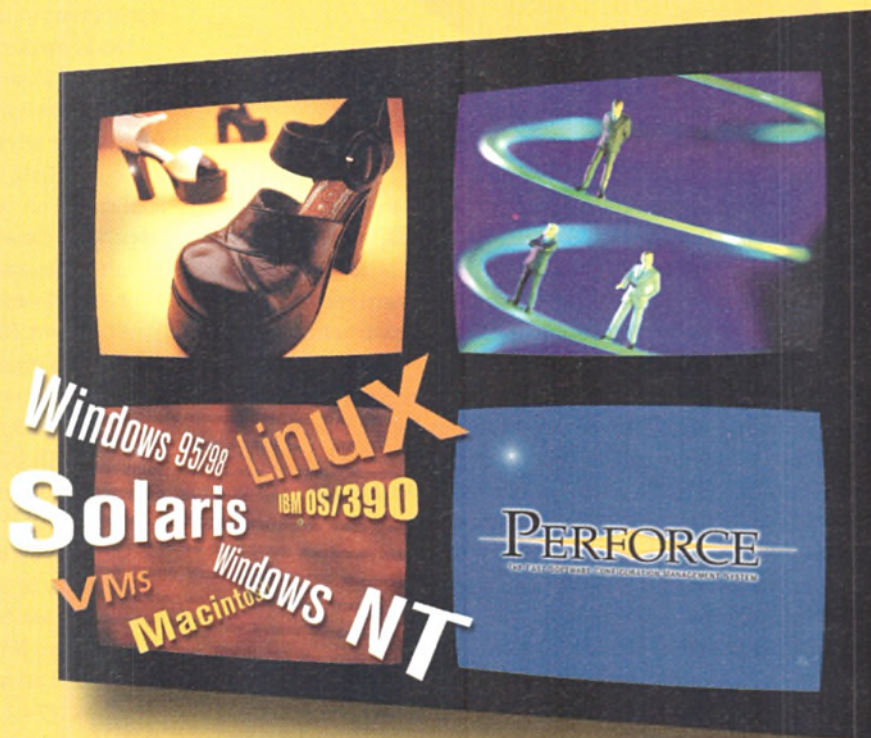
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market applications, such as the one designed by Radiant Systems (see *A point of sales example*).

What will not be permitted, say the NT Embedded team in Seattle, is corporate IT teams using NT Embedded to assist in the lock down of servers. Even if you don't actually strip anything out of the operating system, the simple ability to run from a CD is very attractive. Consider a server sitting in a remote user area or even a server exposed to a public interface; security is a nightmare. Here is an opportunity to minimise exposure and Microsoft is saying that you would be in breach of your

licence if you used NT Embedded in this way. Even if you make a build that doesn't contain certain unwanted components, you would still be unable to deploy it because of the way the licence is worded. However, at a press briefing at Euro Tech Ed in Amsterdam, Paul Maritz stated publicly that he believed this policy was wrong and that Microsoft would not impose any restrictions. It is to be hoped that he is right.

Unlike all the other operating systems I have mentioned, NT Embedded is not a multiple chipset offering. It will be restricted to the x86 platform only and there is not even a projected date for the

A point of sales example

An example of a vertical systems vendor is Radiant Systems, based in Atlanta, USA. They address several vertical markets such as fast food, service stations, and leisure and entertainment sites such as cinemas. Each of these markets has a common feature: point of sales (POS) systems. These systems are generally highly proprietary environments that lock retailers into a single-vendor solution (even OS/2 based POS systems include vendor specific code). Change any one component and you often have to change everything.

If Radiant Systems was going to be able to build applications for its vertical market customers, the first thing it needed to do was develop an architecture for its products. That architecture had to integrate with the chosen development platform, Windows CE, and as early adopters of this platform they found themselves writing a lot of code to provide services and functionality that were missing.

For one solution (service stations), as well as building its own network infrastructure Radiant had to incorporate a key partner, Tokheim, which manufactures fuel dispensers. As they were dealing with hazardous materials, they needed to have more than a simple level of control; they needed to be able to alert people to any dangerous condition and provide full support of standards for hazardous materials. They also had to interface to point of sale systems and highly specialised, proprietary credit card transaction systems. This last point meant that any new device that they supplied to a retailer could work with older systems, allowing a gradual upgrade of the entire POS environment.

In doing this, they discovered that they had to extend the Windows CE operating system and provide a complete set of APIs to interface with the proprietary systems. At the same time, they took the decision to open up their architecture to other companies who were involved in providing POS equipment and software solutions and register their patents on the architecture. This last area is something that UK software houses are particularly slow at identifying. As a result, it often means that they prove a technology yet fail to reap the benefits fully. The Tao Group takes a very similar approach to its development of products and this has proven very profitable for them.

The service station system uses Windows CE to control all the petrol pumps, the POS terminals, and any other system that is required. It provides a remote management capability and is designed to take advantage of some petroleum industry initiatives should they be adopted. At the heart of the system is a Windows CE-based server although it is likely that a computer running NT Embedded Server will soon replace it. Radiant writes its software for the CE platform and then ensures that it will run on NT Embedded.

When you talk to Radiant about its architecture, it is keen to point out how much was already there inside Windows CE. Working with specialised hardware devices where the timing was critical turned out to be easy because Windows CE was able to handle critical timings where the window was less than a couple of milliseconds. This contrasts to the crit-

icism often levelled at Microsoft from some of the RTOS (Real-time Operating System) vendors. The communication and networking components were also more than adequate for Radiant's needs and although the security layer is thin, there is SSL support.

One important thing that has worked for Radiant, and which is often overlooked, is how the platforms and applications were initially targeted. Radiant decided that it would concentrate on making all the applications run under Windows CE. This means that when it makes the move to an NT Embedded Server running each store, it will not have to make any changes to its code, other than to recompile for the change in processor. Jimmy Fortuna of Radiant Systems believes that this particular piece of planning has given Radiant a significant head start over its rivals and has allowed them to develop effectively for Windows CE. Fortuna also makes an important point about the advantage of embedded systems compared to developing for more flexible PC platforms:

'Another benefit is that it actually reduces cost to create the device as an embedded server appliance as opposed to PCs. The costs are not just in terms of acquisition but in terms of ownership over time. If you think about a PC, it's probably one of the most volatile consumer goods in terms of form factor and features of just about anything on the market. So, let's say that you wanted to securely mount a PC product in a wall or a ceiling at a convenience store, you'd have a really hard time doing that just from a mechanical and architectural standpoint if the shape and size of that device was changing every six months. Because you can secure the dimensions of the device by embedding it and making it a vertical market appliance, you can guarantee what the form factor will be for several years at a time. Meaning that the installation and service of the product will be consistent for a very long lifecycle. So there are a lot of benefits that come along.'

For those building consumer-based applications, their primary market appears to be appealing to the early adopters and the toy collectors. Typical of this category are the video players that currently have a very limited market and are generally only used to show off a particular device such as the Cassiopeia. Those that are producing applications that will run on a wide range of devices are often solutions looking for a market. There are now several companies offering mapping systems but, having played with some of these, the convenience is often outweighed by their impracticality.

This problem is exacerbated by the different platforms that are in use. An application that is developed for the HPC platform may be totally irrelevant when put onto a PDA. Yet even this gap is closing with the march of technology. Look at some of the advanced voice systems in the market today and we already have the processing power on PDAs to run these applications. We are within a small amount of the required memory with the E-105 already boasting 32 MB and several HPC devices likely to ship with a potential 64 MB by Christmas. The only drawback is the storage, but IBM has launched a 340 MB hard drive for the HPC platform...

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Windows 2000 version. This is unfortunate because the incorporation of the routing elements inside Windows 2000 Advanced Server offers another opportunity for OEMs and some corporate IT departments to build specialist servers that could combine firewall and routing capabilities for far less money than a traditional solution would cost.

What isn't clear yet is how Microsoft intends to train developers to take advantage of NT Embedded. No plans have been announced for courses under the Microsoft Official Curriculum banner and no details have been announced of an update to the Windows Operating Systems Architecture course to accommodate NT Embedded. Despite the capabilities of the platform builder in syntax checking and build validation, a significant amount of really detailed Windows NT knowledge is likely to be required. Without Microsoft support for the development of training courses, the take up of NT Embedded will probably be severely limited.

Windows CE

Finally, we reach Microsoft Windows CE, which has been around for a little over four years. Yet only now is it reaching a position where it is being taken seriously by developers. By seriously I mean as a platform for more than just building a better micro browser or porting games to, in order to make it a PC-compatible Game Boy platform. There is some serious work being done on the Windows CE platform yet Microsoft has not exactly been helping its cause.

One of the biggest problems for CE developers has been that of supporting different platforms. When Microsoft started to design Windows CE they created an operating system and an environment that could be fairly easily ported to different processor families. What they didn't do was take into account the impact of the operating system, different processors, and the compatibility of applications.

Take a look at the problems of Windows NT. When it was launched, Microsoft talked long and loud about the fact that it not only supported Intel, but that there was support for a range of RISC processors. At the time, this implied that Microsoft was really serious about playing in the mini-computer space by providing an operating system that would scale appropriately. Unfortunately, developers soon realised that they needed to recompile their applications for each chip set and this, in turn, meant re-testing and revalidating their code. The result was a dearth of applications for the RISC platforms, eventually resulting in just Digital staying in there with Intel.

When Windows CE launched there was a similar fanfare about the wide range of devices, the potential for Windows CE, and most of the emphasis was on a graphical diary that would integrate smoothly with the Microsoft corporate platforms. All of this was true, but it appeared that no one had bothered to take into account what had happened to Windows NT. The result has been a nightmare for small developers who have had to tie their fortunes to a particular processor family until they have had the funds to carry out a port to another platform. Some inside Microsoft, particularly the US, would have you believe that it is as simple as just recompiling your code, but any developer knows that is never the case. As a result, despite the number of CE devices that have been sold, there is a significant shortfall in the number of applications that are available. It isn't that there is a lack of diversity in applications, it's simply that the cost of moving from platform to platform is a problem.

Consider the position of a corporate buyer who is faced with the 3Com solution where every application runs on every Palm device and the Microsoft solution where there is no guarantee of being able to get the application for every Windows CE device. Commercially, this is a no brainer. You simply purchase from 3Com because this provides a standard device, standard software, and a single supportable solution. This becomes even more important if, for example, you are looking to develop an internal application for life insurance sales.

Fortunately, Microsoft has bowed to the inevitable pressure and complaints about this and at the Windows CE Developer's Conference in Denver, it announced the Common Executable Format (CEF) that will allow you to compile once and run anywhere. This works by compiling your code to an intermediate format that is then interpreted when it is transferred to the target platform. The cost of this flexibility is in performance with Microsoft admitting that applications taking advantage of the CEF will run at only 80% of a natively-compiled application. However, this may just encourage a number of developers to try shipping their applications in this new format and seeing if the performance is acceptable, before committing themselves to a complete port.

As another inhibitor for the developer community, Microsoft decided that rather than supply the SDK free to those who wanted to develop solutions for Windows CE and simply charge for the licences, it would provide a developer's package.

The price you pay for this package will vary between distributors because they purchase a basic package from Microsoft and are expected to add their own customisation by way of device drivers, support, training, and other value-added services. As a result, Microsoft refuses to talk publicly about what an entry-level package would cost, constantly referring any enquiries to a channel partner. This is extremely unhelpful for small

developers who may be prepared to learn as they go but get penalised by distributors adding their own services to the cost of development. This is very different to other platforms where you can purchase a development language and start programming for DOS, Windows, or NT.

As Windows CE has developed, the quality of the documentation has suffered, although this is part of a common dumbing down of the technical documentation across all Microsoft platforms and not just for Windows CE. Couple this with the fact that four years on and Microsoft has still to launch its own training materials for Windows CE and this sends the wrong message about Windows CE. In fact, some eight weeks after promising to arrange for training materials from one of Microsoft's partners to be shipped to me, I have still to see anything at all.

A typical example of the software's failure is the platform builder that ships with Windows CE. When you use this product to decide on the components that you want to include, there is no validation checking. As a result, you can spend a significant amount of time working with the platform builder and in the end you can get a nicely compiled and totally useless piece of code. Compare this with even simple language development tools that do syntax checking and you realise that Microsoft needs to invest a significant amount of money in this tool. More importantly, simply compare this with the graphical platform builder tool that ships with NT Embedded and you see the lack of foresight that is currently afflicting the Windows CE programme.



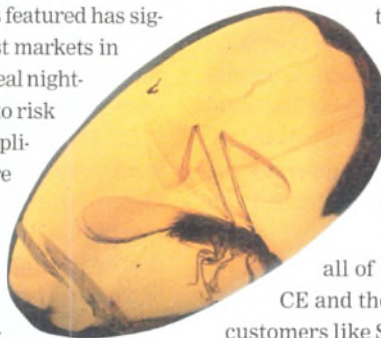
To balance this criticism, it should be noted that those development shops that have invested in Windows CE are beginning to see significant returns on their investment. Most of these companies are in vertical markets where the return is worth the high level of investment.

Complete domination

At the end of the day, the embedded market is developing in such a way that it is unlikely that any one operating system is going to be able to dominate it completely. Each of the operating systems featured has significant strengths and weaknesses as well as specialist markets in which it is likely to dominate. For developers, this is a real nightmare because you have to decide where you are going to risk your time and effort in the hope of finding that killer application that will enable you to sell out to a large software house and retire. For the time being, I would suggest that you decide what market is important to you.

If you are interested in developing an application that will give you the best chance of an early return on your investment, then you should seriously consider the 3Com platform. There is a downloadable SDK, a huge user base, and a large number of corporate customers using it for bespoke application development.

If telecommunications is your speciality, then you must choose EPOC. It will dominate that market, although the acquisition of STNC by Microsoft shows that it is keen to make up lost ground. However, it is inconceivable that the Symbian community would abandon EPOC just to embrace a Microsoft approach.



NT Embedded needs to produce solutions and Microsoft needs to clarify its position before developers can take this seriously. There will also need to be a considerable amount of training development undertaken by Microsoft if this is to take off.

Windows CE is torn between the PDA market, which is desperately trying to win back customers lost to 3Com, and providing the HPC with the opportunity to beat the laptop as a business user's preferred device. The release of the CEF should make this an attractive proposition, but the cost of a development platform is likely to keep small- and some medium-sized development shops out of the market for a while to come. Ultimately, this will dominate a large part of the market but it is unlikely that it will achieve the dominance of the PC operating systems division.

The Tao Group offers an interesting alternative to all of these because it will already sit on top of Windows CE and they are looking at porting it to sit on Symbian. With customers like Sony considering implementing Elate in a vast number of its consumer electronics, this must be watched carefully. Unfortunately, until the SDK announcement is made, watch is really all we can do for the time being.

Ian Murphy is a freelance journalist and trainer because it means getting lots of toys, access to some neat technology, and gives his ego an outlet. When pressed, Ian will go out and do consultancy. You can contact him at ianmurphy@fleet-street.com.

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Component News

AUTUMN 1999

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- Tab ActiveX control provides optimised intelligent scanning and loading of child controls

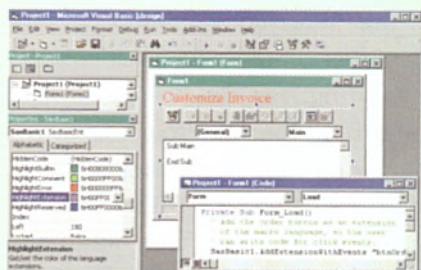
Have a look at the website for the full feature list or why not try it? Download the evaluation or request an evaluation CD today. ■

Finally, a tool package that makes full use of the expanded colour capabilities of today's machines. No more flat, one colour controls. This package is perfect for use across the Internet or any 32bit visual programming environment. Package includes, Panel/Frame, Multi-Column Label, Option button, Checkbox, Command Button, State Button, and Group Button all in glorious multi colour. Written using ATL3.0 - which means no MFC file overhead and no external supporting DLL's. ■

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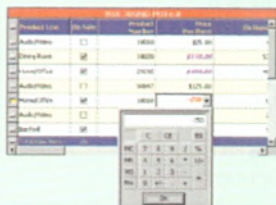
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The worth of one smile



Francis Glassborow suggests the Cheshire Cat idiom be used as the default mechanism for implementing a type during design and development.

One comment that is often made about programming languages is the degree to which they allow the programmer to hide information. I mean really hide, not just restrict access. Failure to hide information can result in massive and costly rebuilds.

One fundamental requirement for information hiding is that the relevant items must be able to be placed in a separate file. If it all has to go into the same file, then anyone who has access to the file can read it. The two main motives for hiding information are commercial secrecy and reducing dependencies that can result in large-scale recompilation of the source code.

Among the most widely used languages today, Java makes it extremely difficult to hide information. All the details of a class have to be out there, visible for all to see. Even worse, for those that want to keep details of their code secret for commercial reasons, Java bytecode can always be reversed into source code. If you want commercial secrecy, then conventional Java compiled to bytecode will not provide it. On the other hand compiling your Java to native machine code destroys one of its great advantages: its machine independence.

How well does Java fare as regards lowering the frequency of recompilations? The object model means that all user-defined types (as opposed to fundamental types) are handled through references, so changes to a class do not force large-scale recompilation. In C and C++, changes in a file force recompilation of all files that include it. The idea behind header files was to limit dependencies between different files of implementation code. However, C++ code that is going to create a class instance must see the class definition. The rules of the language require that all the member declarations must be contained in a single class definition.

You might wonder why this is the case. All that the compiler actually needs to know about a class to use it is its public interface and the amount of storage required for the instance data. Surely, it would not have been difficult to specify that a class definition could be re-opened to add private member functions? If you think a little, you may suspect that such a facility would not work as well as one might hope. Re-opening the definition once might work, but the idea is too prone to abuse.

I suspect the reason that not much thought was given to ways to hide private data and functions was because most experts knew they could already do it by using an idiom that has many names. Most recently, it has been called the compiler firewall idiom, though before that it has been called, among other things, the 'Cheshire Cat' idiom.

An example

Experienced readers will be well familiar with the idiom, but I think it is important enough that every programmer should know it and understand its use. Indeed, I would go further and suggest that it should be the default mechanism for implementing a type during design and development. Let me illustrate the idea with a very simple class. A Rainbow is a type that represents the colours of the rainbow. It provides a very simple set of properties. Instances have nine states (infrared, red, orange, ... ultra-violet). You can get the next colour or the previous one. We define infrared to be its own predecessor and ultra-violet to be its own successor. The basic public interface will be:

```
class Rainbow {
public:
    enum states {unknown, infrared, red, orange,
                yellow, green, blue, indigo, violet, ultra_violet};
    Rainbow(states = unknown);
    Rainbow(Rainbow const &);
    ~Rainbow();
    Rainbow & operator = (Rainbow const &);
    Rainbow predecessor();
    Rainbow successor();
    states current();
    void replace(states);
private:
    // what should go here ?
};
```

Note that I have included the four items that the compiler can sometimes generate for you. I think it is good programming discipline to write those in even if you then comment them out. You should be able to get your text editor to generate them for you from the class name, so it doesn't take up much of your time.

It is worth investing time to get the public interface correct and complete. By doing so you will ensure that other code that uses instances of Rainbow will not be constantly recompiled because of changes you are making to Rainbow.

Before I tackle the only statement needed in the private interface I should remind you that once a type has been declared (as opposed to defined) you can use references and pointers to it. Before defining class Rainbow I must add a declaration of Rainbow_i:

```
struct Rainbow_i;
```

In the private part of Rainbow I place:

```
Rainbow_i * smile;
```

That is it. That is all the users of Rainbow need. As long as I have done a good job at providing a complete and correct public interface my users will not be disturbed by any tweaking I do within my implementation.

Next, let us look at Rainbow_i. Note that only one other file ever sees this because only Rainbow.cpp needs to know anything about Rainbow_i.

```
#include "Rainbow.h"
typedef Rainbow::states colour;
struct Rainbow_i {
    colour data;
    Rainbow_i(colour value=Rainbow::unknown) : data(value) {};
    colour predecessor(){
        return (data < Rainbow::red) ? data : data-1; }
    colour successor(){
        return (data > Rainbow::violet) ? data : data+1; }
};
```

Note the typedef at file-scope. This is just a convenience so that I do not continually have to write Rainbow::states. I do not want to pollute my global namespace with enums in header files, though I might put them at namespace scope. This use of typedef allows me to control namespace pollution while not having to use overly



long identifiers in contexts where shorter forms make sense.

The `Rainbow_i` is a struct because it is only intended for use by `Rainbow` and using a friend declaration seems a little over the top for this. Note that I am not even going to ship this code to users of my `Rainbow` type.

And now we are ready to implement

`Rainbow`. Remember that users will only get the compiled code because they have no need to see the implementation file.

```
#include "Rainbow_i.h"
Rainbow::Rainbow(states value): smile(new Rainbow_i(value)){}
Rainbow::Rainbow(Rainbow const & r): smile(
    new Rainbow_i((r.smile)->data)){}
Rainbow::~Rainbow() {delete smile}
Rainbow & Rainbow::operator = (Rainbow const & r){
    smile->data = (r.smile)->data;
    return *this;
}
Rainbow Rainbow::predecessor() {
    return smile->predecessor();}
Rainbow Rainbow::successor() { return smile->successor();}
colour Rainbow::current() {return smile->data;}
void Rainbow::replace(colour c) { (smile->data) = c;}
```

I think that we can, if necessary, recover most if not all the cost of the indirection through the pointer in the public class by inlining the code in the implementation. If you still need extra performance, you can consider inlining the implementation of `Rainbow` in the release version, but at that stage you will have to expose the definition of `Rainbow_i`.

Once you get accustomed to this method of developing classes you will begin to wonder why you ever did it otherwise. Perhaps the answer is that for student code this is one more layer of complexity and student projects do not normally take hours to rebuild. Unfortunately, the result is that too many have learnt the language but do not know how to use it efficiently in a commercial environment.

One of the worst aspects of Java is its use as a language for introducing programming. It encourages newcomers to expose their implementations for all to see and to expect tools to separate out implementation from interface. However, C++ provides the tools for such separation though too many instructors ignore them. Good instructors can teach programming skills with any language, but no language can compensate for incompetence and ignorance. I think it is time that industry started demanding that academia and training organisations did a better job.

Last month's problem

The following is the definition of a member function in a book by a well-known author. The code is part of his implementation of a simple string class. The class has two data members: `p`, which is a `char *` to handle a dynamic array to hold the string, and `len`, which holds the current capacity of the string object. Read on:

```
strtype & strtype::operator=(strtype &ob){
    // see if more memory is needed
    if (len > ob.len) {
        // need to allocate more memory
        delete [] p;
        p = new char[ob.len];
        if(!p) {
            cout << "Allocation error\n";
            exit(1);
        }
    }
```

```
}
len = ob.len;
strcpy(p, ob.p);
return *this;
}
```

It is difficult to know where to start with this code. First note that the type of the parameter is `non-const` so that you cannot assign `const` qualified instances of `strtype`.

Thanks to the comments we may just notice that the test for needing extra memory has been inverted. Let me be honest, I thought that just might be a typo when I originally copied this code into a review I was doing. However, note that the author calmly throws away the contents of `p` without first checking for self-assignment. This is something that novices learn about the first time they write an assignment operator function. Next, the author uses `new` to grab some dynamic memory. However, he seems to be blissfully unaware that `new` throws an exception for allocation failure and has done since about 1993 (well, the working design for C++ specified that it should).

In the case that there is an allocation failure, the program simply displays a message and then closes the program down with a call to `exit()`. There is no attempt at providing any form of recovery, or providing a graceful closure with the stack being unwound. If I have unreleased resources elsewhere in my program, tough.

Then we have a subtle efficiency problem: why use `strcpy()`? Why not use `memmove()`? Please note that many programmers miss this opportunity to provide extra efficiency when copying. However you should be careful about using `memcpy()` in case the item being copied overlaps the destination.

A couple of these errors could be attributed to poor proofreading prior to publication, but that excuse does not apply to all of them. No one who understands the rudiments of C++ could write that code, let alone claim to be a master of C++.

This month's problem

Look at the following piece of C++ source code and consider the potential problems with it. Do not stop when you find the first problem.

```
#include <iostream>
struct A {
    A() { cout << "A constructed" << endl; }
    ~A() { cout << "A destroyed" << endl; }
};
struct B : public A {
    A(int i = 0):i_m(i) { cout << "B constructed" << endl; }
    ~A() { cout << "B destroyed" << endl; }
    int i_m;
};
int main(){
    B b1(1), b2(2);
    A& a1 = b1;
    A& a2 = b2;
    a1 = a2;
    cout << b1.i_m << endl;
    return 0;
}
```

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Performance Data Helper

How is your application performing? Mark Smith uses the Performance Data Helper library to get runtime characteristics.



Delphi makes a fine Windows development tool, but because of the number of specialised Windows APIs that Borland has not converted to Pascal, many useful Windows features are hidden from view. This is a pity, since the casual Delphi user or the programmer who does not have a pressing need to use a particular Windows API will often end up re-inventing things that Windows already does for you. The JEDI (Joint Endeavour of Delphi Innovators, <http://www.delphi-jedi.org/>) aims to convert the most useful API collections to Delphi, but progress seems to have stalled in recent months despite the project gaining wider publicity on the new Borland Community website (<http://community.borland.com>). A case in point is the Performance Monitoring API, which has been around for a number of years without a Pascal conversion appearing. The Performance Monitoring API lets you retrieve performance information from your Windows NT and Windows 2000 systems in the same way as the Performance Monitor system tool. It is what I want to look at this month.

Runtime characteristics

The Performance Monitoring API provides continuous information about the runtime characteristics of your system. This information relates to system-wide 'things' like the total system up-time, as well as more transient ones like the number of threads in a given process, or even the amount of time an individual thread has been running. The underlying performance information is held in blobs of data stored in

the Registry under the HKEY_PERFORMANCE_DATA key. It is generally more useful to use the Performance Data Helper (PDH) library to get to the information, since it packages it up much more conveniently. The PDH library is documented in the Windows SDK, and that's where you'll find the implementation in a dynamic link library called `pdh.dll`. The PDH functionality is available only on NT and Windows 2000 – the equivalent functionality in Windows 95 and 98 is more limited. If the PDH library is not installed on your PC, you can add it from the Win32 SDK.

The Performance Monitoring API can tell you a lot about the performance of the system your application is running on, and (often more relevant!) how your own application is performing. For example, you might want to display a graph to show an indication of CPU load while your application is engaged in a complex and long-running task. One of my own uses is to create a cut-down version of the Performance Monitor system tool, which just shows the CPU load, page faults, and working set for my application only. This is a lot easier to use than Performance Monitor and since it can be embedded into the application, it becomes very easy to measure performance 'in the field'.

As always with the Windows API, producing a working Delphi implementation of the C header files is a necessary chore. Last month, I tried to use Bob Swart's C header file conversion utility, *HeadConv* (<http://www.drbob42.com>), to convert some COM-based functions without much success. This month, I'm happy to say that since the API

```
type
  TPerfCounter = class (TCollectionItem)
  public
    hCounter : Cardinal;
    Format : DWORD;
    Name : String;
  end;

  TPerfQuery = class (TCollection)
  public
    Query : DWORD;
    UserData : DWORD;
    function AddCounter (AName: ansiString;
                        AFormat : DWORD) : TPerfCounter;
    destructor Destroy; override;
  end;

  TPerfDataComp = class(TComponent)
  private
    FPerfQuery: TPerfQuery;
    FUserData : Cardinal;
    FBrowseDlgData: PDH_BROWSE_DLG_CONFIG_A;
    FActive : boolean;
    FOutPut : TStrings;
    function GetActive: boolean;
    procedure SetActive(const Value: boolean);
  protected
    function NowStr : String;
    procedure RecordMsg (Msg : string);
  public
    procedure Update;
    procedure BrowseCounters;
  published
    property OutPut : TStrings read FOutPut write FOutPut;
    property Active : boolean read GetActive write SetActive;
    property PerfQuery : TPerfQuery read FPerfQuery
      write FPerfQuery;
    constructor Create(AOwner: TComponent); override;
    destructor Destroy; override;
  end;
```

Listing 1 – VCL declarations for PDH classes.

```
Type
  _BrowseDlgConfig_A = record
    flags : TPDHDlgFlags;
    hWndOwner: HWND;
    szReserved: PChar;
    szReturnPathBuffer: PChar;
    cchReturnPathLength: LongInt;
    pCallback: COUNTERPATHCALLBACK;
    dwCallbackArg: LongInt;
    CallBackStatus: PDH_STATUS;
    dwDefaultDetailLevel: LongInt;
    szDialogCaption: PChar;
  end (_BrowseDlgConfig_A);
  PDH_BROWSE_DLG_CONFIG_A = _BrowseDlgConfig_A;

function PDHCallback1 (Arg : DWORD) : PDH_STATUS; stdcall;
var
  ThePerfDataComp : TPerfDataComp;
begin
  ThePerfDataComp := TPerfDataComp(Pointer(Arg));
  PDHCheck (ThePerfDataComp.FBrowseDlgData.CallBackStatus);
  ThePerfDataComp.PerfQuery.AddCounter (
    ThePerfDataComp.FBrowseDlgData.szReturnPathBuffer,
    PDH_FMT_DOUBLE);

  Result := ERROR_SUCCESS;
end;

procedure TPerfDataComp.BrowseCounters;
var
  ReturnPath: shortstring;
begin
  SetLength (ReturnPath, 255);
  FBrowseDlgData.szReturnPathBuffer := @ReturnPath;
  FBrowseDlgData.cchReturnPathLength := 255;
  FBrowseDlgData.dwCallbackArg := Integer(pointer(self));
  FBrowseDlgData.pCallback := @PDHCallback1;
  FBrowseDlgData.flags := [bHideDetailBox,
    bDisableMachineSelection];
  FBrowseDlgData.dwDefaultDetailLevel := 3;
  FBrowseDlgData.hWndOwner := Application.Handle;
  FBrowseDlgData.szDialogCaption := 'Pick a counter';
  PDHCheck(PdhBrowseCountersA (@FBrowseDlgData));
end;
```

Listing 2 – Browsing the PDH counters.

in question doesn't involve COM, the conversion went far better. I had to do some hand coding and cross-referencing with the documentation, but overall it worked well. The sample program for this month (available from EXE OnLine) contains the converted header file in a module called `pdh.pas`, combined with the contents of another C header, `pdhmsg`, which gives definitions of the return values of the functions. It demonstrates the use of the PDH library to build an application that monitors its own performance characteristics.

Since we're using Delphi, the sample project provides an object-based wrapper around the raw API function calls. I've divided the work among three classes: `TPerfDataComp` is a control that makes it easy to manage the process. It holds a `TPerfQuery` object, which is a `TCollection` descendent that holds a number of `TPerfCounter` objects. The declaration of these classes is shown in Listing 1.

Monitoring performance

The first step in monitoring the performance of your application is to build a query, which is merely a holder for a group of counters. You do this by calling `PdhOpenQuery` and storing the handle that the function gives back as a `var` parameter. Note that all calls to `Pdhxxx` functions return a status to indicate success or failure. This makes it easy to build error checking into your calls to the API, since you can wrap them in a call to an error checking function. The procedure `PDHCheck` in `pdh.pas` does this, raising an exception if a problem occurs. It really is worthwhile always making sure to call `PDHCheck`, as it is the only way that the PDH library will indicate something has gone wrong. Ignoring the return value and proceeding can result in a nasty GPF.

Once you have a valid query handle, you need to add counters to it. You do this by calling `PdhAddCounter` (either the ANSI or wide string versions – I’ve used ANSI, but the wide versions work just the same), which returns a counter handle. You can call `PdhAddCounter` repeatedly to add handles for all of the object counters you want to track, selecting any counter available. Once you have set up your performance counters, you need to get some performance information. You do this by calling `PdhCollectQueryData` for your query, and then iterating through the counters to get the performance data for each. Actually obtaining the performance information seems a little obscure. First, you call `PdhGetRawCounterValue`, which returns a record holding the data in ‘raw’ state. Then you call `PdhGetFormattedCounterValue`, specifying the counter

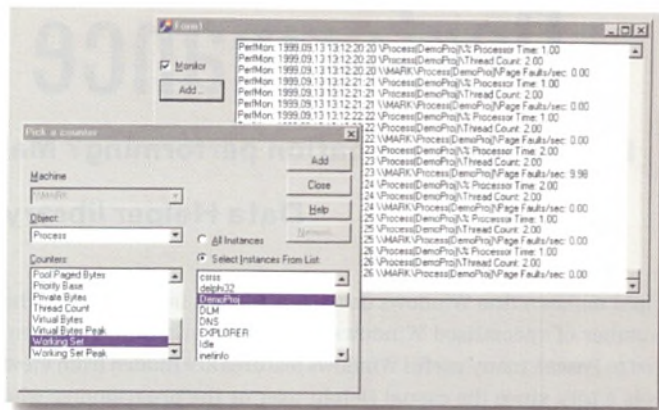


Figure 1 – The demo program in action.

handle and format you want to use for the results. This fills a `PDH_FMT_COUNTERVALUE` record with the information. The format parameter is important. If you use `PDH_FMT_LONG` where a floating-point number should be returned, you often get garbage. However, using the `PDH_FMT_DOUBLE` format where a long integer might have been appropriate seems to work for all the counters I tried. As well as the performance data, the record also contains a status property, which you should check with a call to `PDHCheck`. When you've finished gathering performance data, you need to call `PdhRemoveCounter` for each of your counters, then call `PdhCloseQuery` to close your query.

In the demo application, we gather performance information for Processor Time, Thread Count, and Page Faults/second whenever a timer gets fired and spool the data into a memo, along with the current time and the counter name. The timer is set to fire once a second – more frequently and you start to see (and monitor!) a performance hit caused by gathering the performance information.

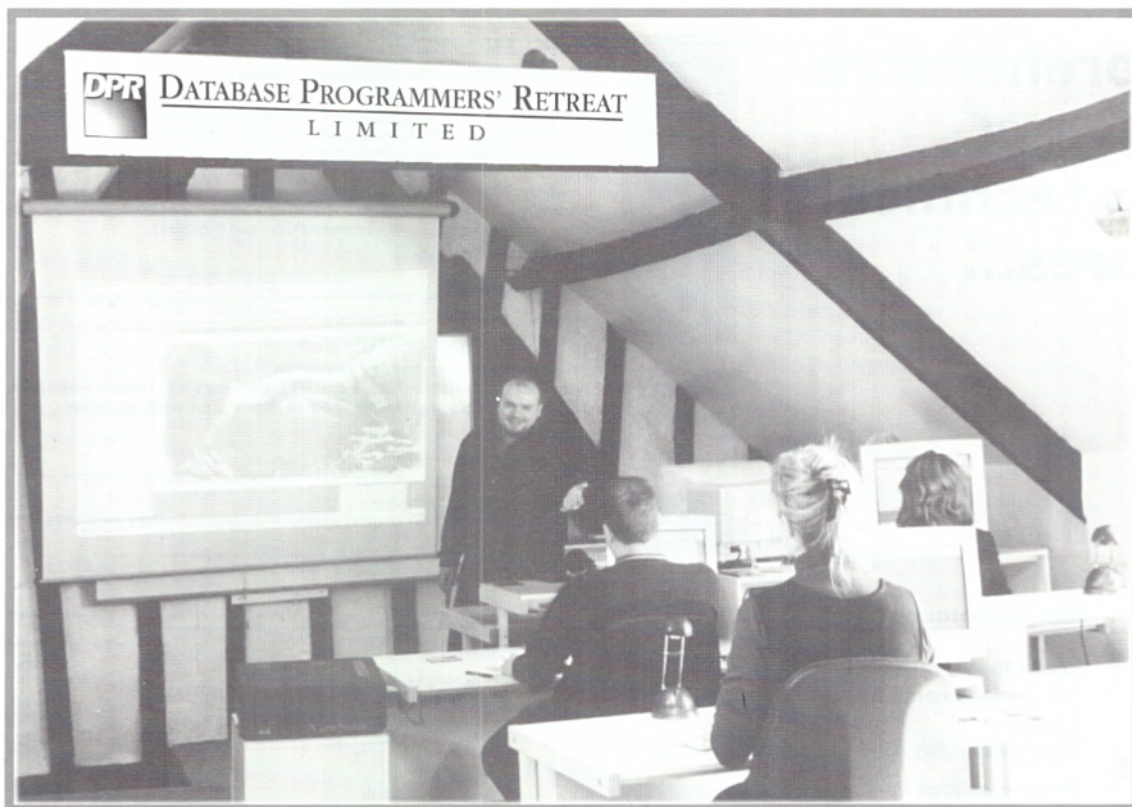
You can use the demo program, to record performance data for other objects, as shown in Figure 1. You could let the user select which objects to monitor, using the `PdhBrowseCounters` function, as shown in Listing 2. The `PdhBrowseCounters` shows the 'Add To Chart' dialog familiar from the NT Performance Monitor application. Essentially, it's a single API call that takes a single structure (also shown in Listing 2) that describes how you want the dialog to appear. If you want the user to be able to select the individual counters for an object, you need to set the `bHideDetailBox`. If you want to restrict the dialog to selecting counters for the host PC, you need to set the `bDisableMachineSelection` flag. You need to provide some allocated string space for the function call to store the name of the selected counter, and you need to provide a callback function that the dialog can use to interact with your program. To make the callback function more modular, I store a pointer to the Delphi object that initiated the `PdhBrowseCounters` call in the `dwCallBackArg` property of the record, so that I can get back the originating object from within the callback function. In the callback function, I cast the property back to a `TPerfDataComp`. Many 'big' NT applications such as Oracle 8 or SQL Server publish additional counter information that you can use to monitor and fine-tune your application's performance. For instance, you could set up your performance monitoring so that you create a log file of your database server's performance while you are sending large queries from the client. You can also add your own performance objects, though that will have to be part of another article.

Mark Smith is a contractor, currently working to improve the performance of a large simulation application. You can reach him at msmitha@cix.co.uk. **EXE ONLINE**

Term	Meaning
Object	An entity that provides measurable data. An example: your application.
Counter	A unit of measurement. An object may expose many counters, or only one. An example: the number of threads in your application.
Instance	An occurrence of an object, such as an application or a process.
Counter Name	The identifier for a counter. Counter names are built in the form <code>\\Machine\Object(instance)\Counter Name</code> . For example, an application called Project1 running on a machine named Herodotus would give rise to the key <code>'\\ Herodotus \Process(Project1)% Processor Time'</code> for the percentage of elapsed time that all threads in the application were using the processor.
Query	A collection of counters.

Table 1 – A short glossary

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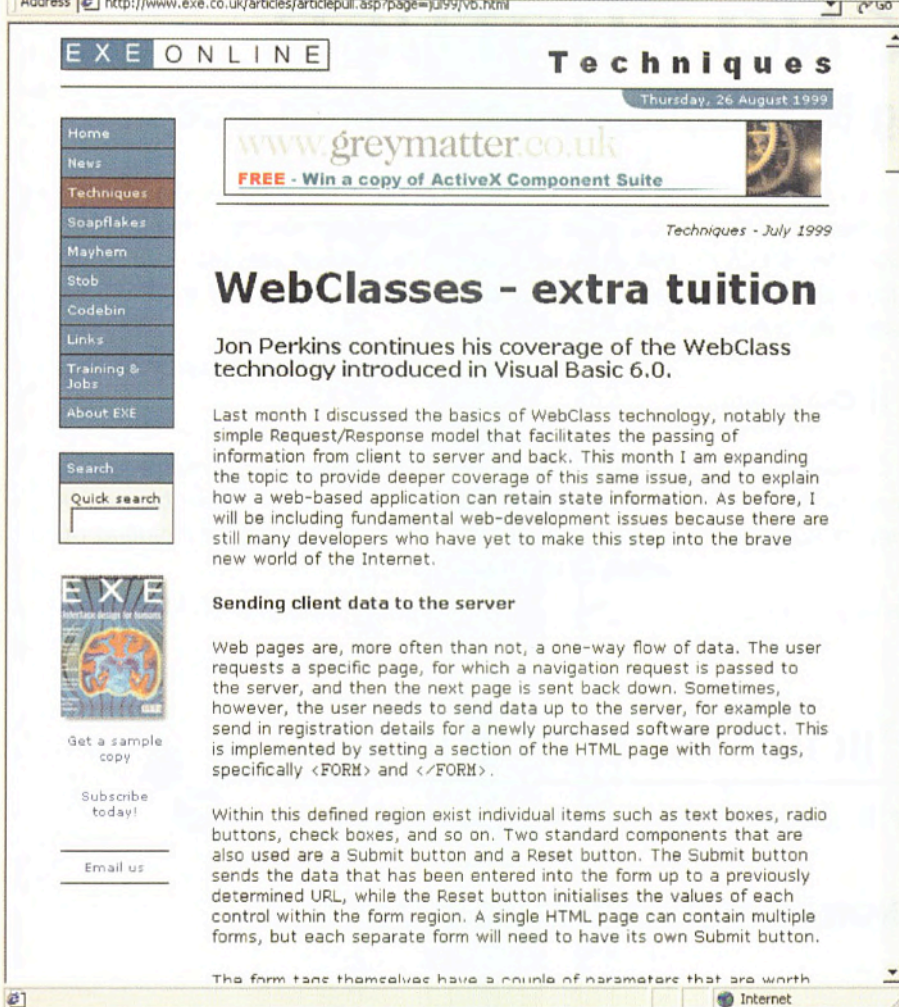
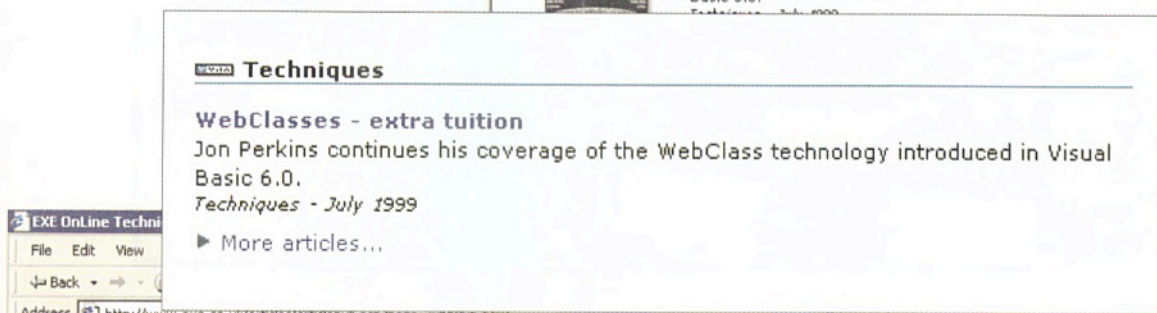
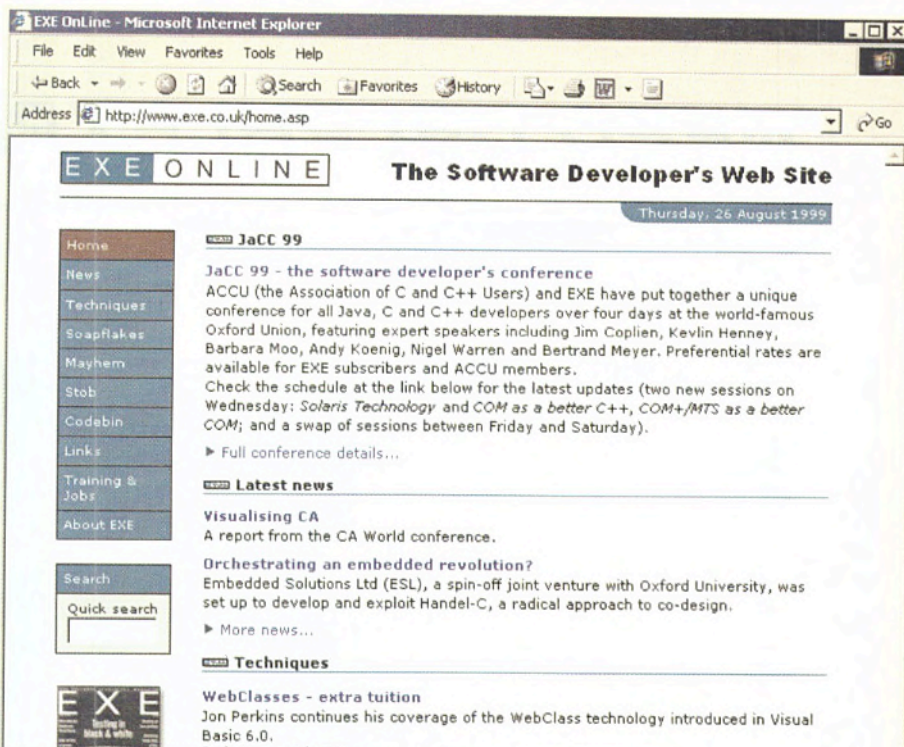
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Exactly 3.0 observations on Java and maths



Lou Grinzo hopes that Sun will do the right thing by the work of IBM's Mike Cowlshaw who has re-engineered the `BigDecimal` class.

The first of my three observations is something that I've been quoting as one of 'Lou's Laws of Computers' for years, namely that you should avoid binary floating-point numbers and all operations with them whenever possible. The reasoning is simple and familiar to experienced programmers: the binary representation of typical floating-point numbers in computers can't exactly represent many numbers we silly humans like to use, like $1/3$. This results in endless 'surprises' for programmers when they find that calculations differ from the expected result by some minuscule but important value, or that comparisons between 'obviously equal' values fail and cause a program to do something decidedly inconvenient. Check the Internet newsgroups for almost any programming topic, and you'll find regular reports from people claiming to have proof that the floating-point support in Java or C or whatever language is broken.

Java, of course, isn't immune to this problem, in that its intrinsic floating-point types, `float` and `double`, exhibit the same quirks as in other languages. (At least we have the benefit of knowing that all of Java's data types are always the same size, regardless of platform. That 'innovation' came along only about 15 years too late for my taste, but that's a topic for another column and another time.)

For certain types of programming, such as financial calculations, the non-decimal nature of binary maths can be an infinite headache. Financial institutions, in particular, are notoriously fussy about having their calculations come out exactly as expected. This is precisely why certain categories of programming are done almost exclusively with decimal representations of numbers. There are numerous ways to encode decimal numbers – probably another side effect of all programmers being serial inventors – but the basic idea is to represent each decimal digit as a unique entity, usually one or two digits to a byte. Some systems include direct hardware support for BCD (binary coded decimal) format numbers, while others have to employ an emulation library, much as we all had to use in the bad old days of PCs and pre-PCs when we wanted to do floating-point maths sans maths chip.

Enter `BigDecimal`

Java's answer to this need is the `BigDecimal` class, which is part of the `java.math` package. This class provides us with fixed-point decimal format numbers that are immutable (meaning that an instance can't be changed once created) and arbitrary-precision (meaning they can be stupendously large, if needed, and will adjust themselves automatically). The arbitrary-precision part can be the most useful aspect, since it allows you to forget about common, nasty problems like overflow and underflow, and calculate away, knowing that your `BigDecimal` values will increase in precision, up to the limits of memory. (Before I forget, please don't confuse the `BigDecimal` class with

its sibling in the `java.math` package, `BigInteger`. The latter class is also arbitrary-precision and immutable, but is simply a very large binary integer format and not a decimal representation.)

This all sounds wonderful, and it can be a real blessing for some applications. But the `BigDecimal` support brings me to my second observation, one that a friend and I have made numerous times over the last few years: that the engineers at Sun who designed Java simply loved character strings, but weren't quite so enthusiastic about numbers. While the string support in Java is very impressive, particularly in the eyes of someone coming to it from a C background, the numeric support has some notable limitations. For example there isn't even an option to raise an exception on integer maths overflow or underflow conditions, and its number formatting capabilities are somewhat weak.

Furthermore, Sun's `BigDecimal` class has more than its share of quirks and shortcomings. Some operations, such as integer division, remainder, and exponentiation to an integer power, are missing altogether. Another issue is that `BigDecimal`'s constructors won't accept strings that represent numbers in exponential notation, which places an unnecessary burden on some programmers. Most dangerous of all, in my opinion, is that using the provided methods to convert a `BigDecimal` to an integer type (`intValue` and `longValue`) can result in 'narrowing primitive conversions', which is language lawyer speak for 'we'll truncate your data in the conversion process and not tell you about it'. The online help for these two methods clearly states that they will return the low-order 32 or 64 bits of the converted values, respectively, and provide no hint whatsoever that anything went awry. Given Sun's near religious zeal about saving us from our pointer-based, self-inflicted wounds, it's surprising that it would do something that so clearly invites disaster and not give programmers even a chance of detecting the error in a reasonable fashion. (It is possible to work around this problem, albeit not in an especially aesthetic way. You can convert your `BigDecimal` number to an integer and then create a new `BigDecimal` instance from the converted integer. Comparing the two `BigDecimal` values will tell you if you got the expected value from the original conversion. That's a level of hackery that I don't care to think about, much less use in production code.)

Enter IBM

My friend and I weren't the only ones to notice `BigDecimal`'s less than optimal design, obviously. Enter IBM, or more specifically, Mike Cowlshaw, an IBM Fellow at the laboratories in Hursley. (Those of you who study or 'collect' programming languages probably recognise Cowlshaw as the inventor of the Rexx programming language, among other accomplishments.) Mike Cowlshaw is the chief architect and author of a re-engineering of the `BigDecimal` class that IBM has donated to Sun. IBM's main site for its version is <http://www2.hurs->



ley.ibm.com/decimal/, where you'll find an online version of the help, a 52-page Acrobat PDF document written by Cowlshaw titled *Decimal Arithmetic for Java*, and a link to the download page where you can get the whole package of compiled code and documentation in a single zip file. The zip actually contains

two implementations of the code, one in `decimal1.jar` for JDK 1.1, and one in `decimal.jar` for JDK 1.2.

While Cowlshaw's version of `BigDecimal` has the same name as the original, it is in a different package: `com.ibm.math`. It closely mimics Sun's version in syntax and semantics, so you should be able to use the new implementation as a direct, drop-in replacement for the original just by installing the `jar` file and changing the import statement in your code from `import java.math.*;` to `import com.ibm.math.*;`

True floating-point

What incentive is there to convert to the new `BigDecimal`? Instead of being a fixed-point implementation, Cowlshaw's version is a true floating-point package, and it was designed with the following guiding principle: 'Computers must provide an arithmetic that works in the same way as the arithmetic that people learn in school.' If you take the time to read *Decimal Arithmetic for Java* (and I strongly recommend you do), you'll see how pervasive this principle is throughout the design.

To make `BigDecimal` retain complete backward compatibility as well as gain more flexible behaviour, Cowlshaw defined a new class, `MathContext`, that contains four pieces of information about how maths operations are to be carried out. These are the number of digits or precision, the form of an exponent, whether to check for lost digits, and the type of rounding to use. (The eight rounding modes supported are the same as those in Sun's version of `BigDecimal`, although IBM's documentation is slightly clearer about exactly what each one means.) All the relevant methods in Cowlshaw's `BigDecimal` class come in two forms: one that exactly matches the signature of the Sun version, and one that takes an additional parameter. This new parameter is a `MathContext` reference that controls how the result is obtained. The key point is that the default settings used in lieu of an explicit `MathContext` object were chosen to maximise compatibility. For example, if you call the old-style `add` method in Cowlshaw's code (the one without a `MathContext`) you will get exactly the same behaviour as if you called Sun's `add` with the same values. But you can also choose to call the second `add` method with a specific `MathContext` and maintain complete control over the operation. This approach allows the programmer to exercise control over calculations on a per-operation basis, if needed.

Cowlshaw also added the missing functions for integer division, exponentiation, and remainder (as well as a pair of `format` methods that provide extensive formatting options), and fixed the truncated conversion problems. Since he couldn't very well change the behaviour of the existing `intValue` and `longValue` methods, he kept them intact and added `intValueExact` and `longValueExact`, which raise an `ArithmeticException` when the result won't fit in the prescribed return datatype. Another noteworthy change is that the constructor `BigDecimal(java.lang.String)` will accept exponential notation such as '3E-5' or '6.4E+9' without throwing a `NumberFormatException`, as Sun's version does.

Almost lost in the flurry of functional changes is the fact that this new version is faster. The `BigDecimal` FAQ says that it is typically

four to five times faster than the original on 'common operations', and that it creates many fewer objects during construction. The FAQ uses an example of constructing a `BigDecimal` from the string '2.5', and says that the old class creates 13 temporary objects, but that the new class manages with only one.

It's worth pointing out that this code is not the work of a solitary cubicle-bound programmer who thinks he knows how floating-point maths 'should' work. These algorithms have already been refined and very heavily tested over a period of 16 years and have been reviewed and ratified by the X3J18 ANSI committee. Its already considerable success, in the form of the `BigDecimal` class, is no doubt largely due to Mike Cowlshaw's commitment to maintaining backward compatibility.

I would even go so far as to say that this is the kind of work that draws a bright dividing line between mere programming and what we used to call software engineering before the term fell out of favour. Any moderately skilled programmer can implement new features or adhere to a standard, but combining the two and claiming 'drop in replacement' capability is the programming equivalent of a high-wire artist working without a net. Pulling off the act without incident is even more impressive.

Prospects

Where does all this stand? It's all well and good to have an alternate implementation, of course, but it's an annoyance for anyone distributing software to have to deal with an additional `jar` file. It would be far more pleasant for everyone involved if IBM's `BigDecimal` rewrite, or something very similar, was part of standard Java. As I write this, Sun has approved the Java Specification Request for `BigDecimal` (JSR-000013). It is possible to read the actual JSR at <http://www2.hursley.ibm.com/decimal/jsr-decimal.html>. The next step is the formal CAFE (call for experts) process to evaluate the requested change. When I asked Cowlshaw what his expectations were, he said: 'Since the JSR has been approved, we would expect to see enhancements to the `BigDecimal` class in the `java.math` package in due course. By the nature of the process, though, there is no guarantee as to the nature of the enhancements that the expert group will eventually agree. We would hope they would closely follow the IBM proposals, as these have been widely discussed (including with Sun's engineers, who made many useful suggestions) and have been freely available (on alphaWorks <http://alphaworks.ibm.com>) since November 1998.'

Obviously almost anything can happen with IBM's proposal at this point. I hope that Sun will adopt IBM's version as written, since it seems to provide a winning combination of exceptional compatibility, new features, and greatly enhanced flexibility. (Given some of the problems with the current `BigDecimal` class, even Sun must agree that something should be done to fix it, and soon.) Sun is fond of talking about working with the developer community and opening up its process, and they certainly deserve credit for making Java more open than most traditional commercial software. But now we're at a crossroads of sorts, as we're about to find out just how receptive Sun and its process are to accepting sizeable changes to the Java specification and code. Which brings me to my third and final, Gump-esque, Java observation: 'open is as open does'.

Lou Grinzo has been working with and writing about desktop computers for more years than he'll publicly admit. He's currently focusing on cross-platform technologies, including Java, Linux, and XML. His website is <http://www.gizmoDrome.com> and you can email him at lou@gizmoDrome.com.



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Administering SQL Server with Visual Basic



Jon Perkins shows how the SQL-DMO library offers an efficient mechanism for manipulating all kinds of SQL Server objects.

Last month I introduced the ADOX library, which makes its debut with version 2.1 of ADO. ADOX is a means of providing the developer with the facility to manipulate schemas in different database backends, albeit with a fairly limited implementation this time around. This month I am discussing SQL Server Data Management Objects (SQL-DMO), a specific library for SQL Server developers that offers control over many aspects of SQL Server functionality. The library has been around since SQL Server 6.0, and has been enhanced with each subsequent release. To demonstrate the amount of control that this library offers I'll just mention that the Enterprise Manager application (the 6.x and the 7.0 version) does its work through DMO calls.

Visual Studio 6 Enterprise Edition ships with a developer-specific version of BackOffice that includes SQL Server 6.5. In this article, I'm actually using SQL Server 7.0 as my discussion subject because it makes sense to address the wider set of features that this newer product has to offer. For any developers who only have access to version 6.5 and want to have a go, I will just point out one important difference between the two implementations. In SQL Server 6.5 the Data Management Object library is referenced as `SQLOLE`, for example:

```
Dim oDatabase As SQLOLE.Database
```

Whereas SQL Server 7.0 has changed the reference name to `SQLDMO`, hence:

```
Dim oDatabase As SQLDMO.Database
```

The SQL-DMO runtime files are installed along with the SQL Server client utilities, so this would be a prerequisite prior to distributing your application. When starting a new project you should include a reference to 'Microsoft SQLDMO Object Library'. SQL Server itself contains additional stored procedures to provide support for this technology. These are installed automatically along with the core product, but should they ever need re-installing then the setup script `sqldmo.sql` exists within the SQL Server installation's Install folder.

One of the most important objects within SQL-DMO is the `SQLServer` object, through which it is necessary to logon to the SQL Server itself. Depending upon your own security level it is possible to perform most key operations, such as starting and stopping the service, creating a new database, and adding new users. Initialising the object is a simple matter, for example:

```
Dim oSqlServer as SQLDMO.SQLServer
Set oSqlServer = New SQLDMO.SQLServer
oSqlServer.Connect "MyServer"
' Do something, then ...
oSqlServer.Disconnect
Set oSqlServer = Nothing
```

Before delving too much into the ways in which the most likely tasks are performed, I'd just like to stay with the `SQLServer` object itself and discuss some of the useful pieces of information that it offers. When you are writing applications of an administrative nature there

is usually a need to know whether the current user has the necessary levels of permissions to perform a certain action. This can apply both at the SQL Server level and the operating system level – which, in many cases, would entail having to make calls to the Win32 API. The designers of the `SQLServer` object have tried to predict the most likely pieces of information that will be required and have made them available. Some of the most useful are:

- `IsNTGroupMember` – A boolean function that will determine whether a user is a member of a specific NT group.
- `IsOS` – Used to check which version of Windows is present.
- `LinkedServers` – Returns a list of linked servers.

There are several other functions that will return a boolean value denoting whether a user has membership of any of the server roles that form part of the SQL Server 7.0 security model. Elsewhere, within the `Application` object, the `ListAvailableSQLServers` method returns a list of all running SQL Servers that are visible within the scope of the network.

```
Private Sub PiLoadDatabases()
    Dim oDb As SQLDMO.Database
    For Each oDb In moSqlServer.Databases
        Combol.AddItem oDb.Name
    Next
    Combol.ListIndex = 0
End Sub
```

Listing 1 – Obtaining a list of databases in a SQL Server.

```
Private Sub Combol_Click()
    Dim oDb As SQLDMO.Database
    Dim oTable As SQLDMO.Table
    Dim liObject As ListItem

    'Empty the ListView control
    ListView1.ListItems.Clear

    ' Get a reference to the selected database
    Set oDb = moSqlServer.Databases(Combol.Text)

    ' Enumerate each table and display info in ListView
    For Each oTable In oDb.Tables

        Set liObject = ListView1.ListItems.Add(, , _
                                                oTable.Name)
        liObject.ListSubItems.Add , , oTable.Owner
        liObject.ListSubItems.Add , , _
            Format(oTable.Rows, "#,##0")
        liObject.ListSubItems.Add , , _
            Format(Left(oTable.CreateDate, 10), "Long date")
        liObject.ListSubItems.Add , , _
            Format(oTable.DataSpaceUsed, "#,##0") & " KB"
        Set liObject = Nothing

    Next

    ' Release the Database object reference
    Set oDb = Nothing
End Sub
```

Listing 2 – Displaying tables within a database.



Accessing database and table information

SQL Server-specific items are exposed through collections, such as the Databases collection and the Tables collection. As is typical, these collections can either be enumerated with a `For Each...Next` construct, or can be accessed directly, such as:

```
Set oPubsDatabase = oSqlServer.Databases("pubs")
```

To show how this database and table information can be obtained and displayed I have built a sample application (see end of column for download details). Figure 1 shows the layout of the application: a drop-down list-box at the top of the screen displays all the databases that can be found on the current server, and then various pieces of information for each table within that database are displayed. With the exception of changing the server name in the `oSqlServer.Connect` method, this should work for any SQL Server 7.0 installation (he says!).

For the table details I have chosen to use a `ListView` control (set to Report View mode). The five pieces of information that are being displayed about each table are the name, the owner, the number of rows of data held by the table, the date that it was created, and finally the amount of data space used. Listing 1 shows how the list of databases is initially obtained and passed into a `ListBox` control. Listing 2 then shows how a click event on the `ListBox` causes a `ListView` control to be emptied and then populated with several pieces of information about each table found within that database.

```
' Module level declaration
Private WithEvents moBulkCopy As SQLDMO.BulkCopy

Private Sub Command1_Click()
    Dim oSqlServer As SQLDMO.SQLServer
    Dim oTable As SQLDMO.Table
    Dim lImportReply As Long

    ' Initialise object references
    Set oSqlServer = New SQLDMO.SQLServer
    oSqlServer.Connect "MYSERVER"
    Set oTable = _
        oSqlServer.Databases("MyDatabase").Tables("MyTable")
    Set moBulkCopy = New SQLDMO.BulkCopy

    ' Initialise the oBulkCopy object
    moBulkCopy.DataFilePath = "c:\sqldmo\testdata.csv"
    moBulkCopy.UseBulkCopyOption = True
    moBulkCopy.SuspendIndexing = True
    moBulkCopy.TruncateLog = True
    moBulkCopy.ErrorFilePath = "c:\sqldmo\bulkcopy.err"
    moBulkCopy.ImportRowsPerBatch = 1000
    moBulkCopy.ColumnDelimiter = ","
    moBulkCopy.RowDelimiter = Chr(13) + Chr(10)
    moBulkCopy.DataFileType = _
        SQLDMODataFile_SpecialDelimitedChar

    ' Run the import job
    lImportReply = oTable.ImportData(moBulkCopy)
    MsgBox CStr(lImportReply) & " records imported"

    ' Release references
    Set moBulkCopy = Nothing
    Set oTable = Nothing
    Set oSqlServer = Nothing
End Sub

Private Sub moBulkCopy_RowsCopied(ByVal Message As String,
    ByVal Rows As Long)
    ' Assume that mlRecordsToProcess has been set somewhere
    ProgressBar1.Value = (Rows / mlRecordsToProcess) * 100
End Sub

Private Sub moBulkCopy_BatchImported(ByVal Message As
    String)
    ' Always supply an event handler
End Sub
```

Listing 3 – A SQL-DMO bulk copy operation.

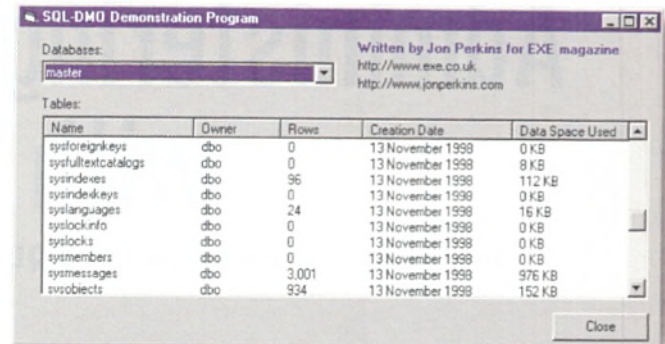


Figure 1 – The SQL-DMO example program.

Data transfer

One of the more likely attractions of SQL-DMO for the developer is the ability to automate data transfer. SQL Server offers both the Bulk Copy Program and the newer Data Transformation Services, and both of these technologies have corresponding SQL-DMO objects. In the case of the bulk copy routines, a standalone `BulkCopy` object (ie one not actually part of the hierarchy) is available to provide the definition for the data to be imported or exported. This `BulkCopy` object is then provided as a parameter to the `ImportData` and `ExportData` methods of a `Table` object. Listing 3 shows the code for a typical bulk copy operation. Note that this example also makes use of the events that are made available by the `BulkCopy` object, allowing us to give some visual feedback of progress to the user. If you are using `WithEvents` in your object declaration for any of the SQL-DMO objects, then Microsoft does strongly recommend that you supply a specific (ie non-empty) `Sub` for each event, even if you don't need it. An unneeded `Sub` merely needs an `Exit Sub` statement to be retained by the compiler. Incidentally, when I was writing some production code using the bulk copy object I sometimes encountered an `EXCEPTION_ACCESS_VIOLATION` error that caused the import job to fail. If anybody gets this under SQL Server 7.0, then the good news is that service pack 1 fixes the fault.

Can you use SQL-DMO to access and manipulate data within SQL Server tables? Well, yes you can, but this probably isn't the best way to do it. In applications that I have written, it was sometimes necessary to update tables with fresh data, and this is easily performed through a series of `Execute` commands. Anything more serious than this requires a more appropriate technology such as ADO. The SQL-DMO library offers a very efficient mechanism for manipulating all kinds of SQL Server objects. If your project is only SQL Server-based, then this is a very appropriate means of performing administrative tasks. If, however, you need a common set of functionality then you will eventually be better off going with ADOX, but this is almost certainly too immature a technology at this time to warrant the effort.

Jon Perkins is a freelance Visual Basic developer and a Microsoft Certified Solution Developer. He is a contributing author of Advanced Microsoft Visual Basic 6.0 by The Mandelbrot Set, published by Microsoft Press.

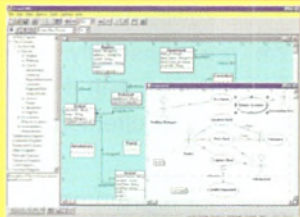
The example SQL-DMO program is called `DmoDemo.zip` and is available from EXE Online or from <http://www.jonperkins.com/exe/col1099.htm>. **EXE ONLINE**

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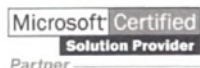
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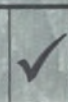
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Cry Hack it! and let slip the Pentiums of War

Cyberterrorism is on the increase these days. From high profile examples – a number of cracking attempts on big business were reported to have taken place during the June 18 anti-capitalist 'event' – to frankly funny events such as the hacking of the Labour Party official website some months ago, the threat of e-war has never been more apparent. With increasing numbers of sensitive and important systems now connected to the Internet, skilled crackers are a weapon that can be deployed by even the smallest rogue state to great effect.

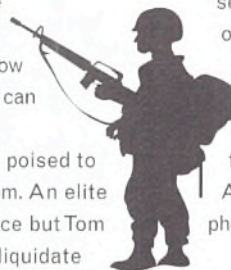
So now Our Boys (well, more accurately The Yanks) are poised to strike back in cyberspace against websites that offend them. An elite team has been prepared (we were going to call it Net.Force but Tom Clancy got there first, I'm afraid) ready to crack open and liquidate enemy sites with extreme net.prejudice. *The Register* (www.theregister.co.uk) reports that the US has offered assistance to the Russians in their current battle against Islamic militants seeking independence for renegade province Dagestan. Under the proposal, US crackers would infil-

trate and destroy pro-rebel websites, which have been used by the militants to spread the word.

Hard though it is to top such an offer, we'd like to try. So, we're offering to set up an elite team of inexperienced New Deal squaddies to solve one of the Net's most persistent problems – personal homepages*. Yes, we'll track down all of those 'My Home Page' created-in-FrontPad efforts, and crack all those which use offensive colours, background images, or animated GIFs. Any animated GIFs at all. We'll be particularly brutal to sites which load WAV or (shudder) MIDI files in the background. And our spleen will be well and truly vented on sites that actually have photos of the owners on them.

If you'd like to join our Net.Posse (sorry, Mr Clancy), just send your details to: **I believe everything I read, EXE Magazine, Next Door to 'Blackmail!', Behind the Water Pipes, Third Stall on the Right, the Gents Toilets, Victoria Station, London SW1.**

* No we're not.



Space blob

No, it's not a spacedog. It's a floating red ball, of course. Boffins at NASA have come up with a concept for a PDA, sorry, PSA – Personal Space Assistant. Apparently, the things will float about the International Space Station like erm... round red floating things, checking instruments and generally making sure there's still oxygen and other vital things (like, presumably, that there's enough chocolate biscuits and tea around to keep the astronauts' catechin levels up). The devices will also be available to aid in international communication efforts by translating for the Russian and European cosmonauts who will man the station alongside their US colleagues. Although presumably it will have to do a better job than AltaVista's Babel Fish.

Other duties the little red blob will perform include waking up the dozing spacemen (and women), acting as portable Internet access devices, and being the target in lightsaber training. Oops. Okay, so it's actually quite a good idea. We shouldn't mock. But the idea of floating robot assistants makes us think of Disney's abysmal 1979 effort *The Black Hole*. Can you say V.I.N.CENT?

Nothing has been said so far about what kind of software the beasts will be running. We can't help thinking that this might be an ideal opportunity for robotics masters Lego to pitch the idea of putting MindStorms, their embedded control software which featured in a recent EXE feature, at the heart of the PSA. At least it would keep the construction costs down.



nine nine ninety-nine

When is a bug not a bug? When it's 9/9/99, of course! The pre-Y2K date passed without so much as a single well-publicised failure. Prophets of Doom will no doubt be terribly upset. It had been reckoned that this once-in-a-century date might see Cobol systems crashing left right and centre, since 9999 (which is the way that most old systems view this particular date) used to be used as an end-of-batch marker. Yet the banks didn't fail, factories didn't grind to a halt, the power stubbornly stayed on, and harassed IT managers the world over were able to take the afternoon off, grinning inanely.

Rumour has it that several Tandy TRS-80s did in fact crash, but to the best of our knowledge the Dancing Demon isn't considered vital software in any industry.

None of this is likely to dampen the ardour of those who insist that Y2K will be the End of Computing As We Know It, however, since the two bugs stem from different causes. While the media ramps up expectations of disaster, and people prepare to go and take all their money out of the banks in case there's a run on them (er...), the government is doing its bit to frighten small businessmen witless by sending out a 'last chance' Action 2000 information pack loaded with calming phrases like 'critical to survival' and 'final lifeline'. Which is ironic, seeing as how the Gartner Group reckons that government is the only sector of infrastructure in the UK where the distribution of Y2K risk is 'moderate' as opposed to 'isolated'. Glass houses and stones, methinks.

A sheep amid the wolves

As we were writing these words it was announced that the long-awaited UK eCommerce 'Tsar' had been appointed. Leaving aside the fact that the government and media insist on spelling it 'Czar', which is patently wrong – go read the British Library guidelines on transliteration of Cyrillic if you don't believe me – this is not quite the cause for celebration that it should be. The man in question is Alex Allan, whose previous jobs include being High Commissioner to Australia, a country that is in the

process of introducing draconian (and probably unenforceable) laws to censor Internet content. Put this together with the UK government's half-baked plans to give the Police power to do unregulated net.snooping, and you could be forgiven for not feeling too confident about the future of e-commerce under Mr Allan.

We would still advise developers to learn all about building e-commerce apps. You might like to start looking at property in California, though. ■

Waltz\$

When the Editor heard the Poet Laureate had taken it into his head to read poems to the TUC, he was not impressed. 'That's bound to set Stob off again,' he said. And so it has.

Radio 4 interview with a programmer

O why do you sit in your crumpled clothes,
Typing so much and so much?
You Dilbertish minnow that society loathes
Why must you sit in your crumpled clothes,
Your mouse in a hot sweaty clutch?
A loner in anorak, with your introvert pose
You drift off to Cyberspace, in a porn-raddled doze
And meanwhile you get rich! How? God only knows!
Typing and clicking so much.

Mr Humphries you realise this is not fair play
Guessing so much and so much.
We techies don't surf on the Net all the day
We struggle to give of Good Think for our pay -
Which isn't so much and so much.
And as for our image: I heard with dismay
You repeated a long since discredited cliché...
- I'm sorry but we're out of time. Here's *Thought for the Day*.
Thank you, Ms Stob, very much.

Trying out my new program

This latest flower of my hard-earned skill,
(Try starting it from D:, that's prob'ly best.)
It has within its screens no showy frill
(Just copy these DLLs; you don't need the rest.)
Only elegant and self-sufficient code,
That will do the job and minimise the load,
And yet is flexible and can be changed to suit.
(Oh dear. I fear that it's time to reboot.)

Because its local database is small,
(Are you sure it's on the path? Yes, yes, I've seen.)
It hardly takes up any disk at all,
And fits upon the most frugal machine.
Its menu structure, as you have inferred,
Is plain as day. (Must you really open Word?)
Even if you've not the manual read.
(Right-click the taskbar now to kill it dead.)

Although the inner workings of design
(Hold on. I'd better hack the reg'stry hive.)
Must be hidden from the untrained mind,
(Are you absolutely sure you're running SP5?)
The centre core is kept in isolated blocks
I could quickly port it to a Mac or other box
In half a month. (What now? That COM port's free!
I give up. Let's go run it on my own PC.)

Pronunciation guide to the M4 corridor

Come friendly bombs and fall on Slough.
But Slough alone is not enough,
Since Betj's tough stuff put Slough in a huff
The rot has spread.

Now IT growth and IT wealth
And pension schemes and plans for health
Have magicked English towns by stealth
To Silicon Undead.

So to Junction 10, and blow up Reading
Don't hesitate! Plunge on unheeding
Zombies' cries as they lie bleeding.
Zoom past without care.

Yet more must die. We'll not be low key!
Head south and nuke foul Basingstoke
Leave just a mushroom cloud of smoky
Death in the air.

Come ordinance and cleanse New-bury;
When Twyford goes we'll all make merry
And have a toast in Bristol sherry
To our murderous art.

Come bombs and rain once more on Slough.
John Betj was very hard on you
There's others worse - but what can one do?
You've got to start
(Somewhere.)

Waltz\$

'Ask Bill why function code 6 [in MS-DOS, to output a string] ends in a dollar sign. No one in the world knows that but me' - the late Gary Kildall, inventor of CP/M and founder of Intergalactic Digital Research, quoted by Robert Cringely in Accidental Empires.

One night in his office, Bill Gates is alone.
He's done all his email and he's ready for home.
But there's a light in the corner from no glowing screen -
It's the ghost of Gary Kildall, all bearded and green.
Cries the spirit: Hey William, with all due respect
Windows is but CP/M, and I've come to collect.
Offer me no argument, I'll not stand for tricks:
For I know why there's a dollar in function code 6.

*Sing: We'll have no excuses, we'll have no more tricks,
Kildall put the dollar sign in function code 6!*

Then Gates eyes the spirit without fear in his soul,
And calls to his rival: Go hence bearded ghoul!
Do you think I will yield to this Scooby-Doo tactic?
Where now is the firm that was 'Intergalactic'?
Your BIOS lies obsolete, your functions uncalled,
And if programmers saw them they'd be quite appalled,
It matters not a bit that you scream and you holler
For what kind of jerk ends a string with a dollar?

*Sing: A currency display bug must most surely foller,
The ghost ends his strings not with NUL but with \$!*

Now when Bill calls the shots we know who prevails.
And it seems so this instance. The spook stops his wails.
Its extremities fade - like the feline in *Alice* -
Till only its head's left, still leering with malice.
But it calls out defiantly: Now don't you forget
You've won in this dollar-world, but there's more to come yet.
CP/M's still wowing 'em where the folks aren't so pure-oh:
For the demons of Hellfire have switched to the Euro.

*Sing: The dominion of Beelzebub makes us all feel uneasy
But at least the exchange rate is on par with the EC.
One two three one three two three two one stop.*

Verity wishes to apologise to Frances Cornford and GK Chesterton ('To a fat lady seen from the train' / 'The fat lady speaks'), Thomas Hood ('A Parental Ode to My Son, Aged Three Years and Four Months'), Sir John Betjeman ('Slough') and R Kipling ('The Looking-Glass') for ripping off their poems.

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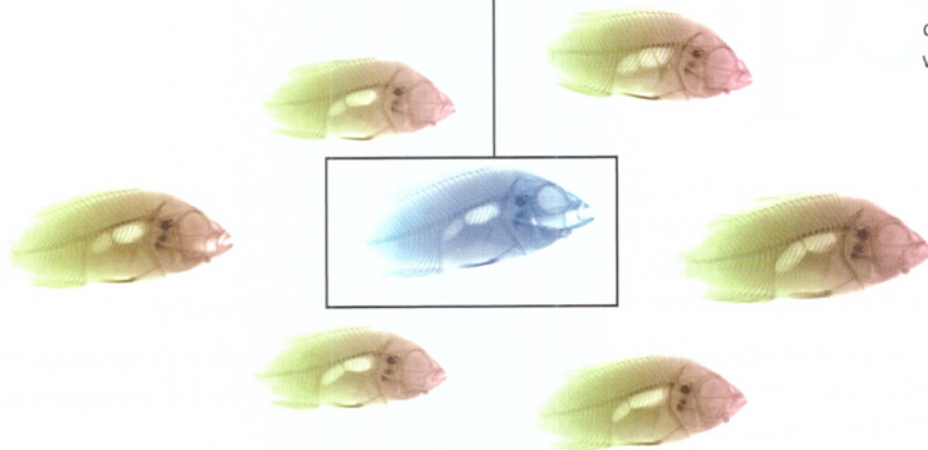
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