January 1997

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The Software Developers' Magazine

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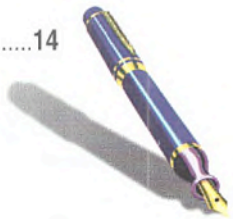

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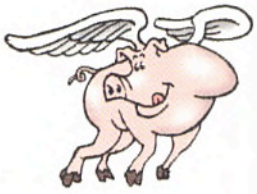

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SoapFlakes

OLE dual interfaces – an almost true story.

In the beginning there were custom interfaces (for people with sandals and beards and intimate knowledge of MIDL and typing), and then there were automation or dispatch interfaces (for button pushers).

...and then the almighty Bill Gates did speak, and he decreed...

'We shall combine them and their glorious union shall be greater than the sum of the parts. We shall, through the mighty mechanism of (single) inheritance, derive custom interfaces from `IDispatch`. These shining new interfaces will combine the best attributes of both. And yea, the new generation of interface will be both crunchy and chewy at the same time, and it shall be known as a Double Decker™'.

Unfortunately the name 'Double Decker™' was already in use. After rejecting the names 'Schizo' and 'JackOfAllTrades' the marketing department finally settled on 'Dual Interfaces'.

Meanwhile on a distant planet, distant in space, time and programming technique, a lowly button pusher was revolting. 'Why should only the lowlevelists get to use dual interfaces, I will use my magic class wizard to produce an OLE-createable automation object and then add an interface derived from `IDispatch`'. This he did. He paused for a few moments to fantasise about inserting his `BIG_INTERFACE_PART` macro before coming back to earth with a crash – it was implementation time.

First he had to implement AddRef. He sought the advice of his mentor. His mentor said 'you have a perfectly good implementation of `AddRef in CcmdTarget`, so delegate it', and the button pusher did as he was told.

Then he had to implement `Release`. He sought the advice of his mentor. His mentor said, 'you have a perfectly good implementation of Release in `CCmdTarget`, so delegate it', and the button pusher did as he was told.

Then he had to implement `QueryInterface`. He sought the advice of his mentor. His mentor said 'you have a perfectly good implementation of `QueryInterface` in `CCmdTarget` so delegate it', and the button pusher did as he was told.

Then he had to implement `GetIDsOfNames`. He sought the advice of his mentor. His mentor said 'you have a perfectly good implementation of `GetIDsOfNames` ...' Then with an evil glint in his eye his mentor stopped and shouted 'delete it all, rip it out, remove it all, and start again. Expunge the dispatch map for it is impure and has been generated unnaturally by... by *tools*. Reimplement `IDispatch` from scratch using interface pointers, more interface pointers and other lowlevelly things'. His mentor was none other than the evil high priest 'Oleguru', a lowlevelist infiltrator.

No shouted Dave – if I can delegate `AddRef`, `Release` and `QueryInterface`, I'll bloody well do the same for `GetIDsofNames`, and `Invoke` to boot. With a deft flick of the copy and paste keys,

```
STDMETHODIMP
  Magic::XMacros::GetIDsOfNames(
      REFIID riid,
      OLECHAR FAR* FAR* rgszNames,
      UINT cNames,
      LCID lcid,
      DISPID FAR* rgdispid)
{
   METHOD_PROLOGUE(Magic, Macros)
   return pThis->
          GetIDispatch(FALSE)->
          GetIDsOfNames(
             riid,
             rgszNames,
             cNames,
             lcid,
             rgdispid);
}
```

...and likewise for the other members of `IDispatch`.

After editing the ODL file using 'Visual ODL Editor' (aka NOTEPAD.EXE) the code compiled and was good. Superb, in fact. At least up to the point of testing it from Visual Basic... for in his rush Dave had forgotten to register his type library. It took a while to type in the call to `AfxOleRegisterTypeLib` as his typing skills had atrophied over the previous three years of visual programming, but soon his work was finished.

The great god MFC looked down on David's work and was pleased. 'You had seven functions to implement. Seven times you were tempted. And yet seven times you said: "no, I shall use YOUR implementation". And for this deference you shall be surely rewarded'.

There was a blinding flash of light and a small, but perfectly formed, header file appeared before Dave. With trembling hands he looked inside. Hardly believing his eyes – there before him were defined the three golden macros of dual interfaces: `BEGIN_DUAL_INTERFACE_PART`, `END_DUAL_INTERFACE_PART` and most resplendent of all, the mighty `DELEGATE_DUAL_INTERFACE`. Just as Dave was catching his breath, the macros began to expand, to declare and yes, yes even to implement those seven functions. Dave, with a tear in his eye, whispered 'thank you, thank you, but half an hour earlier would have been nice'.

Where now is this MFCDUAL.H, this Holy Grail for the dual interface writer? It lies hidden in the cave of Caer Bannon, protected by a man eating bunny rabbit. (Conveniently there is also a copy in the ACDUAL sample on the VC++ CD-ROM)

Perhaps I have consumed too many magic macros today.

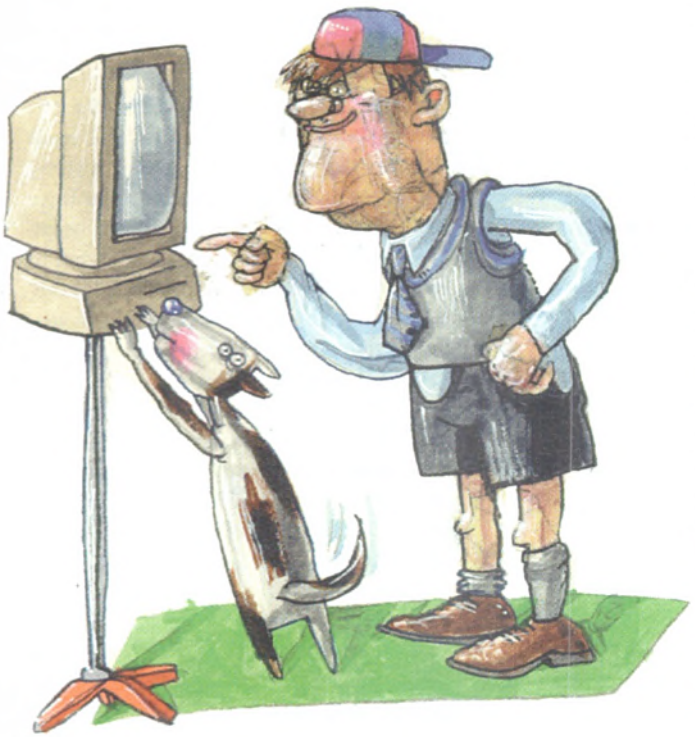
■

Dave the programmer (aka David Forbes)

Mayhem!

Are procedural languages a ball and chain rather than a suit of armour? **Jules** experiences a moment of Lucidity.

One of the courses offered to me when I was at college was about the history of computers. After starting off with a brief nod in the direction of Babbage, the course described a series of computers which were built before computers even had a name. The secrets of the relay-powered Mark One were laid bare, the Leo and the pilot Ace were prodded and probed, and so on to more recent, recognisable machines. Each device was explained in detail, and simulators for many of the machines were available on the departmental computer so we could have a go at programming them ourselves.



Jolly interesting stuff, you may think, and to be fair, it was. But far more interesting was the question with which the course finished. 'All these machines' claimed the lecturer 'worked in pretty much the same way, and that's pretty much the same way that modern computers are built. Are we to conclude from this, then, that this is the only way in which a computer can be built?' Bear in mind that this question was asked just as the Alvey project was building up a head of steam, and the Japanese fifth-generation computing project was well under way.

Of course, neither Alvey nor 5G amounted to much, and the benefit of hindsight would suggest that the answer to the question is 'Yes'. But the question has haunted me, because I still think the real answer is no.

The way in which all these machines were built was to have a large block of mainly passive memory, which is acted upon by a single central processor – the so-called Von Neumann architecture. All the modern wizardry, trickery and jiggery-pokery such as pipelining, vector processing, and look-ahead buffers are just variations on this theme. And, though this model represents a hardware structure, its implications reach right the way up the higher levels of computer architecture, affecting how languages, application programs, and even manuals are written. If so, all the problems we have with modern computers today are traceable to this structure. If there is another way to build computers, the implications would be far-reaching indeed!

Regular readers of this column will know that I'm interested in obscure languages. The vanilla languages like C and Pascal clearly echo the Von Neuman model – variables don't change unless something in the code causes them to change – and even things like object-orientation don't challenge the model to any great extent. But, though most programs are written in these procedural languages, the majority of new programming languages which are designed are not like this at all. Most are non-procedural – that is, they tell the computer not what you want it to do, but what you want to have been done once it has finished doing whatever it is it does.

Non-procedural languages have many properties which make them ideally suited to modern, difficult programming. Firstly, they're very simple: there are no complex algebras defining peculiar data types, and no hideous compatibility rules or access modes. And that's a result of the second advantage: the data types of these languages tend to be non-trivial. A single language might describe user-interaction grammars, or kinematics systems, or communication protocols, with these very high-level objects as primitives of the system. In addition, practically all non-procedural languages can be compiled for all sorts of obscure machines with little extra difficulty. Finally, certain of these languages can make proving a program's correctness a simple operation, so if you need to be sure something is right, you can be.

These advantages seem overwhelming, so how come these languages aren't used more? The simple answer is that they're just not hairy-chested enough for real programming. Most are created as one-time, stand-alone specialist languages, or as part of research projects. Precious few ever reach the stage of maturity needed by jobbing programmers. Basic things which most people take for granted, such as iteration, are totally absent, since they aren't technically necessary. (Not being technically necessary is the main criticism levelled against the `goto` in procedural languages, and though few of us admit to using `goto`s, it would be a brave programmer indeed who would buy a compiler without it).

I think this objection is not really the fault

of the languages, though. When I look back at the history of procedural languages, most of the early efforts seem pretty poor in comparison to today's technology. The reason why today's procedural languages are better-developed and more popular than non-procedural languages is because yesterday's procedural languages, shoddy as they were, were better than yesterday's alternatives. Procedural languages were where the quickest, easiest gains were to be had, so that's where most people concentrated their efforts.

This line of thought has been prompted by my rediscovery of a dusty old book that has sat at the back of my shelf for ten years or more. It's about a language called Lucid, which is precisely a non-procedural language made tough. Recognising that theoretical purity is no basis for a real programming language, but at the same time that the assignment is as harmful as the `goto`, the authors have described a language which seems to make an awful lot of sense. In fact, there's a certain level at which their unique approach encapsulates the notion of objects far better than objects do.

This is something that really could work.

But, of course, there's the skills marketplace. Since most programming is done in procedural languages, procedural languages are what programmers learn. If you want programmers who can work for you, you'd better want a set of skills which programmers are likely to have.

It's all a bit of a shame, really. I mean, we all know that programming is tricky and doesn't work too well at the best of times. Knowing the problems that programming as a discipline has, and knowing that those problems can only get worse, I'm quite certain that if we had to reinvent programming tomorrow, we wouldn't come up with what we've got now. I'm not sure that we'd come up with Lucid either, but that's not the point. The point is that Lucid shows that the theory can be made to work. The fact is we need to be able to take advantage of the enormous body of theory which we have inherited, without being bogged down by the inertia of the current practice which we've been lumbered with.

I've got an idea. I think we should stop teaching programming altogether. Any youngster who expresses an interest in becoming a programmer rather than a policeman or an engine driver should be handed a library of books about programming languages, a computer, and a parser generator, and left to his own devices. Experienced programmers (who, after all, can probably program almost as well as this innocent youngster) should be kept out of sight. And when the youngster declares 'this is how I want to program', anyone who calls 'But you can't, because it's not C' should be forced to program in BCPL.

On a final note, the Lucid book spends some time talking about the impending software crisis. Recalling the book is ten years old, I realised that many of my ideas about what the crisis would be came from there. It suddenly occurred to me: the crisis has been happening for years, but we've all been typing so furiously to try to meet impossible targets, we just haven't noticed. ■

'Lucid, the dataflow programming language' by Wadge and Ashcroft, may still be available. If not, Jules will tell you how good it was if you call him on 01707 662698, or if you email him as jules@cix.compulink.co.uk

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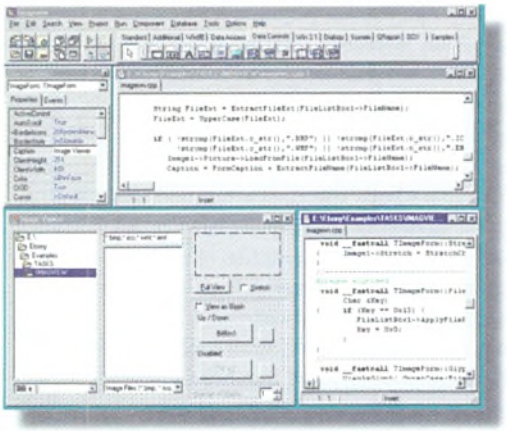


Borland has been working for some time on a project to link its successful C++ compiler technology with the easy-to-use visual environment of its Delphi product range. At the recent SoftDev/WebDev '96 show, it unveiled an early version of this product under the banner of C++ Builder. The visual development environment is the same as that found in Delphi and C++ Builder is also equipped from the bottom up for client/server application development in the same way as Delphi 2.0 client/server edition.

The C++ compiler technology at the heart of the product is based on the successful Borland/Turbo C/C++ compiler, but with significant performance enhancements. In demonstration at Olympia, C++ Builder appeared to compile only slightly slower than the Object Pascal engine in Delphi.

The product is the first genuine 'fill in the blanks' RAD tool for C++, something for which non-Pascal and VB programmers have been crying out for some time. It also makes possible a degree of C++/Pascal integration not previously available. Developers with Delphi installed alongside C++ Builder will be able to freely mix modules of C++ and Delphi Pascal code, use Delphi-built VCL's in C++ Builder projects, and build them all into one final executable, with a single IDE controlling both systems. Full interoperability with Borland C++ is promised.

According to Borland, C++ Builder should be available within the first quarter of 1997. More information is available on the company's Web site at *http://www.borland.com*.

Borland is on 01734 320022

Aonix promises 'end-to-end' modelling development

Tool vendor Thomson Software and modelling experts IDE have merged to form Aonix, which has been working on integrating the two companies' product lines to provide an 'end-to-end' model-based scaleable application development system. The core of the Aonix product line is IDE's *Software through Pictures* visual model development system. A new 'five-dimensional' repository has been engineered into the product, which interfaces with Thomson's client and server development tools to build applications on multiple platforms.

The repository integrates not only traditional application models and business rules, but also project plans, testing procedures and QA models. Aonix is planning to provide integration with third-party tools, notably testing suites and change management software from Pure Atria, Centerline and Forté. Inter-tool communication is handled through the ReposiLink messaging gateway, enabling any tool fitted with a ReposiLink interface to plug directly into the system.

One of the key target deployment platforms for Aonix is Ada; uniquely, its Ada95 compiler is able to generate Java byte-code as well as native binary code. Java is another of the supported platforms, alongside C++, Visual Basic, and 4GLs including Power Builder.

For more information on the complete range of Aonix products and UK pricing information, call 00 415 543 0900, or go to URL: http://www.aonix.com.

Build client/server with a new Vision

Hot on the heels of the recently-released Vision Builder 1.0 comes version 2.0, an improved system for large-scale client/server application development from Vision Software. Vision has developed a system which builds server-side SQL or Oracle code and Visual Basic client code from a single application model held in its repository. Uniquely in the application modelling field, relationships between items in otherwise unrelated tables can be generated using ordinary symbolic mathematical expressions, rather than any generic language or scripting.

The goal is to create a language-independent model of the application at an abstract level which can scale across multiple platforms and tiers. Application, business and data models are built using standard rules, and the encapsulated application definition stored in the repository, where all or some of it may be reused in future projects in the form of active templates. The code generation tools then build triggers and stored procedures in the appropriate language for the server, and in the current release, complete Visual Basic code and project information for the client. Both server and client code can be manually edited and optimised: the Vision code engine automatically recognises which lines have been changed from the original specification and preserves those changes during code regeneration.

Vision Builder 2.0 for Oracle or SQL Server is available at £2999 per seat, or for both at £3750 per seat, with no runtime royalties required.

Vision Software is on 00 32 75281546 *URL: http://www.vision-soft.com*

Mercury Interactive's WinRunner testing suite has been extended to incorporate support for **Nat Systems**' NS-DK and **NatStar** development environments. Non-standard objects built with these tools can now be tested alongside traditional Windows code. 0181 232 9810

Developers targeting the Motorola **68HC11** microcontroller family can get a new version of the **Cosmic Software** C cross-compiler, incorporating a revised parser with advanced precompilation optimisations. 0118 988 0241

Java support has come to the **Forté** Application Environment, courtesy of **Visigenic**'s VisiBroker for Java. Java clients can communicate with Forté servers via **IIOP**, with VisiBroker converting all object interfaces automatically. 01344 482100

PowerBuilder 5.0 Enterprise and Desktop editions are now available for the **Macintosh**. The release provides identical functionality with the Windows versions, and allows Mac clients to run against standard PowerBuilder servers. http://www.powersoft.com

Microsoft's **HTML Help Workshop** is available for downloading from http://www.microsoft.com/workshop/author/htmlhelp/, for developers keen to make the move to HTML-based help for Windows. HTML Help, which is part of the '**active platform**' will eventually be the help standard for all Windows applications.

- Version 2.0 of **Visual Wave** from **ParcPlace-Digitalk** offers expanded support for JavaScript, Java, ActiveX and VRML. Java components will be able to be dropped directly into the Visual Wave environment and used as native parts. 01572 719100

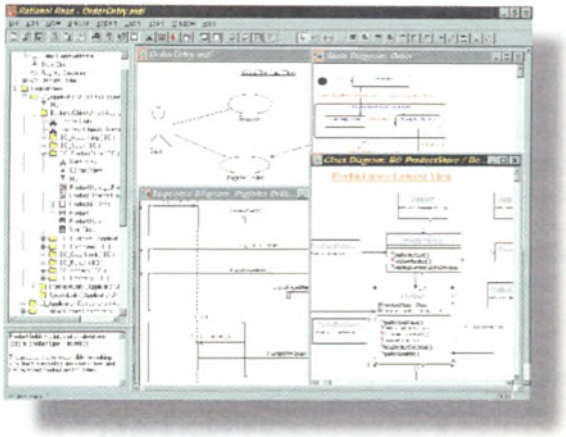
- **Crystal Info** and **Crystal Reports** from Seagate Software are now available for Informix's **Universal Server**. These versions can apparently 'access and report on complex data types in the new Universal Server'. 01628 771299

- Microsoft's **Visual InterDev**, the product formerly known as Internet Studio or Blackbird, is available to download as a beta. Be warned, though – the beta is very large. Alternatively, it can be ordered free of charge on CD from Microsoft. 01734 270002

- Vireo Software's **VtoolsD** 2.04, the VxD development kit, no longer requires users to have a copy of the Microsoft Device Driver Kit installed to use it. By including a copy of Microsoft's WDEB386 device driver debugger and providing the remaining support itself, the package has now become a one-stop VxD solution. 00 1 508 264 9200

- **Oracle** developers can get hold of a copy of the Oracle Web Application Server beta, an HTTP server extender which supplies standard CORBA/IIOP services from Oracle databases to Web clients.

Rose 4.0 implements UML



Having recently acquired Visual Test from Microsoft, Rational Software has launched version 4.0 of its Rational Rose model-based application development system. Rose was one of the first systems to take the modelling approach and to support both the Booch method and Object Modelling Technique (OMT). It now features a full implementation of the Universal Modelling Language (UML) 1.0 specification, as recently agreed. UML has been something of a holy grail in the modelling community, and has been largely developed at Rational by the three men whose individual methods were originally seen as competitors: Grady Booch, Jim Rumbaugh, and Ivar Jacobson. Additionally, Jacobson's use-case technique has been implemented in Rose 4.0 for those developers already using it.

Language support in this version has been improved with full round-trip engineering capabilities provided for C++, Visual Basic, Forte, PowerBuilder, Smalltalk, Ada and Java. Round-trip engineering is the name Rational gives to the process of building source code from the visual model, making changes to the code, and then re-engineering the visual model from the updated source code.

Rose 4.0 is available on Windows NT/95 and most Unix systems, with full Windows 95 interface and OLE automation support on Microsoft platforms.

Rational is on 01273 624814 *URL: http://www.rational.com*

VBA licencees growing in number

Several developer tool and utility companies have announced they are to license Microsoft's Visual Basic for Applications (VBA) for use in their own products. Following Microsoft's announcement that version 5.0 of VBA would be made for licensing, Visio previewed its upcoming Visio Professional product, which has a number of features aimed at the enterprise IT manager, and is programmable with VBA 5.0. Logic Works pledged its support for VBA 5.0 in future versions of its ER*win* client/server visual design tool. One notable exception to this trend, at least for now, is MicroGrafx, whose new flowcharting products will apparently only be scriptable with the more limited VBScript.

If, as seems likely, an increasing number of tools and development environments become VBA-enabled, then the language may become a true *lingua franca* for inter-tool scripting and custom application development based on existing components – something which developers have been promised for a long time but which hasn't yet materialised – on the Windows platform.

Microsoft: 01734 27000 *Visio: 01372 227900* *MicroGrafx: 01483 747526*

The Net according to Big Blue

December's Internet World saw a host of announcements and new products from IBM as part of its overall Internet strategy. Of particular interest to developers were the many Java-related announcements. IBM is taking Java very seriously indeed, and has already released a slew of Java-enabled or related products, including OS/2 Warp 4.0 which runs Java applications straight from the desktop and ships with Sun's JDK; NetRexx, a version of the popular Rexx interpreted language which has come as standard with IBM OS/2, compiles into Java bytecode, effectively allowing developers familiar with Rexx but not Java to write fully-compliant Java applets without a single line of actual Java code; and AppletAuthor, a Java Beans-based visual tool for building Java code for the Web quickly and easily. Other Java projects on the drawing board include net.Mining Services, a set of Java-based data mining classes, and Isis, a set of classes for developing time-based Web content.

IBM officials have been at pains to stress that the company's focus is on the Java Virtual Machine (JVM) and bytecodes rather than the Java language itself; NetRexx will almost certainly be the first of many languages which will be engineered to compile to bytecodes as an option. Information and previews of most of IBM's Java technologies can be found at Alphaworks, an IBM Web site dedicated to ongoing R&D projects. A special IBM Developer Connection CD containing the tools and information from the Alphaworks site along with other tools from companies including Sun has also been made available.

The IBM 'San Francisco' project is moving along at a blistering pace, too. Alpha versions of the code frameworks, written in Java, have been made available to some developers. Only a portion of the expected objects have been implemented so far, however early versions of some of the frameworks should be available early in 1997.

IBM: 0171 202 3744 *URL: http://www.ibm.com* *URL: http://www.alphaworks.ibm.com*

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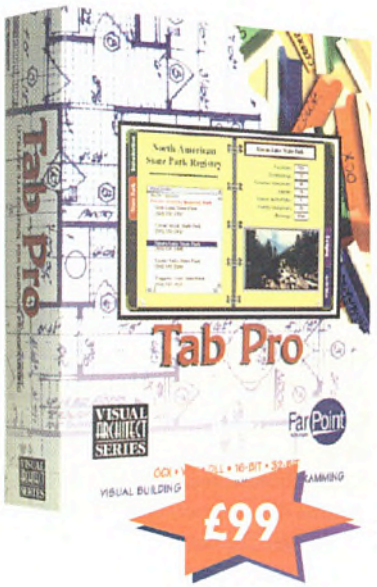

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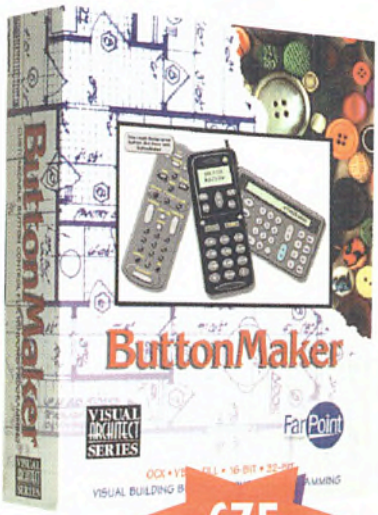

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- Go boldly forth and develop for the Web with **WebCrusader** from Gradient. The product extends a security 'shield' around Web servers and SSL browsers on a corporate network, protecting Web applications built using it. 01279 755247

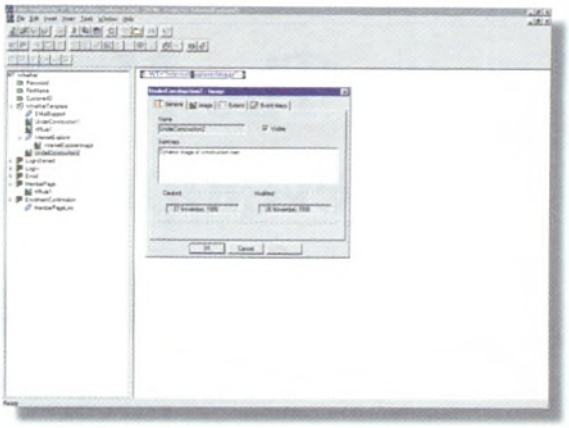
- The **IBM** Voice Type 3.0 developers toolkit for Windows 95 is available for download. With the kit, developers can build applications with integrated support for IBM's voice command and dictation technologies on the Windows 95 platform.

- Users familiar with **Pick's** multidimensional database technology will be interested to know that the **D3** database is available on Windows NT/95. This version maintains the functionality of versions for the Pick operating system, but with a fully graphical look and feel.

- Informix **Universal Server** has shipped on time, according to the company. The server, based on the Dynamic Scaleable Architecture, caters for a variety of rich datatypes which current general servers often cannot handle. 0181 818 1000

- ARM programmers will soon be able to develop for Windows, thanks to a collaboration between Microsoft and Advanced Risc Machines to port the **Windows CE** palmtop operating system to that platform. Look forward to Windows on your mobile phone! 01223 400400

Living on the Edge of the Internet?



Antares Alliance's apparently object-oriented Web development framework, Edge, provides a Visual Basic driven solution for Microsoft platforms. The product is built around Visual Basic for Applications and DCOM technology as shipped with Windows NT 4.0 (and now available in beta for Windows 95). Services and objects on the server are exposed as DCOM objects which the VBA-constructed client software can call across an IP connection as though they were local OLE servers. ODBC-compatible databases on the server can be accessed transparently, as can any other service which can be exposed as an ActiveX object. Implementing server-side services as DCOM objects means that – at present – only Windows NT servers running Internet Information Server can fully service Edge clients: however, this also allows for some fairly clever server-side stuff which would never have been possible with traditional HTTP methods, including persistent objects, custom messaging schemes, and special security protocols.

Since DCOM is the glue which holds both the client and – generally speaking – the server software together, sophisticated integration of tools and other applications can be done at either side: for example, a workstation with Microsoft Office installed could run a custom client which reuse existing Office components through VBA.

A fairly standard IDE is included for constructing scripting and HTML code and the VBA development environment is the same as that supplied with Office 97 (see News, December 1996).

A library of existing Web components to perform common and useful tasks packaged as DCOM objects is supplied with the product.

- *Antares Alliance: 00 1 972 447 5717*
- *A trial version is available for download from the Edge web site at http://www.edgesite.com*

New Gems for Web client/server development

Developers working with the GemStone application object server will shortly have a variety of tools available to them to migrate their projects to the Web. GemBuilder for Web comprises a custom Web server and development environment for the GemScript language; the server integrates a gateway to GemStone objects without the need for any CGI programming, and incorporates transaction management logic features. GemBuilder for Java generates thin Java clients which can access GemStone business objects directly without the need for an application server, by integrating with any one of the leading Java tools including Microsoft's Visual J++, Symantec's Visual Café, or Sun's Java Workshop. The actual GemStone integration tools are provided as Java applets themselves. Finally, GemORB is a Corba 2.0-compliant ORB which provides access to GemStone services to non-Gem clients – for example via Sun's Joe for Java – through Corba.

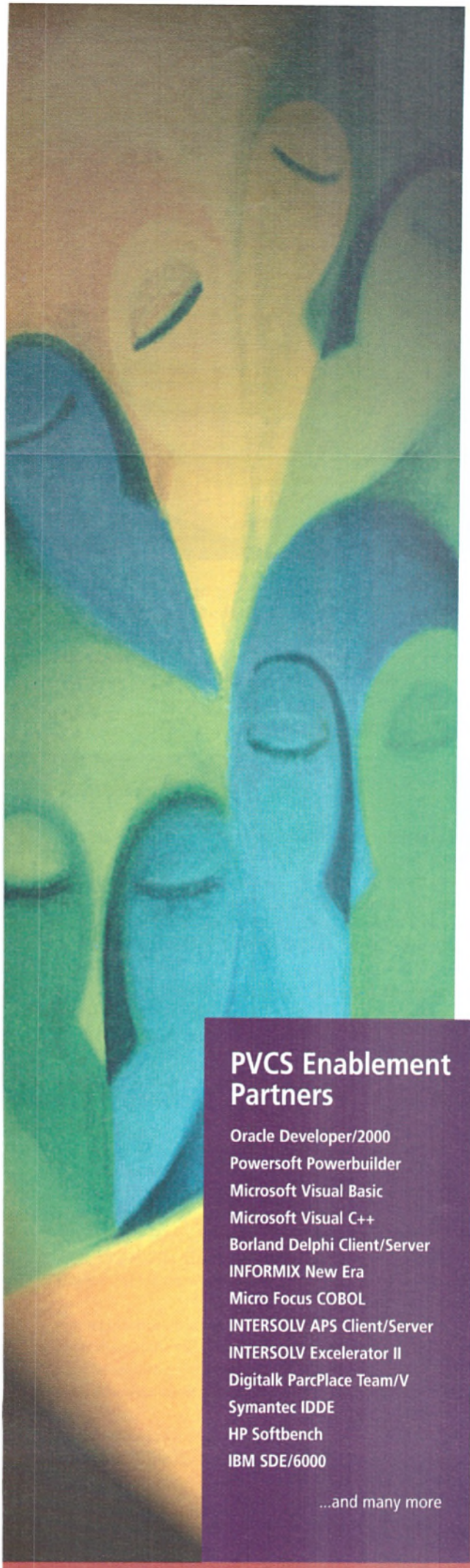
A package of GemBuilder for Web and GemBuilder for Java priced at $5200 per seat on Unix platforms and $4160 on Windows NT will be available within the first quarter of 1997. GemORB will apparently be available in the second quarter.

- *GemStone Systems: 00 1 503 531 2577*
- *URL: http://www.gemstone.com*

Desktop mapping goes ActiveX

MapInfo just added an ActiveX – MapX – to its offering of desktop mapping tools. The strength of MapInfo's tools is to provide easy visualisation for data already available. For example, one could develop a log analysis for Web sites which would plot on a map the number of visitors for each country and possibly offer to drill down to the postcode level. MapX is a cheaper entry point in desktop mapping than products like MapInfo Professional though it provides most of the same functionality. In fact, everything is present apart from the animation layer, buffering capability and map creation. The first two might be added at a later stage. The choice one developer has to make is between MapX, the 32-bit OCX which can be controlled by most languages; MapInfo Professional which is a 16/32-bit solution that also supports OLE automation; and MapInfo with MapBasic. All three products can access local databases directly or remote ones via ODBC. Another recent addition is the MapInfo ProServer which sits just above a CGI-compatible Web site and which delivers information to browsers as GIF files.

- *MapX costs £4170 for 40 seats minimum (£83 per seat plus £850 for the toolkit)*
- *MapInfo ProServer costs £350 per seat with a minimum of 10 seats or £49,000 for an unlimited version*
- *MapInfo is on 01344 482 888*
- *URL: http://www.mapinfo.com*



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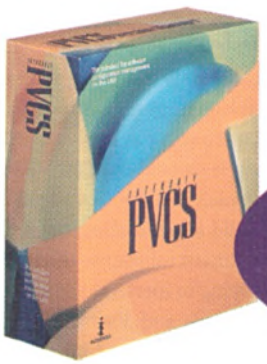

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- **Progress** Software's eponymous Progress, in version 8.1, includes AppServer, a tool for building business objects to be processed on application servers, and SmartObjects, a proprietary reusable component for the Progress system.

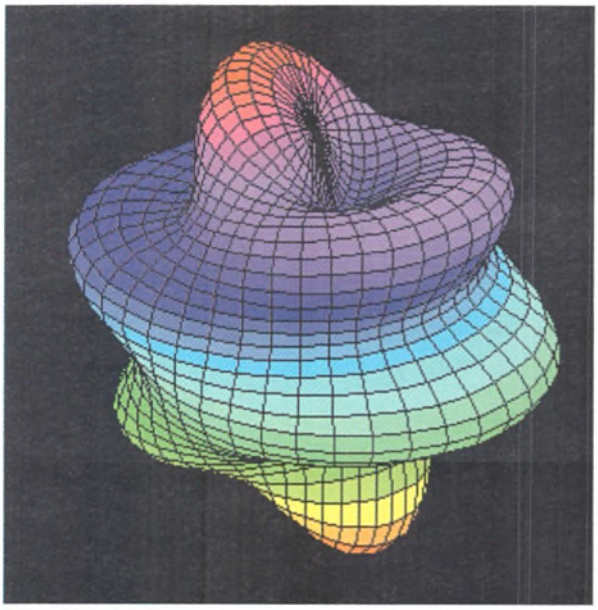
- Oracle **Designer/2000** Web is a modelling and design tool which builds transaction processing applications for the Web. In version 1.3.2, support has been added for dynamic code generation, and the Windows NT 4.0 platform. 0118 924 0000

- Release 5.2 of the **MKS Toolkit** adds a number of extra Web tools including a Perl intepreter, a command line DDE interface, and a number of tools which work in concert with an HTTP server to maintain and update Web pages. 0171 624 0100

- **USoft** Developer 4.1 has been enhanced with native support for DB2 and deployment on Win32s Windows 3.11 systems, as well as Motif on Unix. USoft claims that the features were added in response to user feedback. 0181 891 4000

- User of the **OSE Delta** realtime OS will doubtless be pleased to hear that it now supports run-time loading and unloading of **PowerPC** based embedded systems. This makes automatic software updates via the Motorola standard ELF object format a piece of cake. 01494 465907

Matlab 5.0 from prototype to delivery



The MathWorks is aiming to transform its industrial-strength technical computing platform Matlab into a complete development environment with the release of Matlab 5.0. The package, in beta up to this month, will add an interactive GUI builder, visual debugger, performance profiler and function browser to its mathematical and scientific capabilities. The tools are completely integrated with the rest of the product, supporting the full range of users from engineering analysts to programmers working on final end-user applications.

The core Matlab language itself has been considerably enhanced, with support for customised object data types (with full overloading), multidimensional arrays and sparsely populated matrices. Auxiliary toolboxes have been updated with state-of-the-art differential equation solvers, and improved support for signal processing, simulation and symbolic math. Visualisation performance has been improved by up to two orders of magnitude, and there is now support for a much wider range of rendering methods.

Matlab 5.0 is due to ship this month for Windows 95, NT, Mac, Power Mac and Unix platforms with pricing starting at £1,500 for a single-seat licence. Support for OpenVMS and Linux is planned for a future update. It is distributed and supported in the UK by Cambridge Control.

Cambridge Control: 01273 722838 *URL: http://www.camcontrol.co.uk*

Select Component Manager supports Microsoft CIM

Modelling-tool specialist Select software has moved into the component library and re-use arena with a repository under the name of Select Component Manager. The manager stores components, their source code and binaries either locally or remotely, and provides an object browser which can be used across any IP network. Required objects from several repositories can then be brought together in the development environment and assembled into a working product in minimal time.

The Component Manager conforms to Microsoft's Component Information Model (CIM), a design intended for the eventual Microsoft repository expected to arrive with Windows NT 5.0. Substantial portions of the new operating system will probably be stored in and retrieved from similar databases. Select sees a market opening up for custom applications to be built from collections of stored objects in these sorts of repositories. Additionally, the manager can act as a service provider on the Web, making the components held within available to the Net (if necessary at a charge) or auto-notify interested parties of additions or deletions from its library.

Select: 01242 229800 *URL: http://www.selectst.com*

Novell's DeveloperNet 2000

DeveloperNet 2000, the Novell developers' program formerly known as Net2000 has been expanded to include free online access to SDKs, more software and technical information (the Novell Research anthology CD). To register and access the whole content online is free. If you want to receive a quarterly set of CDs then it costs about £200 ($345) per year. In addition to the SDKs, journals, support, and CBTs, DeveloperNet includes the Novell Software Connection Library: a 100-user licence for all Novell's products. This should allow testing the scalability of your development without having to make any serious software investment (of course the licence is only for test purposes).

Novell is trying to increase the adoption of its NetWare Directory Services (NDS) by distributing a royalty-free source code and distribution licence for NDS to operating system developers. In addition, it is set to distribute a single-server binary version of NDS on NT. Novell has reached a 'strategic alliance' with Sun regarding Java technology and products. One result of this alliance is an ongoing work to specify Java access to directory services.

On another note, Novell released Collexion Natural Language Interface for Help Software Developers Kit or NLIH SDK in short. It is based on the 'Ask Me' technology. It is available in English, French, German, Spanish, Italian and Dutch for Windows 95 and NT.

DeveloperNet part number is 172-000761-001 *Novell is on 01344 724 000*

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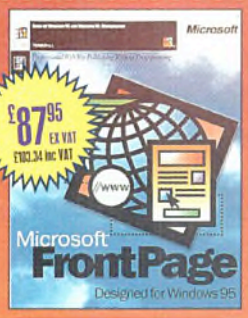

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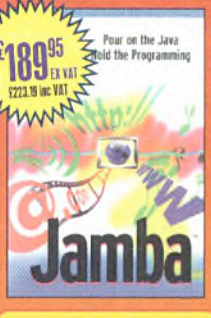

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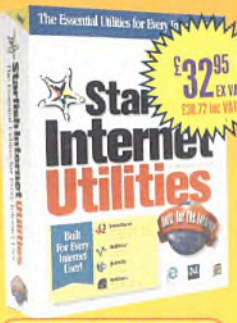

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Carving up bugs

Dear Editor,

I thought the November issue of *EXE* was excellent: full of interesting articles. Particularly I liked Peter Collinson's *Programming Projects*. The article by Mark Harman, *Carving up bugs*, had some oddities, no doubt because of slips in editing somewhere along the line:

a. The paragraph at the top of column 2 ends, '[If we use input value 0] we will find that the variable `p` contains the wrong value.' But what is the *right* value for `p` in this case? (The spec doesn't say. The spec is given in column 1: 'The program is supposed to calculate the sum and product of the sequence of numbers from 1 to the input number `n`.' What *is* the product of the sequence of numbers from 1 to 0 – if not 0?)
b. In the middle of column 2 it says, 'We shall say that we shall construct a dynamic slice *for* a variable *v*, *at* a point *p*, *on* an input *i*.' What does '*at* a point *p*' mean? The article doesn't say.
c. At the bottom of column 2 it says, 'Listing 3... clearly highlights the bug in the original program!' Does it? There are surely two problems with the program as regards inputs less than 2: (1) what to do with input 0 is not defined (see (a) above); and (2) input 1 would not work unless '`s=0`' were changed to '`s=1`' or '`while (n>1)`' were changed to '`while (n>0)`'. The only line printed in Listing 3 is nothing to do with any particular value of input.
d. The title of Listing 4 implies that that is a listing of the output of a dynamic slice, whereas the text (bottom of column 3) refers to the 'program [not slice] in Listing 4'. And the title of Listing 5 ('A *more* dynamic slicing of listing 4') suggests, incorrectly, that there is somewhere a less dynamic slicing with which to compare Listing 5.
e. The second paragraph of column 4 starts 'However, a more precise slice that can be constructed from this criterion is shown in Listing 5.' What is 'this criterion'? The article doesn't say. (It appears from later in the article that the author had in mind input value greater than 0.)
f. The second paragraph of column 4 continues 'We do not need to include the line `y=x+2;` because this line does not contribute to the final value of `y` when the last input is greater than zero.' There's nothing wrong in itself with this sentence, which reminds us that although the program in Listing 4 writes to y 5 times, it's only the value written the 5th time that matters. But the article doesn't explain why it should choose as an example such an odd program!

Alan Leadbetter
Tunstall, Stoke-on-Trent

Here's a reply point-by-point by the article's author:

a. Yes. You're quite right. The input which I should have used is 1, not zero. This will have the effect I was seeking; the dynamic slice will contain the incorrect initialisation (p=0;) alone.
b. In slicing terminology 'at' translates to 'immediately before'. Sorry if this wasn't made clear.
c. I don't agree. As you have pointed out the specification does not define the value of p when n=0. When n=1, however, the specification (both that as printed and that I intended) defines p to be 1. Now this can be corrected by replacing the line p=0; with p=1; but cannot be corrected by replacing the while loop predicate with n>0.
d. I don't think this is confusing (but then I would say that). Listing 4 is a program. The program indicates the subtlety of dynamic information (as the caption says). Now in the text I talk about slicing this program (both statically and dynamically) observing that both the static slice and the dynamic slice (when constructed naively, without reference to this 'subtle dynamic information') are the entire program. Hence Listing 4 is a program and is also the result of (naively) slicing the program.
e. Listing 5 shows that a smaller dynamic slice of listing 4 is possible if we take account of this 'subtle dynamic' information. That is we need not get the whole program as our slice. The slicing criterion is that referred to in the previous paragraph.
f. The programs are intended to illustrate interesting situations. The contribution of the article is to show how dynamic slicing can assist debugging and to explain some of the interesting technical issues surrounding the construction of a dynamic slice. Interesting issues often arise in 'odd' situations rather than 'normal' ones.

Mark Harman

From Romania

Dear Editor,

[...] I'm coming back to beg you something very important to me: I badly need some books, technical articles and software about neural networks, expert and fuzzy systems with applications in control process systems (especially electric). [...] I also beg you to publish excerpts from my letter in your editor column. Maybe someone from UK will help me for my Ph.D. dissertation, which deals with *Neural Networks Trained by Expert Systems for Electrical Power Stations,* and send me some software packages (Amzi! Prolog+Logic Server or LPA Prolog) too.

My name is Doru Turturea, and I'm 38 years old. I'm working as Senior Software Engineer at the Electrical Engineering Center/Dept. of Computer Science, in Bucharest, the capital of Romania. Here, I'm developing graphical user-interfaces, multimedia presentations and expert systems shells, using object-oriented techniques and the C++ language, under Windows 95, Delphi 2.0, Microsoft Visual C++ 4.1, and Microsoft Office Pro 7.0 for Windows 95. Recently, we acquired Windows 95 and three Pentium Digital Celebris GL 5166 with CDROM and CD-R.

Unfortunately, the financial situation is very bad in Romania and we – the experts – are poorly paid (the salary is under $200 per

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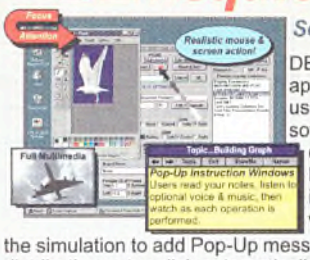

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month!), so you realise the difficulties we are facing. The official rate is US$1 = 3600 Lei, but at the exchanges houses you buy it at 5000 Lei! In November, we held both presidential and legislative elections and they were won by the democratic forces which succeeded to overthrow the communists from power; we voted for a real change and we hope the things will get better! I forgot to mention that I'm still the Secretary of the Romanian ACM Chapter and member of the IEEE Computer Society, and I have written five books: *Introduction to OOP & C++, All About Windows 3.1, Office Windows Applications, Programming Windows Applications in C & C++, (two volumes), Lotus Notes* and I translated *Unauthorized Windows 95*. I wait impatiently an answer from you. [...]

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Crossing the 't's

Dear Editor,

Being only a very occasional reader of *EXE*, I didn't see the October issue, but it sounds like your worst nightmare! Your idea of it being caused by a 'missing' eighth bit is basically flawed, I think. Just striping the MSB will not produce a space for all extended characters – you would get that character minus 128. For example, the ASCII code for the 'tick mark' character is 251; if you subtract 128 from this, you get 123, which is the left curly brace '{' character.

What you describe is actually character *transposition* – if it really was a space that was output. I was thinking that it could easily have been a character code which the Linotype rejected as being invalid and by accident or design, the Linotype advanced a character position right and the driving software didn't throw up an error of any kind. I have certainly seen PC printers behave like this, especially daisy-wheel printers in the days of WordStar v2 on CP/M – whoops, that's a bit of a give-away, age-wise... ;-)

What you didn't make clear was whether the typesetters can reproduce the same problem *now*. Or they could 'fake' it by sending all the characters between chr(0) and chr(255) in that font to the typesetting machine – at least that would probably rule out that side of things. One has to be like Sherlock Holmes in these situations, and remember his maxim: 'after eliminating all other possibilities, the remaining one – however improbable – must be the truth'. I wish you all the best of luck in your sleuthing endeavours.

If all else fails, you should blame it on electrical disruption in the processor at an atomic scale caused by unusual cosmic ray activity on that day at that location. It never fails and it is completely impossible to prove or disprove!

Nick Ramsay

I prefer Occam's razor theory which states that 'Entities should not be multiplied unnecessarily' ('Entia non sunt multiplicanda praeter necessitatem') in other words if two theories explain the facts equally well then the simpler theory is to be preferred. The cosmic ray activity has been disproved (see Letters last month). – Ed

Software amateuring

While I agree with everything that David Mery says under 'Software amateuring' (SoapFlakes, *EXE* Dec '96) I think it's worth pointing out that Windows NT has had memory protection and pre-emptive multi-tasking for quite some time. Even Windows 95 and Windows 3.1 will pre-emptively schedule different virtual machines with respect to one another and have far superior memory management to that provided by Apple.

The sad fact is that the Apple Macintosh was designed by a group of enthusiastic amateurs and, after all these years, still bears the scars of that legacy. Right from the word go, Andy Hertzfeld, Bill Atkinson and the other 'software wizards' on the Mac development team demonstrated an ignorance of basic software design principles by failing to adequately decouple the implementation of the operating system from the application's interface code.

A good case is point is the naively simplistic implementation of moveable memory which involves nothing more complicated than double indirection through a so-called 'master pointer'. Apple happily told developers how memory handles were implemented, meaning that every man and his dog were then free to access memory without bothering to lock the handle first. Not only was this technique widely used outside of Apple, but the same lazy approach could often be seen in Apple's own code! This happened because the company was not far-sighted enough to realise that such an approach would have disastrous consequences when moving to a system that has real memory protection. Effectively, they tied themselves into an architectural straitjacket and encouraged others to add a ball and chain, handcuffs, and throw away the key.

Now contrast this with Microsoft Windows. From the start, a Windows memory was just a 'magic cookie' from the viewpoint of the application and it's still that way today. It wasn't until people like Schulman and Pietrek came along and started disassembling everything that the Windows memory manager finally gave up its secrets. As a consequence, most Windows applications ported from real-mode to 286 protected-mode (and then to 386 virtual-memory mode) with little or no effort. As another consequence, many, many applications that were designed to run on Windows 3.1 or Windows 95 will run quite happily under NT where a radically different memory manager is being used.

And I'm afraid it's just the same story on the hardware front. As I write, I have on my desk a comparative review of an Apple Mac and a Mac-clone (the Umax Pulsar 200). The review (*PCW*, January '97) makes the point that 'All Mac clones are based on Apple's motherboard designs'. Ever wondered why that might be the case? The reason, quite simply is because there are just so many hardware-dependent assumptions in the operating system code. Only Apple knows how to make motherboards that are compatible enough to work with its otherwise incompatible operating system.

Imagine the uproar if NT only worked on AMI or Panrix motherboards, for example. In reality, NT is not only the most capable, but also the most portable operating system that Microsoft has.

It must be at least seven or eight years since I was heavily involved with Macintosh software development. At that time, most machines were running System 6 in one form or another. Now, after all this time, those machines are running System 7 and Mac users are still waiting for real pre-emptive multi-tasking, decent memory protection, and more. Maybe I should be surprised that Apple's core operating system technology is moving at such a glacial rate? Not at all. Given what I discovered about the internals of the system (I spent many happy hours pulling the Mac ROM's apart!) I'm surprised that it's moving at all. We're talking about the difference between professional software engineers on the one hand and enthusiastic software amateurs on the other. The difference couldn't be more marked.

Dave Jewell
djewell@cix.compulink.co.uk

I fully accept your comments regarding NT (which happens to be also true for one previous Microsoft operating system: MS-OS/2) but Windows 3.x and Windows 95 do not have a correct implementation of either multi-tasking (not even mentioning the lack of multi-threading) or memory protection. For a start pre-emptive multi-tasking is limited to VDMs but even though, a VDM can crash the whole system. Windows 3.x and 95 have too many problems (aka bugs) to be considered as examples of great mastering of operating system engineering. As for NT working on all motherboards, the fact is that we have just had one of those motherboard where NT is regularly crashing. It is possible that the motherboard is defective though. – Ed

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Practical JAVA

You know it's out there. Every client you meet wants it. Vendors are falling over themselves to sell you tools for it. And yet from the applications you see, hardly anyone seems to be doing anything meaningful with it.

There are reasons, of course. Java's security is so strict that most traditional application areas are a dead loss. Applets cannot read or write local files and can only access the server they came from. There is no support for things like printing. You can see why most applet demos are just pretty animations. These limits may disappear, of course: with the new security API in JDK 1.1, trusted applets could have access to other servers. Tools and protocols for interoperating with databases (such as JDBC) and distributed object technologies such as CORBA and DCOM will also widen the possibilities. Most of these, however, are not available to everyone, and if you want, say, to get experience of the language before shelling out for an expensive development environment for it, you'll have to use a simpler approach.

I've written the HelpIndex applet for providing Web site indices, which does just this. The content provider runs a Java program (MakeHelpIndex) off-line on the server to create an index file of keywords and their links to pages. This file is then downloaded by the client applet, which uses it to present the user with a searchable keyword database. The security remains intact, and nobody has to get nailed to anything. You can download HelpIndex, along with its source code, from *http://www.phdcc.com/helpindex/index.html*.

Like with various help systems, the user can type in the first few letters of their search string. The matching indices and their pages are listed automatically. The screenshot in Figure 1 shows the results of the user typing *J*, and selecting *Java applet* from the matching pages displayed. A standard server based search for 'Java' on the PHD site threw up over 200 hits; it would be difficult to know which page to go to.

Incidentally, one good use of HelpIndex is to provide an index for all the fields and methods of an API. The standard JDK *javadoc* program is used to produce Web page documentation for an API from suitable source code comments. One of its standard outputs is an alphabetical listing of all fields and methods. If you want to look up the `getAddress` method, then you have to click on the *G* short-cut link at the top of the page, then scroll down through all the `get` methods until finally you get to where you want. HelpIndex allows you simply to type in *get*; then the `get` and `getAddress` methods are listed as indices – much easier.

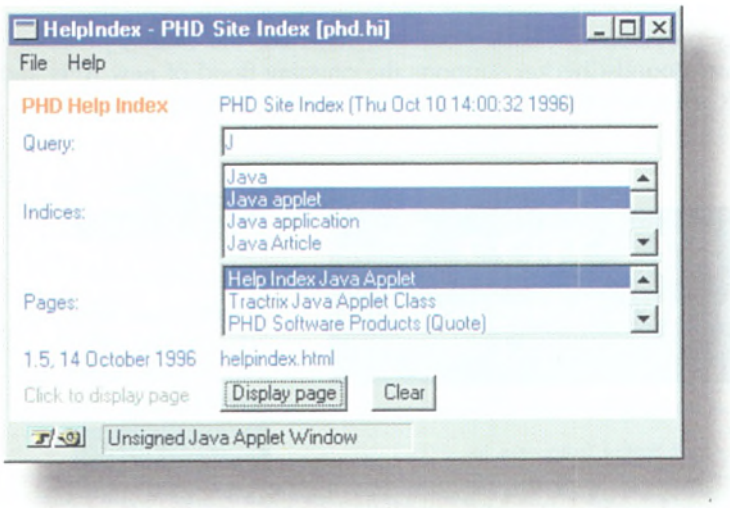

Figure 1 – The HelpIndex applet indexing PHD's Web site.

How to be API

A language or operating system is usually seen in terms of the libraries or classes that come as standard. Originally C had `printf` and the like. C++ had its streams (which I never used). Unix had `exec`, etc (in 1000+ forms). PC BIOS had `INT 10` to `1F`, and `DOS INT 21`.

With the explosion in Internet technology, practically every rival supplier is trying to outdo all the others (not least with acronyms) in providing easy (huh!) ways to lock in, sorry, support users and provide content. So, how is Java faring in this minefield? In particular, what are the baseline class libraries actually like?

The standard JDK API packages include *java.lang*, *java.util* and *java.io*, which provide some of the basic language features such as the `Thread`, `Exception` and `Vector` classes, and support for files and various streams and pipes. The *java.net* network package provides access to TCP/IP sockets, and a URL class for accessing Web pages. There is no core support for SMTP or POP3 mail protocols, but Gamelan has links to applets that can deal with these.

Version 1.1 of the JDK (currently in beta) is catching up fast with other technologies, with support for digital code signing and Unicode-based internationalisation. Unfortunately, the JDK (and the Java language itself) is still in its youth, and will not settle down for quite a while. This may hinder Java's adoption, or at least annoy its practitioners.

Take your pick

Everyone and his dog is writing a Java development environment. Masochists can just get by with the command line tools provided with the JDK. Currently, I am one step up, using Symantec Café Lite *(sic)*, on a CD-ROM from one of the SunSoft books.

I have looked at Sun's Java Workshop 1.0. This has potential, but I found it unusable, mostly because of small but important irritations, like its slowness. In addition, if you use its Visual Java classes (which extend AWT), then you could force users to download an extra 450 KB of files over the Net.

I have not tested Microsoft's J++ (why is that ++ there?), Borland's Open J Builder, Symantec Café or Aimtech's Jamba, not to mention IBM's Visual Age for Java, Scientific Computers' BX-Pro or Software Technologies' X-Designer. Iona has produced a Java-based ORB, Orbix Web 2.0, and Object Design a lightweight persistent object store (PSE Pro).

Sun has a list of its current and proposed Java APIs at *http://java.sun.com/products/apiOverview.html*. Highlights include JDBC, which provides low-level database access akin to ODBC, and IDL and RMI which deal with remote objects (soon to be supported by a Netscape plug-in). Interestingly, there is a new concept of 'servlets', applets which run on a server. Other APIs cover security, financial transactions, network management, multimedia, data sharing, telephony, and 2D and 3D graphics. Sun's contribution to the confusing world of software components is of course the eponymous Java Beans.

Then many suppliers are offering libraries mostly built on top of the JDK to extend the AWT. Some may choose Netscape's Internet Foundation Classes as the baseline for new development (it will be reviewed in detail in a forthcoming issue). It adds more user interface controls, simple animation, drag-and-drop functionality, timers, multi-font text and a persistent object store. Netscape has also licensed Visigenic's VisiBroker for Java CORBA 2.0-compliant ORB. However, you must ask how many users will actually have all of the latest classes. Unless IFC is built into other browsers, to wit IE3.0, then you will be restricting your audience to Navigator 4 users, since no-one will want to download the 500 KB package just to run your one applet.

Strangely enough, things have been quite quiet from that notorious API generator, Microsoft (apart from applet CAB cabinets). Visual J++ adds the ability to talk to COM objects, but this has been done pretty transparently. IBM's San Francisco project (and indeed the rest of the company's interest in Java), on the other hand, is sure to contribute extensively to the language's repertoire.

Being AWTward

Despite the improvements promised in JDK 1.1, the Abstract Window Toolkit (AWT) has proved too limited to establish any real user interface standards. Although its handling of layouts to cope with different screen sizes is valuable, the rest of the toolkit is nowhere near the document/view architecture most developers are used to, and only just provides enough functionality to be workable. The limitations are such that practically every tool vendor is pushing its own windowing extensions, no doubt with proprietary resource formats. It may not be ideal, but *java.awt* is the only system likely to be present on every system, so it is best to get to know it. Because of this, HelpIndex is based on AWT.

To allow for display-independence, AWT lays out *Components* (input fields and the like) in *Containers* (windows and dialog box forms). When placing components, you don't specify absolute locations, but instead provide a `Layout` class with a preferred size and order, and let it get on with the actual layout. This is only one way in which it differs from many other GUI toolkits: it has some sort of event model, but I have been unable to find an event loop. It lacks support for tabbing between fields and default buttons, which are instead handled in HelpIndex by the `GridBagForm` class.

User interactions are relayed via a set of 30+ events, which in JDK 1.02 are passed to components' `handleEvent` methods. These functions can either handle the event locally or pass it up to the parent's `handleEvent` method. By default, events are passed to the `action` method for such things as button presses and menu selections, or to event-specific methods like `keyDown`, `keyUp`, `gotFocus`, `lostFocus` etc. If you want a parent class AWT component (for example a `TextField`) to receive an event, you should return `false` from these methods.

Having received an event, how do you know which object it has come from?

The simplest technique is to associate a variable with each component you create. Alternatively, some of the poor examples in the JDK actually rely on matching a button's label. Change the label and you have to change your code: yuck!

A better technique (methinks) is to have an integer ID for each component of your form. HelpIndex's `GridBagForm` class (in Listing 1) provides this facility wrapped round the `GridBagLayout` class. The event handling code uses the `GridBagForm.getIdFromComponent` and `GridBagForm.getComponentFromId` methods to associate components with their IDs. Obviously, you could just subclass custom components with IDs from each normal component, but keeping the IDs within the container allows you to handle such things as tabbing between components.

Class war

As a C/C++ person, I am used to tracking allocated memory carefully. Of course, this goes out the window with Java, since it deals with all the allocation and garbage collection issues itself. As a result, its concept of object variables threw me a bit at first. For example, when I wanted to make a bit of room around one of my screen components, I tried to override the standard AWT `insets` method as follows:

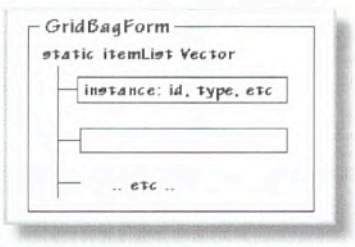

Figure 2 – The GridBagForm class.

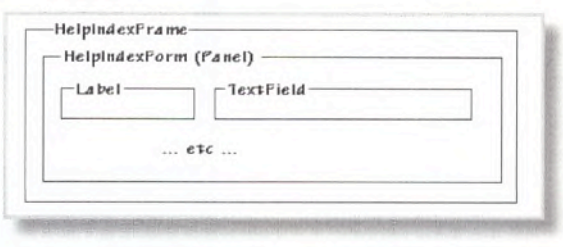

Figure 3 – The HelpIndexFrame component.

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```
public Insets insets()
{
   Insets ri = super.insets();
   ri.left += 5;
   ri.right += 5;
   return ri;
}
```

The problem is that `ri` in effect points to the parent's `insets` member, so the additions will affect the parent. This might cause a problem as this routine could be called many times. A better solution is to return a new `Insets` instance.

```
public Insets insets()
{
   Insets ri = super.insets();
   return new Insets(
               ri.top,ri.bottom,
               ri.left+5,ri.right+5);
}
```

It is currently advisable to keep the number of classes in an applet to an absolute minimum, to reduce download time. This definitely goes against the grain of conventional methodology, as it tends to make code less understandable. Object-oriented programming enthusiasts will no doubt be turning in their swivel chairs, objecting.

It can be very difficult to avoid multiplying classes: even a simple structure must be defined as a class. You can sometimes get away with an array-of-objects solution, but this is messy. New exceptions, too, mean new classes, so you should try to reuse more generic ones.

In some situations, you can get away with having a static class represent a collection of instances. This technique is used in `GridBagForm`, where each instance is an individual form component, and the static class is used to manipulate the whole form. As you can see in Figure 2, `GridBagForm` has a static vector (called `itemList`) which holds all of the applet's individual `GridBagForm` instances. Obviously, you can only have one such collection in your program, and this won't work if there are multiple instances of an applet, since static classes are shared between all the applet instances. In general, you should be *very* careful with static variables in multiple-instance applets.

Applet programming

It used to be a cardinal sin for an applet to put up any sort of child window, even a message box, since these windows could frequently lock up the computer. Even now it is best to try to work within your provided boundaries. HelpIndex can run in two modes: from within a page or as an icon which, when clicked, brings up the search form as a floating window above the browser. Floating windows are derived from the `Frame` class, and unlike applets can resize themselves and have menu bars.

HelpIndex copes with the two modes with the `HelpIndexForm` class, which extends AWT's `Panel` class and acts as a container for all the form components. In 'applet mode', this form is simply added to the applet container. In 'floating window mode', clicking the icon results in a new `HelpIndexFrame` window class being created, and the form being added to it, as shown in Figure 3. `HelpIndexForm` can thus handle all user interaction independent of how the applet is being run.

The following simplified code shows how the floating window is created. It is not clear whether the preferred size for the frame returned by `preferredSize` is supposed to include the borders, but you do need to add something, so the code adds the frame's insets [`preferredSize` is replaced in JDK

```
//  HelpIndex: (c) 1996 PHD Computer Consultants Ltd
//  see http://www.phdcc.com/helpindex/index.html
//  GridBagForm statically represents a whole form
//  instances represents individual components on form

import java.awt.*;
import java.util.Vector;

class GridBagForm {
// Class constants and variables
  public static final short FORM_LABEL = 1;
  public static final short FORM_TEXTFIELD = 2;
  public static final short FORM_TEXTAREA = 3;
  public static final short FORM_LIST = 4;
  public static final short FORM_BUTTON = 5;
  public static final short FORM_SCROLLBAR = 6;
  public static final short FORM_CHOICE = 7;

  private static boolean inited = false;

  private static Container      container  = null;
  private static GridBagLayout  gridbag    = null;
  private static GridBagConstraints constraints= null;
  private static Vector         itemList   = null;

  private static int TabCurrent = -1;
  private static int itemCount = 0;
  private Component  component;

// Instance variables
  private int      id;
  private short    type;
  private String   name;
  private short    size;
  private Color    bgColour;
  private Color    fgColour;
  private String   statusText;

private GridBagForm(int _id, short _type, String _name, short _size,
                    Color _bgColour, Color _fgColour, String _statusText) {
  component = null;
  id = _id;
  type = _type;
  name = _name;
  size = _size;
  bgColour = _bgColour;
  fgColour = _fgColour;
  statusText = _statusText;
}

public static void init( Container _container, Font font,
                         int anchor, double weightx, double weighty) {
  container  = _container;
  itemList   = new Vector();
  gridbag    = new GridBagLayout();
  constraints = new GridBagConstraints();
  constraints.anchor = anchor;
  constraints.weightx = weightx;
  constraints.weighty = weighty;

  if( font!=null) container.setFont(font);
  container.setLayout(gridbag);
  TabCurrent = -1;
  itemCount = 0;
  inited = true;
}

public static Component addComponent( int id, short type, String name,
                int size, Color bgColour, Color fgColour, Font font,
                String statusText, int gridwidth, int fill) {
  if( !inited) return null;
  GridBagForm newItem = new GridBagForm( id, type, name, (short)size,
                                         bgColour, fgColour, statusText);
  if( newItem==null) return null;
  switch( type) {
    case FORM_LABEL:
      newItem.component = new Label( name);
      break;
    case FORM_TEXTFIELD:
      newItem.component = new TextField(size);
      break;
    case FORM_LIST:
      newItem.component = new List(Math.abs(size),(size<0));
      break;
    case FORM_BUTTON:
      newItem.component = new Button(name);
      break;
  }
```

Listing 1 – The HelpIndex applet *(continued on page 22)*

1.1 by `getPreferredSize` – Ed]. The `resize` call must come after `show` for compatibility with IE3.0.

```
ourFrame = new HelpIndexFrame
       (this,FrameTitle);
ourForm = new HelpIndexForm(this);
ourFrame.add("Center",ourForm);
ourFrame.show();
Dimension frameSize =
       ourFrame.preferredSize();
Insets frameInsets =
       ourFrame.insets();

ourFrame.resize
       (frameSize.width+
       frameInsets.left+
       frameInsets.right,
       frameSize.height+
       frameInsets.top+
       frameInsets.bottom);
```

If you are working with your own visible frame, then you'll need to derive your own class from `Frame`, at the very least to catch all `Event.WINDOW_DESTROY` messages and set up the window's menu bar at construction time.

Green light

It is worthwhile checking that your applet works with the common PC browsers, Netscape 3.0 (NS3.0) and Internet Explorer 3.0 (IE3.0), which do have some significant differences. Ideally, you should test on other platforms and earlier browser versions as well.

Unless you are using one of the new development systems, you usually need to stop and restart the browser whenever you want to test any changes to the applet. This is a bit of a bore. You can solve the problem by setting the disk and memory cache sizes to zero, at the expense of performance.

IE3.0's Java implementation seems slightly behind NS3.0. For a start, NS3.0 lets you set the foreground colour of `Label` components. Perhaps more importantly, only NS3.0 generates the `MOUSE_ENTER`, `MOUSE_EXIT`, `GOT_FOCUS` and `LOST_FOCUS` events. In IE3.0, if you make a Java call to show a web page, where the URL is a local file with an anchor name, then the page is not displayed. To its credit, though, IE3.0 supports the ZapfDingbats font, which has a horde of useful symbols.

One area that causes a lot of confusion is exactly how browsers start and stop applets when users navigate between pages. First, it needs to be pointed out that applets seem to keep running and try to keep the input focus when the user moves to another page, which is a decidedly poor situation in my opinion. At the very least, I would have expected an applet's threads to be suspended.

In addition to the standard static initialisation and `finalize` methods, applets have `init`, `destroy`, `start` and `stop` methods. The first time an applet it run, a new instance of the applet class is created, its static initialisation is performed, `init` is called, then `start`. Fine.

When you leave the applet's page, `stop` is called. If you then go back then the applet is still there and `start` is called again, so `start` might be the appropriate place to bring the input focus to the desired initial place. You might deem it necessary to perform all initialisation in `start`.

Now, in NS3.0, but not IE3.0, if you reselect a link to an applet's page (as opposed to just going *back* to it), then the applet is restarted in a rather odd way. The static initialisation is *not* called, but a new applet is created and `init` and `start` are called. In other words, all the applet's components need to be rebuilt, so be very careful to make sure that your `init` method handles this case properly. To be completely safe, you might want to perform all the initialisation of your variables and classes in `init`.

The `destroy` method is supposedly only ever called when the browser is shut down. I have not confirmed this yet.

Decreasing reponse time

Threads are a real boon for speeding up the response time for users. If there is a long task to be performed at start-up, it is better to do it in a separate thread started in `init`,

```
  if( newItem.component==null) return null;
  newItem.component.setBackground( bgColour);
  newItem.component.setForeground( fgColour);

  if( font!=null) newItem.component.setFont(font);
  constraints.gridwidth = gridwidth;
  constraints.fill = fill;
  gridbag.setConstraints( newItem.component, constraints);
  container.add( newItem.component);
  itemList.addElement( newItem);
  itemCount++;
  return newItem.component;
}

public static int getIdFromComponent( Object component) {
  for( int i=0; i<itemCount; i++) {
    GridBagForm thisItem = (GridBagForm)itemList.elementAt(i);
    if( component==thisItem.component) return thisItem.id;
  }
  return 0;
}

public static Component getComponentFromId( int id) {
  for( int i=0; i<itemCount; i++) {
    GridBagForm thisItem = (GridBagForm)itemList.elementAt(i);
    if( id==thisItem.id) return thisItem.component;
  }
  return null;
}

public static void start() {
  //  browsers complain that neither TabCurrent nor itemCount can be
  //  accessed.
  //  TabCurrent = itemCount-1;
  Tab(true);
}

public static void Tab( boolean onwards)
{
  if( !inited || itemCount==0 ) return;

  // look for next item for focus
  for( int i=0; i<itemCount; i++) {
    if( onwards) {
      if( ++TabCurrent >= itemCount) TabCurrent = 0;
    } else {
      if( --TabCurrent < 0)          TabCurrent = itemCount-1;
    }

    GridBagForm thisItem = (GridBagForm)itemList.elementAt(TabCurrent);
    if( thisItem.type != FORM_LABEL) {
      thisItem.component.requestFocus();
      break;
    }
  }
}

public static String GotFocus( Object component) {
  if( !inited) return null;
  // serach for the new focus
  for( int i=0; i<itemCount; i++) {
    GridBagForm thisItem = (GridBagForm)itemList.elementAt(i);
    if( component==thisItem.component) {
      TabCurrent = i;
      return thisItem.statusText;
    }
  }
  return null;
}

public static String statusText() {
  GridBagForm thisItem = (GridBagForm)itemList.elementAt(TabCurrent);
  return thisItem.statusText;
}
} // end of class
```

Listing 1 – The HelpIndex applet (continued).

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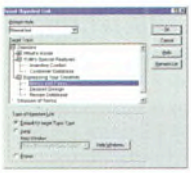

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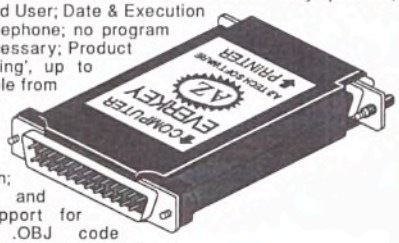

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since the applet will not be displayed until `init` returns.

HelpIndex's `init` starts a thread to download the index from the server (which may take several seconds), and displays a status message until it has been read. The user can type away into the applet's fields, but a lookup does not occur until the index has arrived.

The lookup task itself is also performed within a separate thread, since it can take a couple of seconds for large indices. The thread is carefully designed so that it can be stopped and restarted when another key is pressed. Cooperation between threads is accomplished with the `synchronized` keyword, which can be used on individual blocks, as well as entire methods, as this simplified example shows:

```
private Thread TaskThread = null;
private void DoLookup() {
   synchronized(this) {
      if(TaskThread != null)
         TaskThread.stop();
      TaskThread = new Thread(this);
      TaskThread.start();
   }
}

public void run() {
   LookupIndices(QueryField.getText());
   synchronized(this) {
         TaskThread = null;
   }
}
```

HelpIndex's `keyUp` routine simply calls `DoLookup`. If there is a search in progress, then it is stopped and a fresh one started. The actual search is done in `run`, as the applet `implements Runnable` to do the thread's work.

Overall, there is a lot to get right in a fully functional Java program. Despite the buzz still surrounding the system, both the language and its libraries are still young and evolving. There is a positive side to the excitement, though: there are various places where you can register your applet to make it visible to as many people as possible. In the US there is Gamelan, the UK has Java Centre, and JARS rates applets as well. (As a matter of fact, HelpIndex was rated in the top 25% for October 1996).

Java pros and cons

Java's data types have some really nice features. Characters are standardised as 16-bit Unicode unsigned integers, so you only have to use one set of string routines. Similarly, it is nice to have a basic `boolean` type and 64-bit `longs`.

When building a string using the + operator, the compiler neatly converts the basic types and classes to their string representation. It can do this for custom classes too, if you provide a `toString` method. In the same vein, it's good practice to provide `equals`, `getAppletInfo` and `getParameterInfo` routines.

Thankfully, you don't have to cope with multiple inheritance, and can instead declare classes to implement an abstract interface. I sometimes like to think of interfaces as call-backs. A good way to cut down on class numbers is to avoid subclassing from the `Thread` class, and instead implement the `Runnable` interface. A new thread can then be created with your applet passed as a constructor parameter, which will call your class's `run` method to do its work.

Not all aspects of Java are so nice, though. Constants usually have to be declared as `public static final int CONST = 0;` or similar, which is a bit of a mouthful. If you have constants you want to share across projects, you cannot simply include a header file. They have to be declared within a class, so you must import the class; I presume that the class must be loaded at runtime for these constants to be visible.

In contrast to the automatic conversion to strings mentioned above, `String s = i` does not work. `String s = ""+i` does. However you are supposed to use `String s = new Integer(i).toString()`.

The object wrappers for basic types can be slightly awkward. For example, to make a vector of integers, you have to make them into objects, and use `myVector.addElement(new Integer(i))` to add an integer, and `((Integer)myVector.elementAt(n)).intValue()` to retrieve it. Of course, you could derive your own `IntVector` class to improve the syntax.

Initialising simple structures is difficult. If you had a colour lookup class:
`class ColourLookup { String name; Color colour; }`
then it would be nice to initialise an array of instances the way you can in C. However this is not easy. The best you can do is:
`Object[][] colours = { { "white", Color.white }, { "red", Color.red } };`
This way you have to cast each element to its appropriate type. Worse, this solution will not cope with basic types unless you wrap them as objects, eg instead of `5` you have to type `new Integer(5)`.

One of the most annoying features of the original JDK and subsequent compilers is the fact that compilers insist that each compiled class or interface sits in its own separate .class output file. This is just silly – imagine if the MFC library was distributed this way. More importantly, it has serious speed ramifications for applets – a browser has to put in a separate request for each class file. Luckily, version 1.1 of the JDK introduces Java Archive (JAR) libraries containing multiple compressed files which a `ClassLoader` can grab in one go. JAR file entries can be digitally signed to verify their origin. Microsoft is separately touting its existing CAB (cabinet of files) format to solve the problem, and has made classes available for building and downloading cabinets.

Java is still a young language, with a relatively new APIs, and as such it's a good idea to regularly check Sun's list of known bugs at *http://java.sun.com/products/JDK/CurrentRelease/KnownBugs.html* and the various FAQs (eg *http://www.www-net.com/java/faq/*) before resorting to the *comp.lang.java.** newsgroups. For other resources, check out the UK's Java Centre (*http://www.java.co.uk/javacentre.html*) and Gamelan in USA (*http://www.gamelan.com*). ■

Chris Cant runs PHD Computer Consultants Ltd. He can be contacted at chris@phdcc.com. You can try HelpIndex at http://www.phdcc.com/helpindex/index.html

	Static initialisation	new Applet	init	start
First visit	x	x	x	x
Going back				x

Table 1 – Applet initialisation methods.

VB5 CCE First contact

Aiming to make ActiveX the standard for all internet development, Microsoft has released the Visual Basic 5 Control Creation Edition onto the Web. **Dave Jewell** takes a sneak peek.

Over the last few months, Microsoft has been making an increasing number of free goodies available on the Web. One of the most significant of these is the Visual Basic 5 Control Creation Edition, made available ahead of the main VB5 release next year to get the technology into the hands of developers as soon as possible. Cynics might infer an additional intention to ramp up the ActiveX marketplace but, being only a humble programmer, I couldn't possibly comment on that...

I should point out at this stage that the emphasis of this article is firmly on the CCE and control development – I won't go into any specifics of the development environment except insofar as they relate to controls. This is partly because we'll be reviewing the full VB5 package in next month's *EXE*, and I don't want to steal any thunder from that article – particularly as I'm down to write it! Just as importantly, there are various restrictions on what we're allowed to say about VB5 at the present time. For now, just bear in mind that Visual Basic 5 is a functional superset of the CCE – it will do everything you can do with CCE and a whole lot more besides.

A brief history of controls

Back in the early days, custom controls were a mess. They were all implemented as DLLs called directly by application programs. In order to be able to visually lay out interfaces that used particular controls, you had to add extensions to the DLL to interface with resource editors like Microsoft's Dialog Editor or Borland's Resource Workshop. Needless to say, there was no universally accepted standard and the extensions required by one editor were different from those needed by another. Thus, you ended up with the situation where control vendors often had to supply multiple versions of the DLL – a 'lean and mean' version for run-time usage and a bloated version which would work with all known resource editors... allegedly.

VBXs were a step in the right direction, since they at least imposed some kind of binary standard of what a control was supposed to look like. Unfortunately, the architecture of VBX controls is needlessly complicated and closely tied to the small memory model – VBX controls make extensive use of 16-bit pointers, which makes things *very* interesting if you want to write a control in Pascal (where pointers are always 32-bit).

Eventually, Microsoft realised that its OLE development work was really just a specific case of the general problem of getting two different pieces of software to talk to one another through interfaces that might only be 'discovered' at run-time. This concept is central to the idea of drop-in reusable controls, and thus OLE-based controls were born. Microsoft had a lot of work to do in convincing developers that this was a good idea since the general perception at the time was that OLE was slow, cumbersome and difficult to implement [hence the name change – Ed.].

The new 'ActiveX' controls are really a stripped-down rationalisation of the original concept. In particular, Microsoft stresses that because ActiveX controls are so small, they're ideal candidates for putting in Web pages for download over the Net. Well that's the good news, but it's not the whole story...

The whole story

Let's get the bad news out of the way first. It needs to be clearly appreciated that ActiveX controls built with CCE are strictly a Windows-only proposition. There's been a lot of noise about making ActiveX into a platform-independent industry standard, but whether this will ever become a reality is anybody's guess. For now, bear in mind that every CCE-built control isn't quite as load-and-run as it may seem, because:

- They rely on VBRUN500.DLL.
- And VBRUN500.DLL relies on a host of other Windows API calls.

The Microsoft documentation positively encourages you to assemble new controls from pre-existing Windows based controls. In reality, if you want to do anything really sexy in your control, you'll almost certainly end up hitting the API yourself.

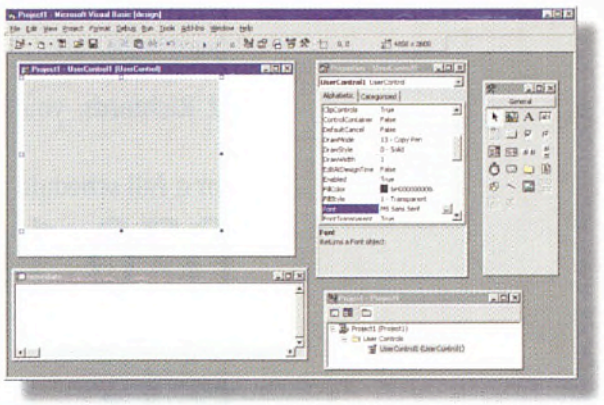
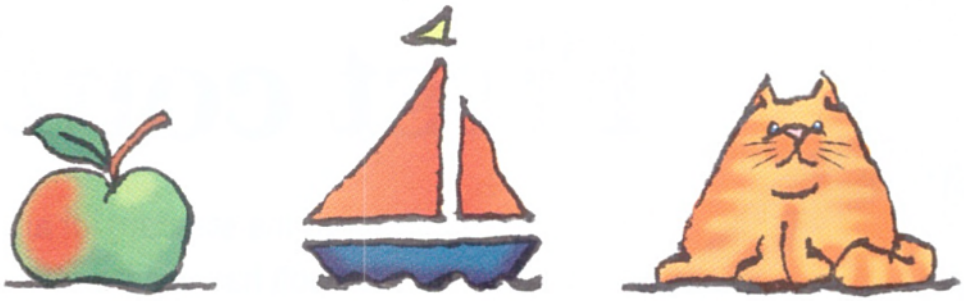


Figure 1 – The CCE development environment. What looks like a form design window is actually the display surface of your new ActiveX control.

There's basic visual training...



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Relying on the run-time DLL means CCE controls are not stand-alone. Certainly, you end up with a small OCX file which behaves just like an OCX control should – I've used CCE to build OCXs which I've then plugged into VB4, Visual C++ and Delphi, and in all cases everything has worked as advertised. Internally, however, the control could be a native code executable or virtual machine p-code but either way it relies heavily on a DLL which is over 1.3 MB in size. Consequently, if you're planning to deploy CCE-built controls over the Internet, you'd better hope that Microsoft gets the VB run-time files onto everyone's desktop ASAP.

OK that's the end of the bad news. The good news is that CCE brings an unprecedented level of simplicity to the business of creating ActiveX controls.

When you first fire it up, you'll see a dialog box that gives you a number of choices about what sort of project you want to create, or whether you want to open an existing project (more on that next month!) If you elect to create a new ActiveX control, you'll see something like Figure 1. There's the familiar *Properties* window, a toolbox palette, an *Immediate* window (used for debugging) and a *Project Explorer* window.

You can also see what looks like an ordinary Form design window. However, instead of representing an application window, this form actually shows the display surface of your new ActiveX control. Just as with a normal form, you can choose existing controls from the toolbox and add them to your control's form. Re-sizing the form window provides a default size for your new control. Using this paradigm, it's very easy to build up

```
Option Explicit
'Default Property Values:
Const m_def_ShadowOffset = 1
Const m_def_ShadowColor = 0
'Property Variables:
Dim m_ShadowOffset As Long
Dim m_ShadowColor As OLE_COLOR
'Event Declarations:
Event Click() 'MappingInfo=TheText,TheText,-1,Click
Event DblClick() 'MappingInfo=TheText,TheText,-1,DblClick
Event KeyDown(KeyCode As Integer, Shift As Integer)
Event KeyPress(KeyAscii As Integer)
Event KeyUp(KeyCode As Integer, Shift As Integer)
'MappingInfo=TheText,TheText,-1,MouseDown
Event MouseDown(Button As Integer, Shift As Integer, X As Single, Y As Single)
'MappingInfo=TheText,TheText,-1,MouseMove
Event MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)
'MappingInfo=TheText,TheText,-1,MouseUp
Event MouseUp(Button As Integer, Shift As Integer, X As Single, Y As Single)
Private Sub UserControl_Initialize()
   Shadow.Left = TheText.Left + m_ShadowOffset
   Shadow.Top = TheText.Top + m_ShadowOffset
End Sub
'Initialize Properties for User Control
Private Sub UserControl_InitProperties()
   m_ShadowOffset = m_def_ShadowOffset
   m_ShadowColor = m_def_ShadowColor
   Shadow.Caption = Extender.Name
   TheText.Caption = Extender.Name
End Sub
'WARNING! DO NOT REMOVE OR MODIFY THE FOLLOWING COMMENTED LINES!
'MappingInfo=TheText,TheText,-1,ForeColor
Public Property Get ForeColor() As OLE_COLOR
   ForeColor = TheText.ForeColor
End Property
Public Property Let ForeColor(ByVal New_ForeColor As OLE_COLOR)
   TheText.ForeColor = New_ForeColor
   PropertyChanged "ForeColor"
End Property
'WARNING! DO NOT REMOVE OR MODIFY THE FOLLOWING COMMENTED LINES!
'MappingInfo=TheText,TheText,-1,Enabled
Public Property Get Enabled() As Boolean
   Enabled = TheText.Enabled
End Property
Public Property Let Enabled(ByVal New_Enabled As Boolean)
   TheText.Enabled = New_Enabled
   Shadow.Enabled = New_Enabled
   PropertyChanged "Enabled"
End Property
'WARNING! DO NOT REMOVE OR MODIFY THE FOLLOWING COMMENTED LINES!
'MappingInfo=TheText,TheText,-1,Font
Public Property Get Font() As Font
   Set Font = TheText.Font
End Property
Public Property Set Font(ByVal New_Font As Font)
   Set TheText.Font = New_Font
   Set Shadow.Font = New_Font
   PropertyChanged "Font"
End Property
'WARNING! DO NOT REMOVE OR MODIFY THE FOLLOWING COMMENTED LINES!
'MappingInfo=TheText,TheText,-1,Refresh
Public Sub Refresh()
   Shadow.Refresh
   TheText.Refresh
End Sub
Private Sub TheText_Click()
   RaiseEvent Click
End Sub
Private Sub TheText_DblClick()
   RaiseEvent DblClick
End Sub
Private Sub TheText_MouseDown(Button As Integer, Shift As Integer, _
                              X As Single, Y As Single)
   RaiseEvent MouseDown(Button, Shift, X, Y)
End Sub
Private Sub TheText_MouseMove(Button As Integer, Shift As Integer, _
                              X As Single, Y As Single)
   RaiseEvent MouseMove(Button, Shift, X, Y)
End Sub
Private Sub TheText_MouseUp(Button As Integer, Shift As Integer, _
                              X As Single, Y As Single)
   RaiseEvent MouseUp(Button, Shift, X, Y)
End Sub
Public Property Get ShadowOffset() As Long
   ShadowOffset = m_ShadowOffset
End Property
Public Property Let ShadowOffset(ByVal New_ShadowOffset As Long)
   m_ShadowOffset = New_ShadowOffset
   Shadow.Left = TheText.Left + New_ShadowOffset
   Shadow.Top = TheText.Top + New_ShadowOffset
   PropertyChanged "ShadowOffset"
End Property
Public Property Get ShadowColor() As OLE_COLOR
   ShadowColor = m_ShadowColor
End Property
Public Property Let ShadowColor(ByVal New_ShadowColor As OLE_COLOR)
   m_ShadowColor = New_ShadowColor
   Shadow.ForeColor = m_ShadowColor
   PropertyChanged "ShadowColor"
End Property
'Load property values from storage
Private Sub UserControl_ReadProperties(PropBag As PropertyBag)
   m_ShadowOffset = PropBag.ReadProperty("ShadowOffset", m_def_ShadowOffset)
   m_ShadowColor = PropBag.ReadProperty("ShadowColor", m_def_ShadowColor)
   ForeColor = PropBag.ReadProperty("ForeColor", &H80000012)
   Enabled = PropBag.ReadProperty("Enabled", True)
   Set Font = PropBag.ReadProperty("Font", Ambient.Font)
   Shadow.ForeColor = m_ShadowColor
   Shadow.Left = TheText.Left + m_ShadowOffset
   Shadow.Top = TheText.Top + m_ShadowOffset
   Shadow.Caption = PropBag.ReadProperty("Caption", UserControl.Name)
   TheText.Caption = Shadow.Caption
End Sub
'Write property values to storage
Private Sub UserControl_WriteProperties(PropBag As PropertyBag)
   Call PropBag.WriteProperty("ForeColor", TheText.ForeColor, &H80000012)
   Call PropBag.WriteProperty("Enabled", TheText.Enabled, True)
   Call PropBag.WriteProperty("Font", Font, Ambient.Font)
   Call PropBag.WriteProperty("ShadowOffset", m_ShadowOffset, _
                              m_def_ShadowOffset)
   Call PropBag.WriteProperty("ShadowColor", m_ShadowColor, m_def_ShadowColor)
   Call PropBag.WriteProperty("Caption", Shadow.Caption, "")
End Sub
Public Property Get Caption() As String
   Caption = TheText.Caption
End Property
Public Property Let Caption(ByVal New_Caption As String)
   Shadow.Caption = New_Caption
   TheText.Caption = New_Caption
   PropertyChanged "Caption"
End Property
```

Listing 1 – Code for the simple 3D label control.

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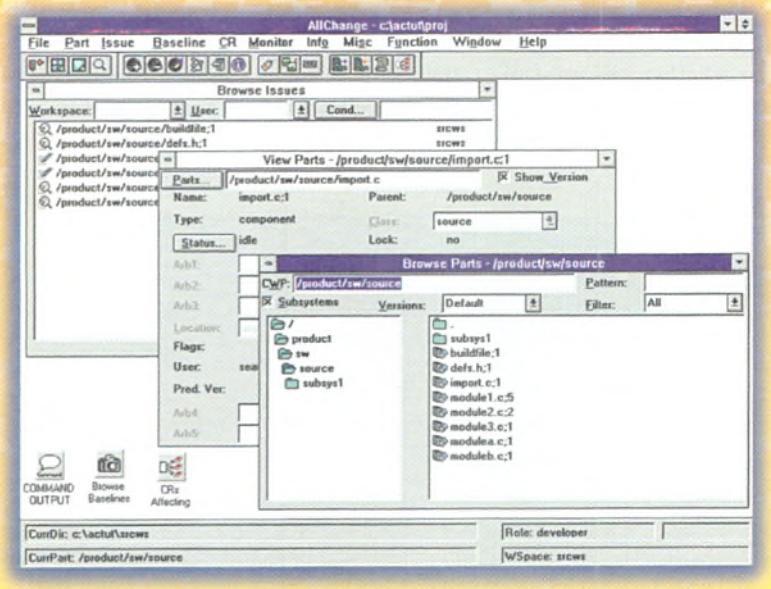

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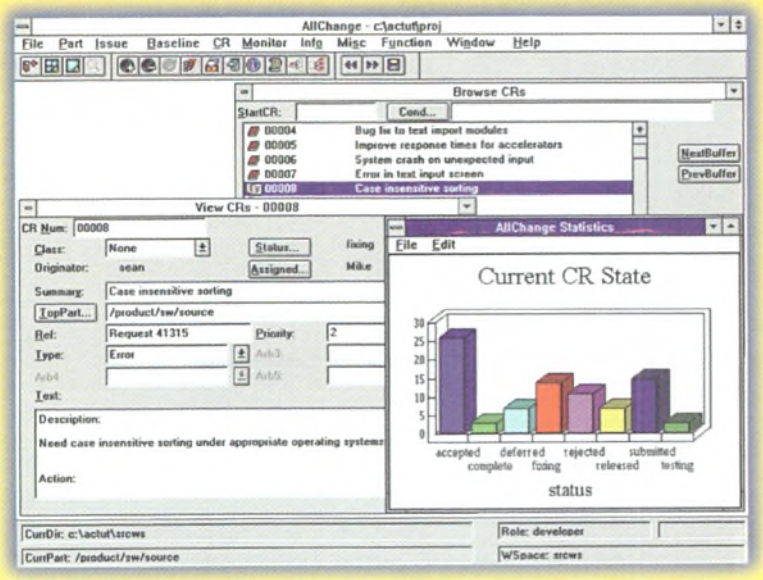

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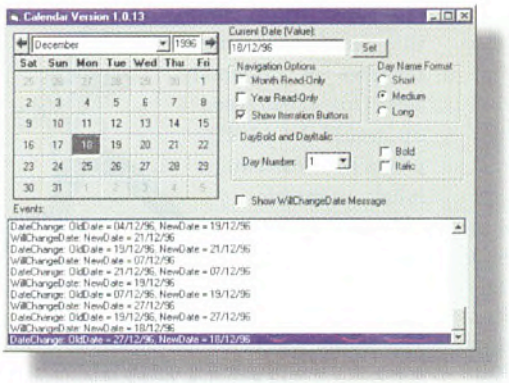


Figure 2 –A composite calendar control example. The source code is freely downloadable from Microsoft's Web site.

Figure 3 – Here's our 3D label control. Not exactly rocket science, but it illustrates the basic steps needed to get an ActiveX control up and running.

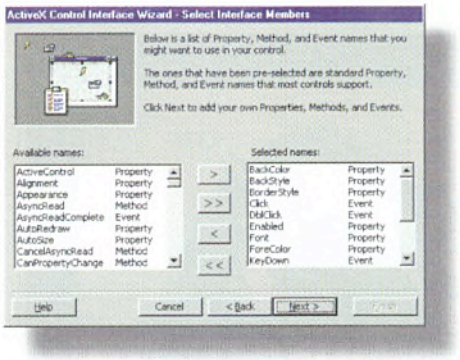


Figure 4 – The ActiveX Control Interface wizard allows you to specify what properties, methods and events should be made available by the new control.

a complex aggregate control that's made out of one or more existing subsidiary controls. Obviously, controls created with CCE can be added to the toolbox just like any other control, and included in composite controls.

To give you some idea of what's possible using this approach, take a look at Figure 2. The top left corner of this window shows a calendar control, created by Microsoft as one of the CCE samples available from its Web site. The control is made up of a combo box, a text box, two command buttons and a certain amount of custom display code for the main part of the control.

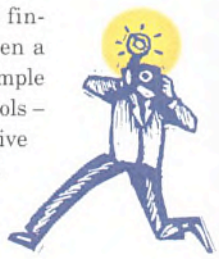
None of the above should be taken as implying that you can *only* create new controls from collections of pre-existing components. You're completely free to design new custom controls from the ground up which do not contain any subsidiary components. And because there are few restrictions on what you can do inside your control, you can make Windows API calls just as easily as from 'regular' Visual Basic. Just add a code module to your project, stuff it full of Windows API declarations, and off you go. It's a nice change from Java!

What's even nicer is the fact that you can test and debug your custom control projects from within the CCE environment. An interesting feature of the new version of Visual Basic is its support for a 'Project Group', enabling you to maintain a project consisting of several sub-projects. In the case of CCE, this means that you can assign your new control to one subproject and set up an ordinary EXE application as another. Although CCE won't build stand-alone EXE files, it will allow you to run executable projects within the CCE environment. Thus, you can make a quick change to your control, swap over to the EXE file sub-project and immediately test the changes to see if everything works as advertised. Only when you've got your control working as desired do you need to actually generate an OCX file.

This is just as well since things can potentially get a bit confusing once you've generated the OCX. The development system has selectable project options which ensure that generated OCX files are consistent with OCXs you've already created. This is great for when you've got existing OCXs out in the field and you don't want upgrades to break existing software, but 'binary compatibility mode' (otherwise known as 'strict bondage and domination' mode) can get a bit in the way when you're developing an OCX for the very first time.

Creating a control

In order to give you a flavour for custom control development with CCE, I've put together a very simple little 3D label control – you can see it being used in Figure 3, along with a sexy-looking backdrop courtesy of Borland Delphi. Let me hastily point out that this isn't a finished control, nor even a particularly good example of how to design controls – it's just intended to give you a feel for how it all works.



I started off by creating a new control project (as per Figure 1) and added a couple of `Label` controls. I positioned them in the top-left hand corner of the control's 'form', and renamed them as `TheText` and `Shadow`. Obviously, `Shadow` goes behind `TheText` to give the effect of a drop shadow.

Having got the thing looking vaguely right, I then fired up the Control Interface wizard, which you can see in Figure 4. This can save a lot of time by generating most of the boring 'boiler-plate' code automatically. It looks at the subsidiary controls in your custom control and builds a list of properties, events and methods that you'd most likely want to provide. In the figure, you specify what properties you want by moving them from the Available list on the left to the list on the right. For each property that's added to your control, the wizard generates a pair of `Get` and `Let` routines using the new `Property` keyword. As an example, here's the code that implements the `Caption` property in my 3D label:

```
Public Property Get Caption() As String
  Caption = TheText.Caption
End Property
Public Property Let Caption(ByVal
New_Caption As String)
  Shadow.Caption = New_Caption
  TheText.Caption = New_Caption
  PropertyChanged "Caption"
End Property
```

Once you've specified properties, the wizard can map them onto subsidiary controls, saving a lot of time. You can even specify custom properties, setting their names, assigning them a type, initial value and a description string (which appears as the 'hint string' at the bottom of the Properties window when the property is selected). As you can see from Figure 5, properties created with the wizard can be designated as read-write, read-only etc.

When the wizard has finished, you end up with a source listing (something like Listing 1). Notice that there is very little 'control-code' generated, so you can do quite a lot without treading on the wizard's toes. If you change your mind and want to delete a property that you've included, it's just a case of deleting the two associated `Property` routines. If you want to add more properties, just type in new `Get/Let` routines similar to those already

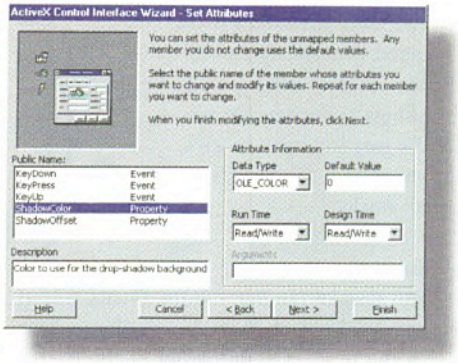


Figure 5 – The wizard lets you set up the attributes of your own custom properties. Again, if you get it wrong, it's easy to change later.

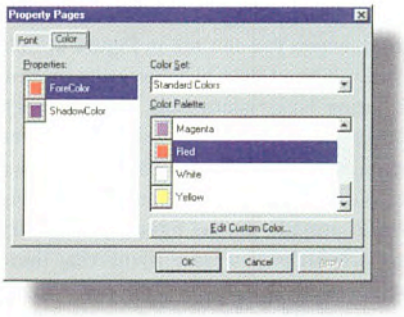


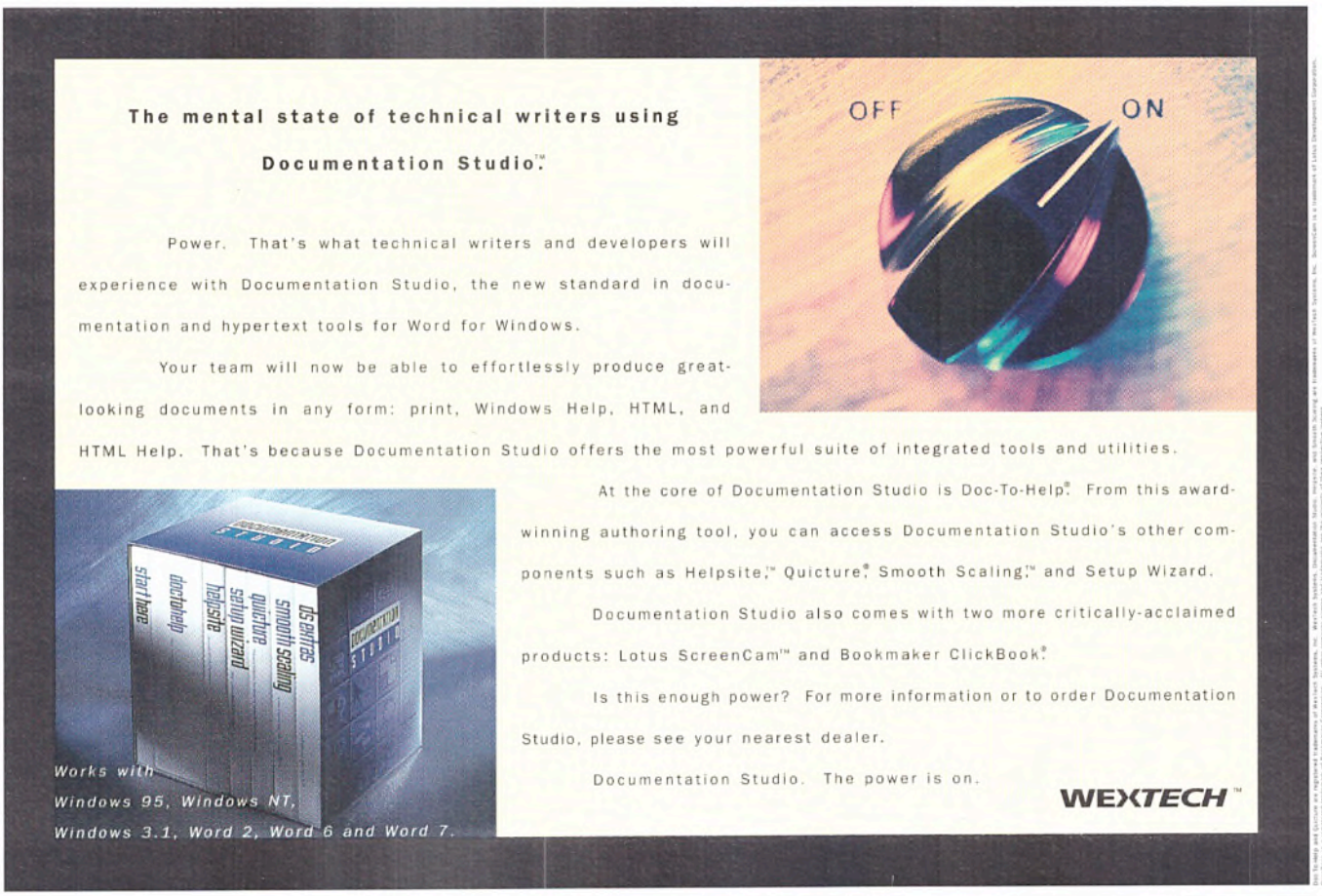
Figure 6 – The Font and Color property pages come 'for free', but you can easily add your own custom pages, and even put instances of the new control on a property page.

there, and they'll instantly be recognised by CCE. Swap over to the *Application* sub-project, add a copy of your new control to the program form and – hey presto – the new property will magically appear. It would be nice if you could just type in a single `Get` or `Let` routine in order to have read-only or write-only properties respectively, but CCE doesn't seem to regard a property declaration as valid unless both procedures are provided. Obviously, you can achieve the same result in other ways....

For this simple 3D control, I just had to ensure that changes to the `Caption`, `Font` and `Enabled` properties mapped onto both of the `Label` controls inside the component. At the same time, I added a couple of custom properties called `ShadowColor` and `ShadowOffset`. These set the colour of the background shadow (through the `ForeColor` property of the `Shadow` label) and control its horizontal and vertical displacement.

This simple example doesn't use the Windows API, but there is certainly scope for doing so. In particular, the speed at which this particular control redraws is extremely slow. One way to speed it up would be to dispense with the two label controls and simply write the text out into an off-screen bitmap using `CreateCompatibleDC` and `CreateCompatibleBitmap`. This would enable you to implement `BackColor` and `BackStyle` properties for the control, which would be difficult with the composite implementation because specifying an opaque background for the foreground label would overwrite the shadow label. I suppose you could get by with mapping the `BackStyle` property only onto the shadow control, but in general the API will provide the most flexibility.

There are one or two interesting glitches in the CCE documentation. For example, any subsidiary controls you create belong (architecturally speaking) to a special object called `UserControl`, which provides a number of default properties and methods onto which you can 'piggy-back' your own code. The more important fields of `UserControl` include `UserControl.hWnd`, an API-level window handle that corresponds to the aggregate con-



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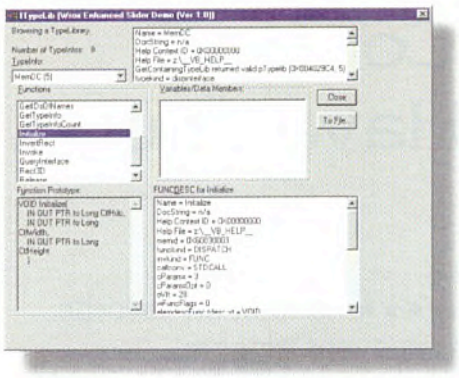

Figure 7 – Here, you can see the exported interface to MemDC, a class module which I used as part of a slider control. This Microsoft utility reveals that I've inadvertently exported more information than I intended...

trol and `UserControl.hDC` which provides a device context for the entire control. According to the beta documentation, you can't use `UserControl.hWnd` in an ActiveX control, but in practice I found that it worked just fine. Access to these fields is crucial. For example, a very common requirement is the ability to capture the mouse inside a control, to receive mouse messages even when the mouse isn't directly over the control (as in the case of a pressed push-button or tracking a thumb inside a scroll-bar). To capture the mouse, you need to make a call to the `SetCapture` API routine, and you can't do that if you haven't got a window handle that you can use.

When you've got your control working, you can create a set of property pages for it manually, or use another wizard which does a rather nice job of automating the procedure. The system includes standard pages for `Font` and `Color` properties, and you can add your own custom pages. These can even include one or more instances of the control itself (if you see what I mean!) Taking this to its logical conclusion, you could design a visually complex control, place an instance of it on one of its own property pages and maybe use a private interface to highlight different elements so that end-users can clearly see what each option does.

No such thing as a free lunch?

So is there such a thing as a free lunch? Well, CCE comes about as close as you're going to get. It's certainly a great way of putting together ActiveX controls, although it remains to be seen how (and *if*) Microsoft is going to tackle the VBRUN500.DLL problem. In addition, in the time-honoured tradition of 'Lite' and 'Trial' products, CCE doesn't include on-line help. Or at least, when you highlight a word in the IDE and then hit the F1 key, you get chastised with the message that context-sensitive help isn't available in the CCE edition of Visual Basic, and you really should go and buy the full version. This may change in the final release: CCE is after all still a beta product.

One final word of warning: while browsing around with one of Microsoft's OLE-sniffing tools (specifically OLE 2 Object Viewer) I discovered that an interface to a class module I'd incorporated into an OCX control was visible from outside the control. There's an option for changing this from inside CCE (right-click the class module in the Project Explorer, select `Properties` and change the Instancing property to `Private`), but you should bear in mind that things are visible by default. ■

Dave Jewell is a freelance consultant, programmer and technical author. You can contact Dave as DSJewell@aol.com, 102354.1572@compuserve.com or DaveJewell@msn.com.

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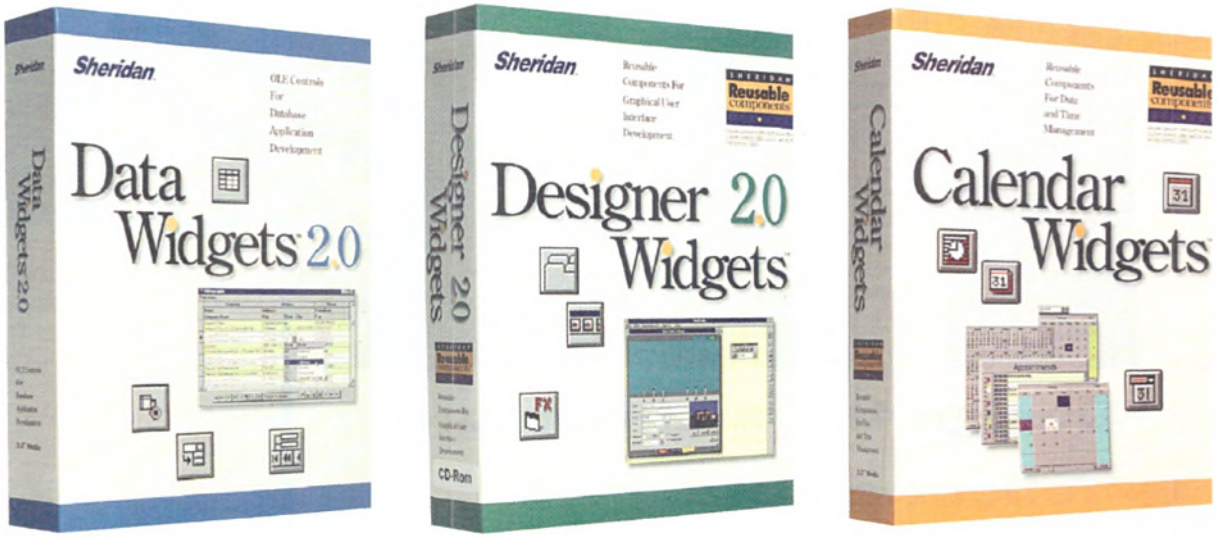

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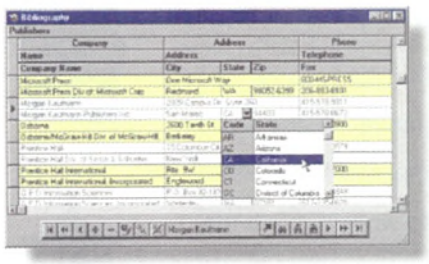

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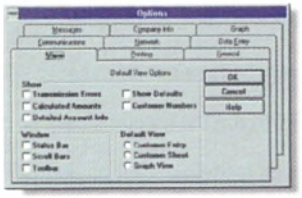

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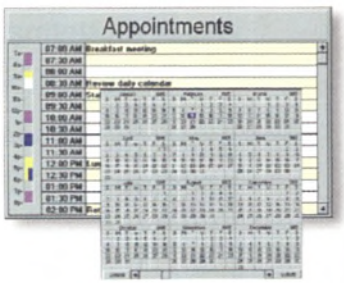

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CIRCLE NO. 018

Program slicing isolates the various sub-computations which make up program code. In the last part of his series, **Mark Harman** shows how the overlap of these threads can be used to measure program cohesion.

Ever since early programmers were counting how many lines of code they had written to work out how many punched cards they'd need, the idea of measuring code has been applied to understand and predict aspects of its production. Program measurements have come to be known as code metrics, and their application has spread from the final code, back through design and specification stages of the life cycle, and on to encompass the complete life cycle itself in the areas of 'process improvement measurement'. The clarion call of their advocates has its root in a public address made by Lord Kelvin in 1889, which has become loosely paraphrased in the aphorism: 'How can we control what we cannot measure?'

Cleaving together

The application of metrics to controlling software development has had a rather chequered life history. The misuse of metrics as a predication of the quality of developers has tended to give the whole field a bad press among the development community. However, there are several very valid applications of cohesion metrics, as discussed at the end of this article. Before coming to that, we'll see how the cohesiveness of programs can be measured via the technique of program slicing (discussed in my October and November 1996 *EXE* articles).

Cohesion

A *cohesive* program is one in which the modularisation of functionality is performed 'correctly'. More precisely, a cohesive module or function should perform only closely related tasks. A function that divides two numbers and returns the result and remainder would be categorised as highly cohesive, whereas a function that returns the largest of two numbers together with their product would be less so. The principle is mirrored in object-oriented programming by the concept of encapsulation: well-encapsulated objects contain all necessary data and function members within themselves.

The motivation for measuring and assessing the cohesiveness of programs rests upon observations and claims that highly cohesive code is easier to maintain, modify and reuse. Cohesion was a product of the effort to define principles for programming, to turn the activity from a craft into an engineering discipline.

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```
x=1;
y=2;
z=3;
if (x>4) z=z+1;
if (y>4) y=y+1;
x=x-1;
```

Listing 1 – A simple program fragment. The example functions we shall use are written in a C-like programming language, but I have made a few simplifications to avoid becoming distracted by the details of the C syntax.

```
x=1;
/* deleted */
z=3;
if(x>4) z=z+1;
/* deleted */
/* deleted */
```

Listing 2 – Slicing Listing 1 on z at the end of the program.

```
void Marks()
{
  int Pass, Fail, Count;
  Pass = 0 ;
  Fail = 0 ;
  Count = 0 ;
  while (!eof()) {
    input(Marks);
    if (Marks >= 40)
      Pass = Pass + 1;
    if (Marks < 40)
      Fail = Fail + 1;
    Count = Count + 1;}
  output(Count) ;
  output(Pass) ;
  output(Fail) ;
}
```

Listing 3 – A program with three processing elements.

```
void Processing_element_count()
{
  int Count;
  Count = 0 ;
  while (!eof()) {
    input(Marks);
    Count = Count + 1;}
}
```

Listing 4 – The processing element for Count.

```
void Processing_element_Pass()
{
  int Pass;
  Pass = 0 ;
  while (!eof()) {
    input(Marks);
    if (Marks >= 40)
      Pass = Pass + 1;}
}
```

Listing 5 – The processing element for Pass.

However, this concept of cohesion is clearly rather subjective: how do we decide which tasks are related? In this article I shall look at how the *quantity* of cohesion possessed by a function can be gauged via the technique of program slicing.

Levels of cohesion

In their highly influential book *Structured Design*, Constantine and Yourdon identify seven levels of cohesion, defined in terms of *processing elements*. In ascending order of cohesiveness, they are:

1. *Coincidental*: the lowest level – functions exhibit no cohesion other than the coincidental inclusion of several tasks.
2. *Logical*: at each invocation of the function one of the processing elements is executed.
3. *Temporal:* the processing elements are all executed within some limited time frame.
4. *Procedural*: the processing elements are all the elements of some construct.
5. *Communicational*: the processing elements either share common input data or produce common output data.
6. *Sequential*: the output of one processing element is provided as the input to another.
7. *Functional*: all processing elements implement a single specific function.

Of these levels, the most desirable is functional cohesion. However, even this definition is rather open to interpretation. Fortunately, we can take advantage of program slicing to associate functions with a number representing the 'amount' of functional cohesion they possess.

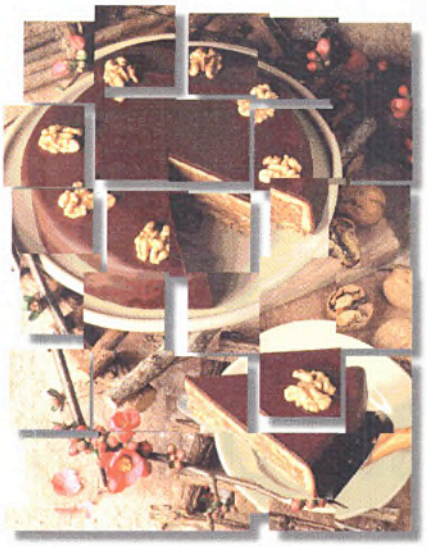
Using slices to assess cohesion

Program slicing isolates the sections of code that affect the value of a chosen set of variables at some chosen point in a program, producing code fragments known as *slices*. The technique was explained in detail in the October 1996 issue.

In general, slices are constructed for a set of variables, but for simplicity we'll just consider slices constructed for a single variable. For a slicing criterion consisting of a variable v and a point of interest n, we shall say that the slice is constructed *for* v *at* n. Consider the simple program fragment in Listing 1. If we slice this program for the variable `z` at the end of the fragment, then we isolate (in the slice) those lines of the program which are involved in the overall computation of the final value of `z`. This slice is depicted in Listing 2. Lines which have been removed are replaced by comments. These lines play no part in the computation of the final value of `z`.

If this technique is used repeatedly to capture the threads of computation associated with each of a program's variables, we can examine the overlap of the resulting slices to get a crude measure of the program's level of cohesion. Think of it this way: a slice captures a specific thread of a program concerned with the computation of some variable. If we took several slices from a function, each for a different variable, and we found that these slices had a lot of code in common, then we would be justified in thinking that the variables were related in some way. We might go further, and decide that the function's 'tasks' are captured by the computation it performs on these variables, and therefore we would conclude that the function's tasks were strongly related and thus that the function was highly cohesive.

The first step in developing a formal measure of cohesion based upon this idea is to pin down what the processing elements of a function are. We shall take the view that a



The measure of cohesion is the number of statements in the function's cohesive section relative to the number of statements in the function as a whole.

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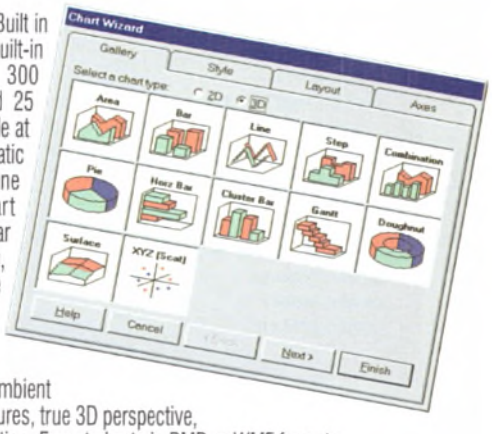

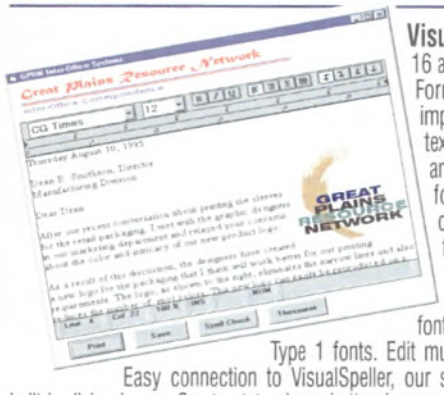

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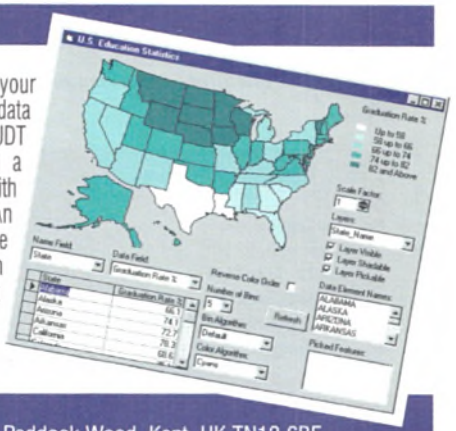

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CIRCLE NO. 020

processing element is a piece of code which calculates a value. We further specify that this value must be visible outside the function in order to constitute a 'result'. Such values are those printed by the function and those stored in global variables or call-by-reference parameters.

Each of these forms of 'output' can be thought of as the calculation of a value for a variable. We shall therefore focus our attention on the values printed out by a function. To simplify matters further, we shall assume that the values are printed out at the end of the function, and that each output consists of printing the value of one of the function's local variables. Relaxing these simplifying assumptions does make the calculation of cohesion slightly more involved, but does not render the approach we shall describe inapplicable.

We can isolate processing elements of this type by slicing the program for each particular output variable. Consider, for example, the function `Marks` in Listing 3. It outputs the value of three variables and therefore has three processing elements, one for each variable. These can be isolated by slicing, as shown in Listings 4, 5 and 6, which show the slices associated with `Count`, `Pass` and `Fail` respectively. The three processing elements have very little overlap, since the calculation of passes, fails and the overall count are largely independent of one another. The cohesive section of the function is made up of the statements shared between all of its processing elements: in this case, just two lines. This can be visualised by placing markers by each line of the program, indicating which slices it belongs to, as in Listing 7. We can calculate a simple measure of the function's cohesion as proportion of statements in the function that are 'more cohesive' (shared between all the processing elements): in this case, 2/10 or 0.2.

For the function `MinMax` in Listing 8, we would construct two slices associated with the two processing elements. As you can see from the labelling, this function is measured as more cohesive than `Marks`, with six of its ten lines shared between both processing elements, giving a metric of 0.6.

Acknowledgements

Cohesion measurement based on slicing, is the brainchild of Linda Ott and has been developed by Jim Bieman, Arun Lakhotia, and Ott's students, Longman and Thuss. What I have presented essentially serves as an introduction to their work. Jim Bieman and Benjamin Kang have developed a tool, FUNCO, for measuring functional cohesion. Bieman and his team have kindly made FUNCO freely available on the internet from URL: *http://www.cs.colostate.edu/~bieman/funco.html*.

The distinction between a measurement and a prediction system was first highlighted by Norman Fenton and is well described in his book *Software Metrics: A Rigorous Approach*, Chapman and Hall, 1991.

Jens Krinke provides a web page full of links to slicing work and other freely available slicing tools. The URL is *http://www.cs.tu-bs.de/~krinke/Slicing/slicing.html*.

David Voelkel at the excellent Building of Bath museum in Bath, provided historical information regarding the Window Tax.

Our cohesion measure is a poor predicator of program quality, but it is a reasonable predictor of the likelihood of knock-on program errors.

```
void Processing_element_fail()
{
  int  Fail;
  Fail = 0 ;
  while (!eof()) {
    input(Marks);
    if (Marks < 40)
      Fail = Fail + 1;}
}
```

Listing 6 – The processing element for Fail.

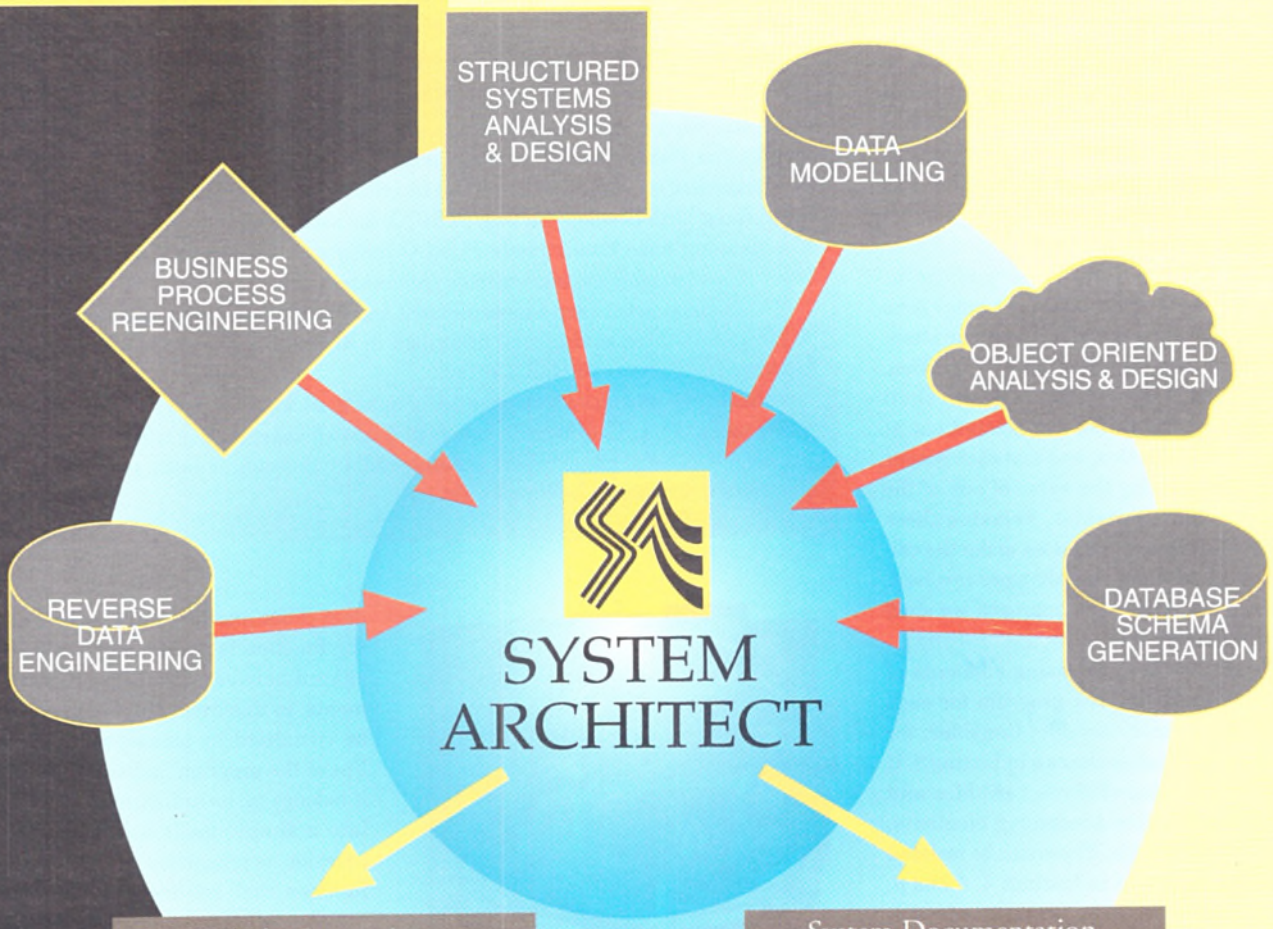
```
void Marks()
{
int Pass, Fail, Count;
Pass = 0 ;                    P
Fail = 0 ;                            F
Count = 0 ;           C
while (!eof()) {      C       P       F
  input(Marks);       C       P       F
  if (Marks >= 40)            P
    Pass = Pass + 1;          P
  if (Marks < 40)                     F
    Fail = Fail + 1;                  F
  Count = Count + 1;} C
output(Count) ;
output(Pass) ;
output(Fail) ;
}
```

Listing 7 – A function with low cohesion. P indicates the lines in the slice for Pass, F for Fail and C for Count.

The misuse of measurement

This measure of cohesion, based only upon the number of statements in a function's cohesive section relative to the size of the function as a whole is rather crude. Well-written functions tend to comprise few statements, and thus the result can be affected greatly by the inclusion or absence of a single statement in a slice. In addition, no differentiation is made between the relative importance of the various statements in a function. For example, an initialisation statement in all slices should obviously be regarded as of less importance than an assignment which stores the result of a complex expression in a variable.

The measurement also suffers from being fundamentally *syntactic*, rather than *semantic*. That is, the cohesion reading we obtain does not (and cannot) tell us anything about the intent of the function. The function in Listing 3 performs three tasks which are all strongly semantically related, but this is not taken into account in our cohesion rating. Our measure might be better termed 'syntactic cohesion'.



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```
void MinMax()
{
  int Smallest, Largest;
    int num, i;
  for (i=0;i<10;i=i+1) {          L   S
  input(num);                     L   S
    NumArray[i] = num;}           L   S
  Smallest = NumArray[0];         L   S
  Largest = Smallest;             L
  i = 1;                          L   S
  while (i<10) {                  L   S
    if (Smallest > NumArray[i])       S
      Smallest = NumArray[i]      ;   S
    if (Largest < NumArray[i])    L
      Largest = NumArray[i];          L
    i = i + 1;}                   L   S
  output(Smallest);
  output(Largest);
}
```

Listing 8 – A highly cohesive function. The label L indicates lines which are in the slice for Largest, and S for Smallest.

As a result, the cohesion measure would be most inappropriate as a tool of management. One could imagine the manager of some software development project deciding that, as low cohesion is considered harmful, all functions which fail to rise above some threshold reading (0.5 has a ring to it) will be rejected. This arbitrary diktat is typical of the kind of misuse of metrics which has rightly given the field a bad name among developers, and will not actually provide the manager with any meaningful information. Any program can be trivially modified to fool the measurement tool into providing a suitably high cohesion value. For example, consider the version of the `Marks` function in listing 9. We have added three lines of code which will have absolutely no effect upon the semantics of the program, but make it appear that the computation of each variable depends upon the computation of the other two. As a result, the cohesion measurement tool will include all the preceding computation for the three variables in each of their

How can we control what we cannot measure?

```
void Marks()
{
  int Pass, Fail, Count;
  Pass = 0 ;                                    C     P     F
  Fail = 0 ;                                    C     P     F
  Count = 0 ;                                   C     P     F
  while (!eof()) {                              C     P     F
    input(Marks);                               C     P     F
    if (Marks >= 40)                            C     P     F
      Pass = Pass + 1;                    C     P     F
    if (Marks < 40)                             C     P     F
      Fail = Fail + 1;                    C     P     F
    Count = Count + 1;}                   C     P     F
  Pass = Pass + Fail-Fail + Count-Count;              P
  Fail = Fail + Pass-Pass + Count-Count;                    F
  Count = Count + Fail-Fail + Pass-Pass;      C
  output(Count) ;
  output(Pass) ;
  output(Fail) ;
}
```

Listing 9 – Syntactic mischief to fool the cohesion measurement tool.

slices. (The slices and cohesive section are depicted by labels in Listing 9.) This simple syntactic mischief has changed the program's cohesion reading from 0.2 to 0.77.

This trick could be performed on *any* function, and our manager could find himself with a set of code with the same quality as before, magically rendered cohesive, maintainable, reliable and reusable by the mere presence of some rather odd assignment statements. This unfortunate misapplication of measurement is not new: in 1784 William Pitt imposed the 'window tax', the idea being that the value of a property was related to the number of windows (above 6) it had. The legacy of this tax can still be seen today in the shape of beautiful Georgian houses 'deListed' by their hastily bricked-up windows.

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Measurement & predication

The reader will be forgiven for assuming that the measurement of cohesion is best avoided. However, this is not true. It does have an important role to play, but not as a predicator of the quality of a program nor of the quality of the programmer who produced it.

It is a well known fact that faults in individual functions often have a knock-on effect, causing a whole raft of other problems which disappear when the fault is corrected. Programs measurable as syntactically cohesive are likely to be especially prone to this, since they take such care to reuse sections of code and share computation of intermediate results. A high cohesion rating can therefore serve as a warning to watch out for these sorts of bugs. In addition, slicing analysis similar to that performed when measuring cohesion can prove helpful in tracking the code likely to be affected by such errors (see *A piece of cake*, *EXE* October 1996).

The discussion reveals the need to distinguish between the *calculation* embodied in a metric and the *application* to which the results are put. The calculation is well defined, being comprised of a working algorithm. What the measurements predict about the software is less well defined and requires some careful analysis.

Highly cohesive code is easier to maintain, modify and reuse.

Efforts to relate the outcome of *any* measurement to the quality of software is, in my view, doomed; there will always be a way of fooling measurement tools into predicting high quality. At a time when the software engineering community is becoming increasingly concerned with 'software architecture' it would be the height of folly to impose the crude software equivalent of the Window Tax, which would be answered by the software equivalent of bricked up windows. Instead, software measurement should be a tool for *developers*, providing the same form of basic measurement information that is routinely collected by engineers in other disciplines. ■

Mark Harman is director of research at the School of Computing University of North London. He teaches programming in C++ and formal methods in Z and leads 'Project Project', a research group concerned with the development and application of program slicing technology (http://www.unl.ac.uk/~mark/projproj.html). He can be contacted via email at m.harman@unl.ac.uk. Dr Harman's at http://www.unl.ac.uk/~mark/welcome.html contains some of his team's other publications on slicing and pointers to the work in this area.

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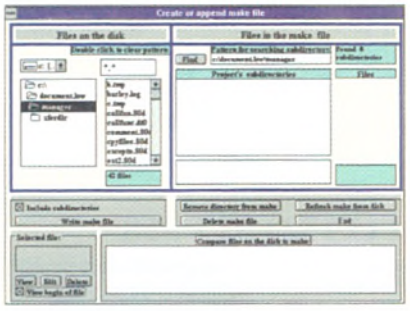

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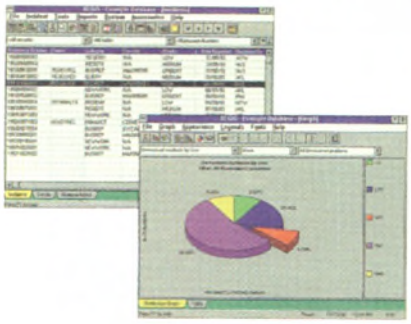

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Testing the beast

When the pressure is on, planning a test strategy without being drowned out by the customer's demands can seem impossible. **Peter Collinson** has some tips on how to avoid the bends...

Patricia Deardorff

Last year, I wrote two articles that derived from the work that I am doing on a medium-sized software project. Currently, the project has reached that interesting limbo period just after the software is written and just before delivery takes place. Of course, this is generally where Quality Assurance kicks in and some form of official testing is needed. To this end, I've been creating a formalised test plan.

Now, there's a lot of theoretical methodology related to software testing and quality assurance, but much of it is expressed in very general terms and comes across as either vapourware or bovine excrement. There is also much debate about whether formal methods actually do result in better software for the end user, and it can be hard to convince management of the need to buy into the cost/benefit of formal testing. Advocates of these testing methods often assume that time will be found to perform them, but the bottom line is that most developers testing code are being screamed at to deliver immediately or better, yesterday. It takes time to execute the process of formal testing and time is usually one luxury that developers are not allowed to have.

Self confidence

My first programming language was Fortran IV, with punched cards as an input medium. Everyone was encouraged to walk through their programs line by line before putting the card deck into the machine, and we really all did examine everything, because the cycle time of getting the job run was so long that it was worth the effort. We didn't think of it that way, but this was of course a form of testing.

These days, such testing can be done online with source debugging tools and I always walk through my code line by line as I build it. Well, it's perhaps more realistic to say, as I build *sections* of it. On various varieties of Unix, I favour Mark Russell's public domain debugger `ups` (*ftp://unix/hensa.ac.uk/pub/misc/unix/ups*). If you are an acolyte of the One True Microsoft Way, however, the standard visual development environments contain source debuggers that allow you to exercise your code a line at a time.

In my November 1996 article, I said that one of my maxims of coding is to deliberately separate the control of actions from the actions themselves. Code that performs some specific task is placed within a function that does one thing and one thing only, and the control logic (loops, switch statements and the like) occupies a separate routine. This practice helps immensely in improving the readability and comprehensibility of code. It assists with line-by-line code examination, since debuggers can trace routine calls as if they were language statements, so once you are satisfied that an action routine is working, you can concentrate on its control.

Apart from source debuggers, there is an increasing number of tools that can be used to improve your own confidence in your code. One which springs to mind is Pure Atria's Purify system and library for monitoring usage of the heap. Purify can help to seek out and destroy the two main enemies of C programmers: memory leakage and illegal pointers. (Incidentally, the company was recently demonstrating a Windows NT version of this product).

As ever, `lint` is worth a mention. At some point, it's always a good idea to put your code through `lint` or turn on those extra warning flags in the compiler. It's true that ANSI C's function specifications have removed one of `lint`'s main jobs (the checking of routine parameters) but I find that it works well at picking up those `return` statements from functions that should return a value and do not, simply because I didn't remember to put the value in.

Stepping through the code and using program verification tools gives you as the developer the confidence that your code is working and that there are no obvious bad mistakes in it. The process is, however, hard to document, harder to quantify, and perhaps too detailed to use in a formal test plan.

Component tests

When I started climbing the mountain of creating a test plan for my project, I began to ponder the issues of demonstrating that the low-level code itself works, as opposed to proving the functioning of the system as a whole. It seems to me that unless you address the reliability of the low-level code, it is rather a waste of time to test the system itself.

It may sound a little counter-intuitive, but I think tests should not be dependent on the tester having an understanding of how the code functions or even the fine details of what it is intended to do.

In general, when I execute a test, I am only interested in whether it is passed or failed. I freely admit that I instantly forget the workings of programs that I have written and just relearn them module by module on a 'need-to-know' basis.

There's an additional agenda for the tests. My system will be ported to various Unix flavours and I wanted to have a test sequence that I could run on different machines to check that the code works in the new environment.

I came up with the idea of having a set of tests for the low-level code that I have called *component* tests. The idea is that each module in the system is tested by a custom program that exercises it. Of course, I originally partitioned the code into modules to help the implementation process. It does pay off when you come to create tests. The goal was to make all the modules self contained, with only one entry point and no global data. But rules are of course made to be broken and some modules have more than one entry point. If a program has global state, I usually place the variables in a single structure shared by all its modules.

Each test program uses `#include` to pull in the source of the module under test, and so has full access to the module's internal data structures and static routines. An alternative approach is to place the testing code within `#ifdefs` in the module itself. I've done this in a few places, but it can be restrictive: for instance, you may sometimes want to use the same module source in different test harnesses. I think that if you cannot isolate the code for a module and wrap a test program around it, then you have discovered a piece of bad design, and you should examine how your code is put together and think about changing it.

I expect to be able to test all my code by including it in small test programs, apart from the code in the module that contains the `main()` routine for the program. In my source, the code in the `main()` section of the program is usually operating system-specific, dealing with argument decoding, signal handling and so forth. As such, it will be tested later in the higher level system functionality tests.

There's a danger of having to test the test code unless you make the wrapper programs very simple. Of course, you are creating a new program, albeit from old code, so you should probably walk through the source at some point to make sure it is working as you expect it to.

The test programs in this project just do some set-up, call the module under test and print the results. This linear sequence can be repeated several times if the need arises.

The printing of results needs to be coded with care. If you are printing out a structure, then always print all of its fields. If pointers are `NULL`, then print a string saying so. It's a good rule of thumb to ensure that `if` statements in the printing code always have `else` branches that print something, and that every `switch` block has a `default` statement.

Scenarios

Next, there is the task of creating test scenarios. The first few scenarios are usually easy, just simple tests to check that modules are doing what they're supposed to do. Incidentally, you should not feel that any test is not worth doing: several of my fundamental library routines are just a few lines of code with few branches that call standard system routines. Writing code to exercise these functions feels like a waste of time, but it's not. This is precisely the area where problems are likely to occur when porting the code to another environment. Actually, you are creating an insurance policy: later, if something trivial is not working properly, you will know instantly.

Test scenarios for failure are much harder to create. I adopted the approach of looking through the code under test and ensuring that the tests generate every error message. As a principle, I always test for the result of every function or system call that returns a value and will print a message when an error is signalled. Actually, some of my error messages will never happen because some system calls will not fail (for example, `fstat` on a good file descriptor) or will not fail in one part of the code because they have succeeded elsewhere (say `chdir("..")`).

Once you have been through the source looking for possible causes of failure, then you need to generate some tests that call the module with silly values. For example, does the module check for `NULL` pointer parameters and deal appropriately with them? When coding, it's usually sensible to place a `NULL` pointer test just before any code that indirects through that pointer. It's never a good idea to say to yourself 'I'll never call that routine with a `NULL` pointer'. Someone else maintaining the code will not know that, and could unknowingly create a problem that does not manifest itself for some time.

Harnessing the test

Once you have a test program, what then? My test programs are mostly not too clever: they rarely check for errors themselves, but just exercise the code and leave the interpretation of the output to a human. The idea is that the program should be run at some

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point to generate a standard test result file that is stored along with the test. Then when the test is run again, its output can be compared with the control result file using the `diff` command. If the new output is the same as the stored file, then you can be reasonably confident that the code is working the same way as the original version.

This mechanism can be automated using the `make` utility. Each test program lives in a separate directory along with a `Makefile`. Calling `make` with no arguments builds the binaries. The target `test` runs the tests in that directory. The `check` target runs the tests with its output glued to a temporary file, and compares the text stored in the temporary file against the standard results, stored in a file called `results`. So to create the results file, I'll say:

```
$ make test > results
```

and later to test the code again:

```
$ make
```

`$ make check` will do the job.

Using a `test` target makes it possible to build several tests into the `Makefile`. It's often convenient to create a number of test scenarios using standard commands and use a simple test program several times to check on different aspects of a module. For example, in my current application, there's a module that copies files from one part of a filesystem to another. Since this is a major part of the work, there are many test scenarios that exercise different sections of the code. Each test copies some files into place, runs the test program and then checks that the files have been moved correctly. Finally, the results file is compared with the standard results file to prove that the test succeeded.

I've added an extra test to check that my memory allocation routines actually fail when virtual memory is exhausted. The test is run twice: once to prove that the routines function correctly, and again with a memory limit set to prove they fail correctly.

As I said, the `check` target uses the `diff` command to compare the output of a test run with a standard results set. If the `diff` command reports that the outputs are identical, I print a message like: `Test name OK`, otherwise I just allow the command's normal output to be displayed.

Not all test programs are so simple: some must print data that varies from run to run. For example, the routines that generate log file entries output the date and the time on each output line (log file output is generally diverted to the standard output of the test program). Also, some test programs print hexadecimal addresses that may differ if the library is changed and the test program recompiled. This type of output is handy when debugging code, so it is sensible to create some test programs that generate it.

My strategy for dealing with this in the automated test suites is to remove the text that varies from run to run just before the comparison is done. This doesn't invalidate the comparison since it is the other information in the output stream that we are interested in.

I've used two different mechanisms to remove variable text depending on where it originates. If the variable text is generated by the test program, it's simple for me to control exactly what form it takes, and I encapsulate it in a string:

```
VARDATA(0x3f67ff78)
```

This is convenient for processing with the `m4` macro processor using a little macro definition file like:

```
changequote({,})dnl
define({VARDATA},{})dnl
```

The first line changes the quote character for `m4` from forward and reverse quotes to curly braces. I actually tend to do this out of habit – it's not just to ward off the famous *EXE* quote faeries. The second line defines an empty `m4` function `VARDATA()`. When `m4` applies the function to the data in the results file, the variable text marked with `VARDATA` will be deleted.

The situation is a tad more complicated when the variable data is printed by the modules under test. I didn't want to have to change the module code to make special test versions that use the `VARDATA` trick. The tests must be done on the actual application code and not some variant, otherwise the code is not being tested properly.

It turned out that there were only two sources of variable text in the application. Some of the start-up routines print their process id value (PID) and many routines print the date as part of a call to the standard logging functions. These values can be determined in the test program before the test module is called, so I made the test programs print lines like:

```
+++PID/15907
+++DATE/Nov 19 14:44:57
```

to the results data stream. The results data is passed through `grep` to get all the lines starting with three plus characters and then through `awk` to generate a `sed` script. (The slash character is used as an `awk` field separator). For the example above, the generated `sed` script would be:

```
s/15907//g
s/Nov 19 14:..:..//g
```

The first line removes all occurrences of the PID in the results, the second deletes any date string. The dots match any single character in the source file, so time can pass while the test programs are running, and the text will be ignored. A `sed` script is generated for both the standard results file and the current run of the program. The 'edited' data is then used for comparison.

This whole structure has worked very well. There is now a top level `Makefile` that runs all the tests with a single command, taking some time to chunter through all the tests printing OK messages when each one is complete. To create the whole set of tests, I progressed through my sources a file at a time creating test programs and testing scenarios. I actually discovered about three stupid coding errors during the process, so the exercise was worthwhile.

The test plan

Although, I've spent most of the space in this article describing the component tests, they actually form only a small part of the formal test plan. I've gone on to specify tests that treat each application in the program suite as a self contained module, testing how they work when interacting with the whole system. These tests are specified in the usual sort of 'press this, type this, see that' text document designed for humans to exercise the system.

Part of the application is a custom Internet protocol I developed (discussed in last September's *EXE*), and I generated an extensive set of tests for it. Like most Internet protocols, it is client driven and as a result it has proved advantageous to write a diagnostic program that can generate the protocol primitives and test responses from the server. This approach decouples the testing of the protocol and server from testing of the client.

At some point soon, the project will undergo a complete functioning system test, as yet unspecified, that will move real data in the real environment. After my other tests, I expect that this will just be a rubber stamp exercise. ■

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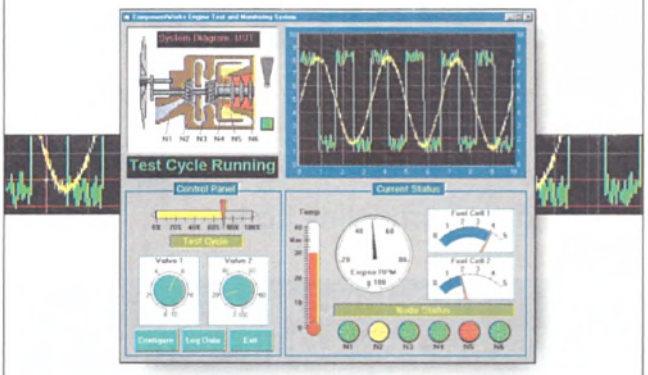

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Tropic of Cancer

As the ISO draws the nascent C++ standard under veils of darkness in Hawaii, some dangers in the standard templates and exceptions threaten to remain in limbo. **Francis Glassborow** shimmies ably below the bar.

The most recent joint meeting of ISO SC22/WG21 and ANSI X3J16 was hosted by Plum Hall, a Hawaii-based company that specialises in quality assurance software for C and C++. I doubt that many of the delegates attending had much objection to the location. Many of us spent a few extra days there so that we could do some sightseeing after we had finished our work. Three intrepid delegates actually went to the observatory nearly 14000 feet above sea level, though to the best of my knowledge none walked across the main caldera of the most active volcanoes – perhaps they felt that being required to keep to a narrow track threading its way between areas of thin crust was a little too reminiscent of C++ standardisation.

The meeting itself brought several important points to the surface. First of all, the ISO has made a bid to seize control of the copyright of all documents involved in the standardisation process. Until now, it had been content with the copyright only to the actual international standards. Though many of us are unhappy with this move, we decided to keep to the new rules for the time being, the result being that such things as committee drafts are now restricted to those who can show that they need access as part of the standardisation process. The situation is similar to the non-disclosure agreement (NDA) procedures applied to those wanting access to beta software.

The new Committee Draft voted on at the Hawaii meeting, called CD2, will only be available from restricted ftp sites and through hardcopy. Even so, controlling who gets the documents is awkward. In America, the situation is easy since you have to pay for a position on ANSI committees, but UK policy is that committee members do not have to pay for their seat. To keep on the right side of the authorities, we will need some form of signed NDA for access to CD2. If you are interested, get in touch with me.

In the above context it is interesting to note the number of commercial compiler vendors who will lack any legal access to the current C++ standard. Symantec, for example, has let its membership of X3J16 lapse, and Salford Software and TopSpeed (of *Clarion* fame) have never been involved. When you realise that tiny companies such as Plum Hall actually host meetings (at an estimated cost of about £15000) and such one-person companies as OCS Ltd participate fully, you can understand my distaste for those that use the work without contributing anything towards it.

Microsoft, at the very least, pays for its seat on X3J16, although its level of participation is such that it has lost its voting rights for failing to attend any of the last three meetings. As the real cost of developing the standard is in the thousands of man-hours spent working on detail, I think that a wealthy company such as Microsoft could do more. A few hundred hours of the time of a couple of its implementation experts would mean little to it but could be of great help to those of us struggling with some of the more obscure issues. Could it be that it does not have anyone with the expertise to contribute at this level? I doubt it, but whatever the skills of its employees, their understanding of important issues will suffer through lack of participation.

Allocation time

Back to Hawaii. We spent the first three days cleaning up a range of minor issues, as well as tackling a couple of major ones related to libraries. I hope that future language standardisation efforts (such as for Java) will note that co-standardisation of the core language and major libraries should not be a monolithic process. Certainly, working on both items on the same time does provide benefits – advanced library design will always place stress on a language specification. However, standard libraries require a couple of years work after the core of a language has been fixed. In the case of C++, we do not have that option, and so the standard C++ library is less well specified than some of us would have wished.

The concept of general memory allocators has been an integral part of the C++ library for several years. It was intended for STL containers to use allocators, but those responsible lost their nerve and stripped the specification back to the point where it is only necessary for an implementation to support ordinary pointers. In fact, the heat generated within the workgroup concerned resulted in several experts walking out. It says much for Andy Koenig's diplomatic expertise that he got them back round the same table and produced a compromise we could live with. Even so, when it came to the vote the UK contingent was against both the allocator amendment and the release of CD2. Interestingly, the negative vote was welcomed by almost everyone, since it makes it likely that the issue will now be revisited as a result of national body comment on the CD. We have come a long way from the days UK delegates were looked upon as obstructionist pains in the proverbials. Much of the credit for this belongs with Steve Rumsby and Sean Corfield who have been so unstinting in donating their time. In fact, Rumsby has just replaced Dan Saks as Secretary of X3J16 (what a mixed up world where an English C++ expert is elected to office on an American standard's committee).

The other big issue was the lack of exception safety in STL containers. They can be left in an unstable state while being processed by

some algorithms. For example, if an exception is thrown through a container representing a balanced tree while it is being re-balanced, the result can be a 'panic', which can leave the container in a state where even its destruction will cause undefined behaviour. It is only recently that we have realised that the strict performance characteristics placed on STL algorithms and containers make it impossible to provide fault tolerance at all times. What we need is a separate set of fault-tolerant STL specifications for use where safety is essential even at the price of considerable degradation in performance. The standardisation process does not have time with both the safety and performance-optimised libraries, so we will have to leave it to implementors to provide fault-tolerant libraries where their customers need them. I would hope that this can be done at no more cost than a relaxing of the performance constraints.

Another library issue was the current specification of `auto_ptr`. It became clear to the UK members in August this year that various apparently minor modifications made to its specification had, in our opinion, broken it. Or, to be more precise, made it unsafe for use by any but the most skilled C++ programmers, who generally will not use it since there are better solutions in most particular situations. The original purpose for introducing `auto_ptr` was to help the less experienced with exception-safety, so I find it particularly ironic that the current cure is more dangerous than the disease. Though a fix was provided in Hawaii for the most glaring problem the result still does not provide a simple and safe way to handle dynamic resources in an exception throwing environment. I will attempt to cover more fully methods for ensuring dynamic resources are released during exception handling in a future column.

That we managed to ship a CD before the end of the meeting was a credit to the many editors and reviewers who worked from 5pm Wednesday till 7pm Thursday with little sleep. I think they deserved their beach party.

On Friday the formal proceedings and official vote on shipping CD2 were enlivened by Andy Koenig showing his mastery of Postscript by producing a copy of the whole working paper on a single side of a sheet of quarto paper. So, next time someone says the C++ specification is too large, we can reply 'Rubbish. It fits on a single sheet of paper.'

A book for 1997

Just as with most technology, the standard template library is taking time to filter down from the theoreticians to the ordinary user. The world's C++ experts immediately recognised it as a significant contribution to programming based upon the many years of experience from its designers at Hewlett Packard. The true impact of STL, however, is on less experienced programmers: it is not expert C programmers who rely upon third-party or library functions, but the novices setting out to write their first program. Unfortunately, most developers will have trouble convincing management to give them any time away from immediate product deadlines to master the STL. They simply don't have the time for such expert-level treatises as *STL Tutorial and Reference Guide* (Musser and Saini, ISBN 0-201-63398-1).

In this context I was delighted with Leen Ammeraal's latest book, *STL for C++ Programmers* (ISBN 0-471-97181-2). It probably will not be the last book that you read on STL but for many it will be an excellent introduction. By the time you have finished reading it you will, I hope, appreciate what it was that enthused so many experts when they were first introduced to STL.

I am biased, because I did the final technical review before publication (and Ammeraal had the good sense to take almost all my advice). In case you are any doubt, technical reviewers do not get any of the profits: just a share of the blame for anything that is wrong.

Last month's problem

Last month I asked: when are `int` and `signed int` different.

The answer is when you are declaring a bit-field. If you got that right, congratulations.

This month's problem

C++ remains full of surprises, and I came across a couple more over countless drinks and discussions in Hawaii with Martin O'Riordan, ex-Microsoft C++ implementor, humorist and one of Ireland's leading C++ experts.

Under what circumstances does the following do something in C?

```
i; /* i is a variable */
```

When you have decided I will be able to explain that, as from Hawaii, it does rather less in C++. It was a rude shock to discover that it could actually do anything.

The other item is to consider the following two functions and decide whether either or both are defective.

```
void fn1 (){
   for (int i=0; i<10; i++){
      for(int i=i; i<10; i++) {
        cout << i << " ";
      }
      cout << endl;
   }
}
void fn2 (){
   for (int i=0; i<10; i++){
      for (int i(i); i<10; i++){
        cout <<i << " ";
      }
      cout << endl;
   }
}
```

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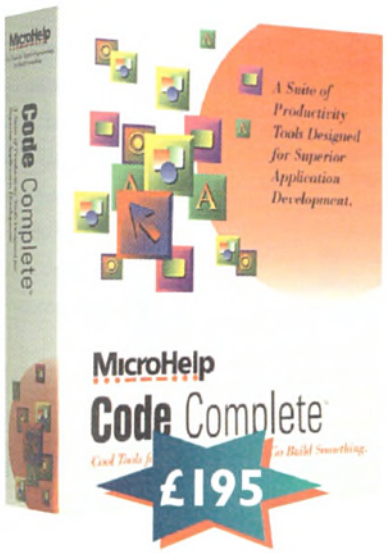

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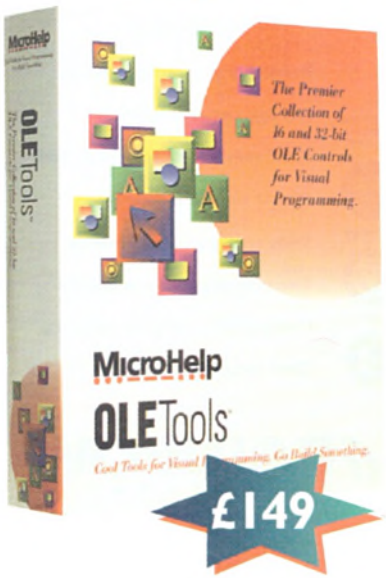

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Atomic Café?

Symantec is lining up as the latest to leap into the Java pit with Visual Café. **Will Watts** has been poking the beta with a stick.

OK First establish provenance: Symantec is the inheritor of the Zortech C++ compiler and the Macintosh Think range of compilers. When Java madness first started to strike, the company was very quick off the mark, first adapting its C++ IDE so that it could be used as a shell for the Sun compiler, and then introducing Café, a Win32/Mac-hosted Java IDE with compiler, debugger and rather primitive form painter.

Visual Café, which should just be through the door by the time you read this, is an all-over souped up version – a 'visual RAD tool' is how Symantec puts it – of the original product, from which it will be a chargeable upgrade. This review is based on the Win32 Preview Release 2.0.

Photo: Franwyn Black

The 'Visual' bit

A glance at Figure 1 shows that Visual Café's environment conforms to the familiar multiple floating window pattern established by Visual Basic. A main menu bar runs along the top of the screen (and irritatingly insists on filling the full width). It holds a number of dockable toolbars for file saving and loading, debugging run/stop commands, a tabbed component set, a component alignment palette, a palette which controls which floating windows are on display, and a drop-down combo box which selects the current 'workspace' (this being Symantec's term for one-layout IDE windows). By default you get an *Edit* workspace, which contains the form designer, the property editor and so on, and a *Debug* workspace, which brings up watch windows and thread views and the like. You can make customised workspaces too, if you enjoy that sort of thing.

Most of the windows – properties editor, form editor, code editor (with colour highlighting, natch, and Basic-based macro scripting that is too fancy to be any use) – are self explanatory, but the project manager window (with the tree view on the left), is worth a few extra words. The Explorer-style hierarchy of icons it displays does not relate to inheritance but containership: a button is shown as a 'child' of a panel, which is a 'child' of a frame. And, somewhat startlingly, the hierarchy is editable: pick up a button from a panel and drop it into the main frame, and the form editor and the properties editor and the source code editor (for Java does not support resource files) all change in sync to reflect the update.

This is the feature that Symantec calls 'two way tools', but I think they are understating their case: it's actually more like 'three way tools', or even 'four way tools'.

Another example may give you a flavour of just how impressive it is. When you drop a button onto a form, Visual Café generates a suitable declaration in the applet's class:

```
//{{DECLARE_CONTROLS
java.awt.Button button1;
//}}
```

Towers of Hanoi benchmark

	Development System	Visual (17)		Non-visual (23)	
		Windows 95	NT 4	Windows 95	NT 4
Java	AppAccelerator (Borland C++)	60	53	942	926
	Netscape 3.01	158	164	505	443
	Sun JDK 1.02	62	54	985	916
	Sun JDK 1.1 Beta	46	42	700	551
	Visual Café	29	22	123	163
	Visual J++	34	28	176	198
Non-Java	Delphi 2.01	46	16	10	10
	Visual Basic 4.0 32-bit	131	118	192	195
	Visual C++ 4.2	23	27	7	8

Notes

1. *All timings are in seconds.*
2. *Visual benchmark performed using 17 discs, non-visual benchmark using 23.*
3. *All tests performed on a Pentium 90 with 32 MB RAM, and a Diamond Stealth 64 VRAM video card.*
4. *AppAccelerator test: file compiled and viewed using Borland C++ 5.01 with AppAccelerator for Java enabled.*
5. *Netscape 3.01 test used .class file produced by Visual Café*
6. *Visual Café test compiled using Visual Café prerelease, run using Café 1.51 environment with Symantec's JIT compiler 2.0 installed.*
7. *Visual J++ test run with Internet Explorer 3.01.*

Table 1 – Towers of Hanoi benchmarks.

and some initialisation code in the applet's `init` method:

```
//{{INIT_CONTROLS
// (stuff omitted...)
  button1 = new java.awt.Button
              ("Button");
  button1.reshape(105,45,89,26);
  add(button1);
//}}
```

where `"Button"` is the button's caption. Now if you go into the code editor and change the constructor call to, say,

```
button1 = new
java.awt.Button("Hello");
```

and do a *Ctrl-S* to force a reparse – blow me! – the form and properties editor are updated with the new caption. Plus, parsing a source file takes no time at all.

The IDE's class hierarchy editor displays the inheritance relationships of all the classes in your project, with drag-and-drop editing. It is smartly implemented and undeniably impressive, but not especially useful for editing, as far as I could see.

By contrast, the class browser, shown in Figure 2, is dead handy. Right-clicking in the top right pane brings up a context menu which allows you to add methods and data members to the current class. The bottom pane then shows the Java code for the method or member, and allows you to edit it. You can navigate around the class by clicking nodes in the member window, or move to other classes with the top left pane. You have complete freedom from the physical text file that contains your code. This is a brilliant tool, especially for doing the first hack at a class design. Other vendors please copy.

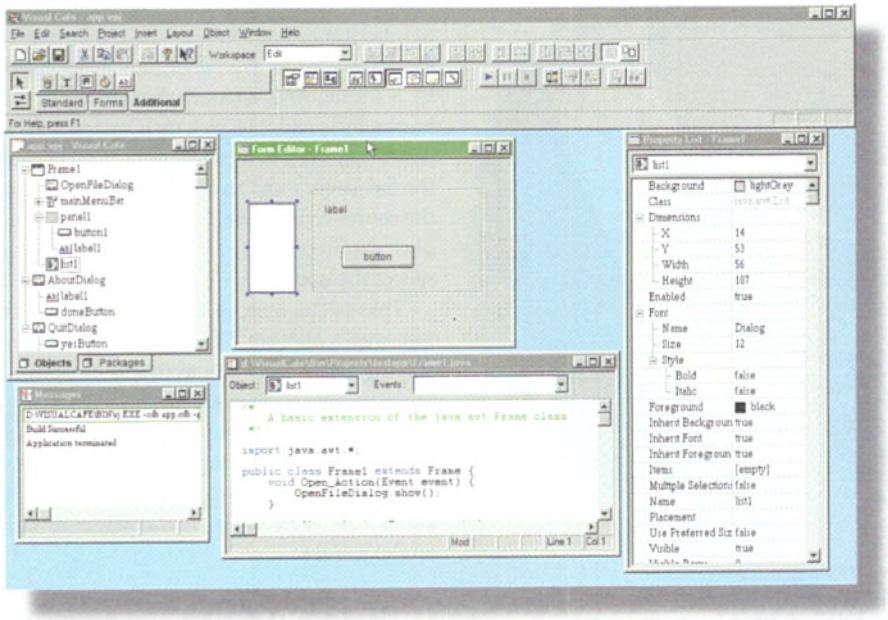

Figure 1 – The Visual Café development environment.

Event handling

A key feature of Visual Basic and Delphi, the feature that has allowed the masses to participate in the great GUI programming revolution, is the way they do event handling. So how does Visual Café cope?

The process is guided by the Interaction Wizard. First you draw a line between two components on your form to join them in a state of holy interaction, as in Figure 3. When the second component has been selected, the wizard appears (shown in Figure 4). With a couple of canny choices and a few swift clicks of the mouse, you can accomplish such feats as copying the contents of an edit field to a list box, and everything is just peachy.

Except it isn't, quite. Figure 5 shows the code that the wizard generates for our click-button-to-fill-list-box task. It is clear that as more actions are added `handleEvent` will quickly turn into a dog's breakfast of 'if it is this control and that event then call this

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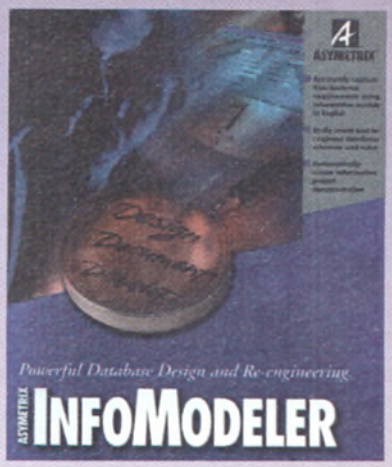

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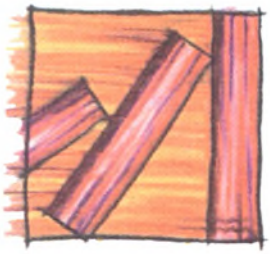

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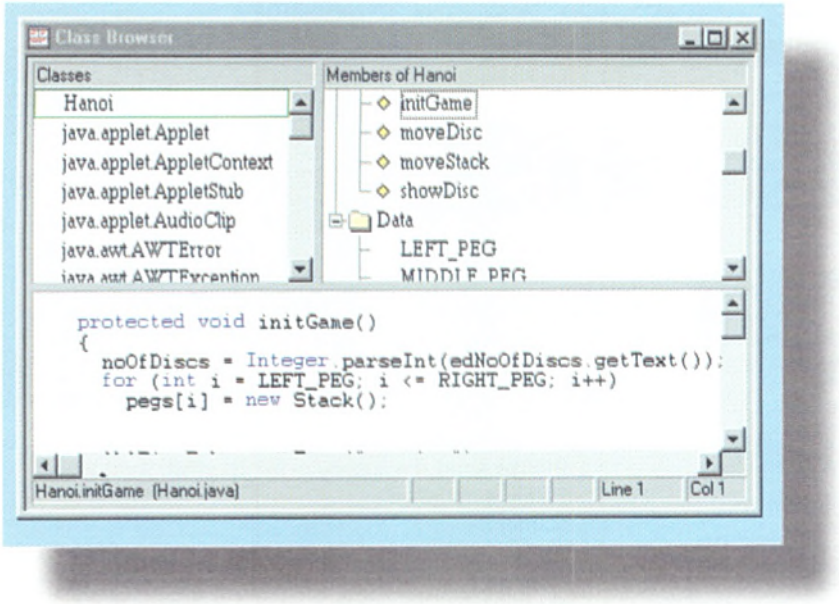

Figure 2 – The class browser.

method' statements. Good enough for C users who are programming in the Petzold style, but a rude shock to effete Delphi types like me. This is not really Symantec's fault: the event model of the JDK AWT is a given, and at any rate is rumoured to have been cleaned up in the (just released at the time of writing) JDK version 1.1 [it has, and `handleEvent` has in fact become a deprecated feature – Ed].

A more puzzling irritation is Symantec's pretence that event handling is about the interaction of two components. It is no such thing. Event handling is about doing whatever you need to do when something generic happens, whether or not it involves components, instance data, other methods or old Uncle Tom Cobbley. If you want to just increment a counter at every button click then that's your right, but Visual Café will make you connect your button to a form (or something), invent some sort of interaction to keep the wizard happy (like 'on button click disable the applet'), go edit the code in the source editor, delete the applet-disabling line and finally insert your counter-incrementing code by hand. This is much quicker in doing than describing, but still: why not include a simpler wizard for ordinary event handling?

A brief word about the debugger, which seems to be the same as before. Visual Café includes a competent set of debugging tools for both applications and applets, with facilities for tracing through the source and windows for data, threads, stack and watch variables. Bonus points to Symantec for stealing that splendid Visual C++ feature where if you let the mouse cursor rest over a variable in your code, after a second its contents spring up in a ToolTip window.

Tower testing

Symantec supplied a table of benchmarks with our press review kit. As is usual with benchmarks supplied by anybody under these circumstances, the results indicated that the review product was consistently faster than all it rivals. However, one thing caught my eye: the choice of algorithm. Instead of the usual Sieve or Whetstone or whatever, Symantec used the Towers of Hanoi – one of the classic problems and hallowed favourite of college lecturers who want to make recursion seem difficult and mysterious.

I accepted Symantec's chosen battleground, and resolved to implement my own Towers of Hanoi. In fact I wrote two versions. One displays the discs in the Towers as the game progresses and is thus, in the jargon, 'I/O bound'. The other, a hacked down version of the first, works through the moves without displaying anything at all and stays 'CPU bound'. I implemented the programs as applets instead of applications, because the only Java programs I encounter in real life are applets. Symantec pointed out that this is not a fair test of the pure JVM; probably true but tough luck. By the way, you will find the applets on the *EXE* Web site, where you can run them for yourself, and criticise my coding.

So far, so good. I then spent the evening in the pub with two programmer pals from the Javo-sceptic wing of the party, and over the second (or maybe the third) pint got into a big argument about which was the slowest: Java, Visual Basic, Visual C++ or Delphi. To cut a long hangover short, I ended up reimplementing my program in Delphi 2.0 and Visual Basic 4.0, and

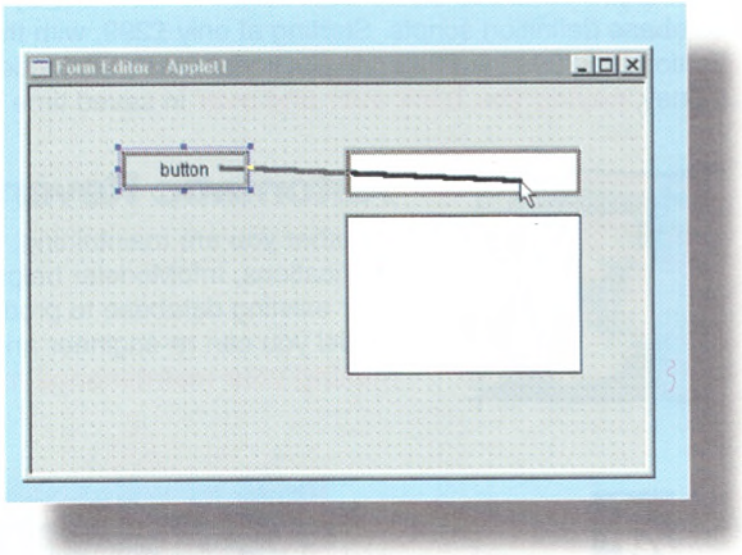

Figure 3 – Starting the interaction wizard.

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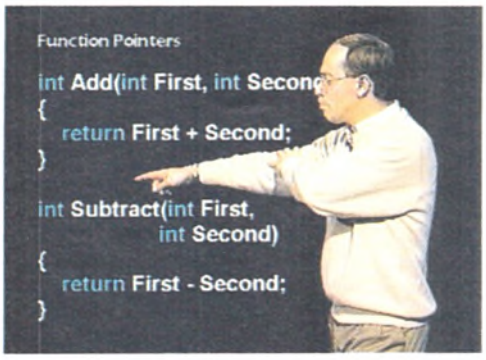

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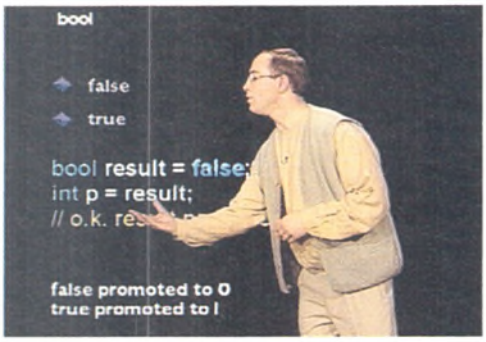

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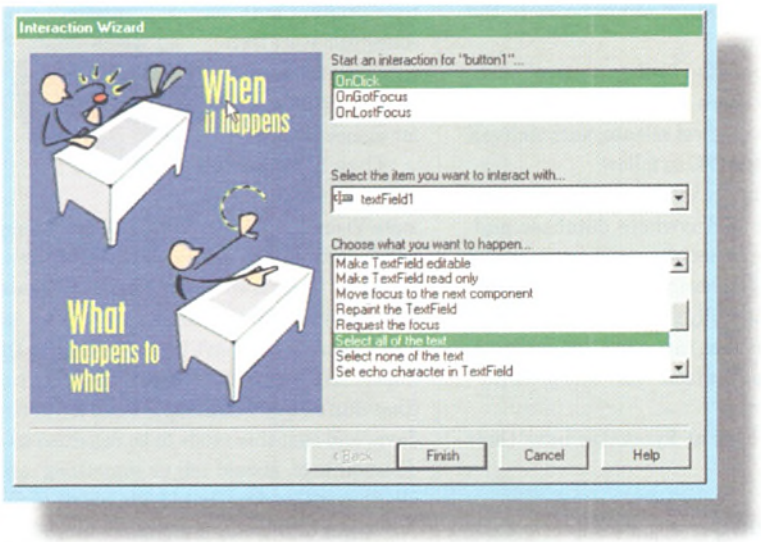

Figure 4 – Interaction wizard's dialog.

my friend Brian put together a Visual C++ 4.2 version. We adopted the general rule that when porting to another language we would implement everything the 'natural' way – ie no bypassing native libraries and calling APIs directly to save a few cycles in the tight loops. Brian suppressed his natural instincts and accepted my frightful code as the standard – so if you look at the source of the C++ version (also on the Web), this is why there is one line (which would do the work of the next five) commented out.

Table 1 shows the results and, though I say so myself, damned interesting they are too. Visual Café is consistently and clearly the fastest Java product, just as Symantec said. Apologies for doubting. Visual J++ is consistently second best, and mostly faster than Visual Basic. The JDK's performance is distinctly unremarkable – even in the brand new 1.1 incarnation. Visual C++ fails to emerge as outright speed king because of a freakishly slow performance with the visual test under NT4 (repeated five times with the same result, by the way; God knows what was going on).

But with apologies to the subject of this article, the most striking result is Netscape 3.01, whose Java performance is wretched, especially for a company whose entire livelihood is so tied to the Net. Netscape currently uses Borland's HTL (Hopelessly Too Late, geddit?) compiler technology and is about to switch to Symantec's. One can sympathise with the decision.

One final thought. Why do compiler companies go to all the trouble to build rival JIT systems? After all, the user of a Java application will use whatever implementation of the JVM is installed on their machine, and in the short to medium term this will be part of the operating system. This is already the case with the new OS/2, it will soon be true of Windows and it will obviously apply to the new Java-based hardware being created by Sun and its allies. There is only one Netscape contract to be won, so what is the point?

```
public boolean handleEvent(Event event) {
  if (event.target == button1 && event.id == Event.ACTION_EVENT) {
    button1_Clicked(event);
  }
  return super.handleEvent(event);
}
void button1_Clicked(Event event) {
  // to do: place event handler code here.
  list1.addItem(textField1.getText());
}
```

Figure 5 – Event handling code generated by the Interaction Wizard.

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CIRCLE NO. 046

But it's not fini

Of all the pre-release products I have ever reviewed for *EXE*, this one was the furthest from completion. 'Beta' is an outrageous exaggeration of its state of readiness; for that matter, 'late Alpha' would be coming on a bit strong. Huge, important chunks of Visual Café were missing, and parts of the system were less stable than a 2CV on a tight curve in a strongish wind. But Symantec swore it would have the product out the door by the beginning of 1997, and the Editor understandably wanted something to put in his Java issue, so here we are.

A list of some of the things that were missing, and which therefore cannot be commented on in this review:

- Live Editing: the Form Editor should run in a Java Virtual Machine. Controls dropped on the form should be real executable byte-code; in the version I had they were simulations. This meant, for example, that colour properties were ignored at design time. There was an early test version of live editing included; this was too unstable to permit any comment.
- A help system for the IDE. Of course, the absence of this may mean I have missed other important bits too.
- The API for adding components to the IDE's palette.
- Support for lots of other control standards: the Java beans standard to be included in the first release, with ActiveX and Netscape IFC to follow.
- A Pro version of Visual Café will include Symantec's dbAnywhere database middleware and a set of data-aware controls for building instant forms. One will be able to create fully fledged Java database applications that run across the Internet. None of the database stuff was present.

In short, the boys at Symantec have their work cut out.

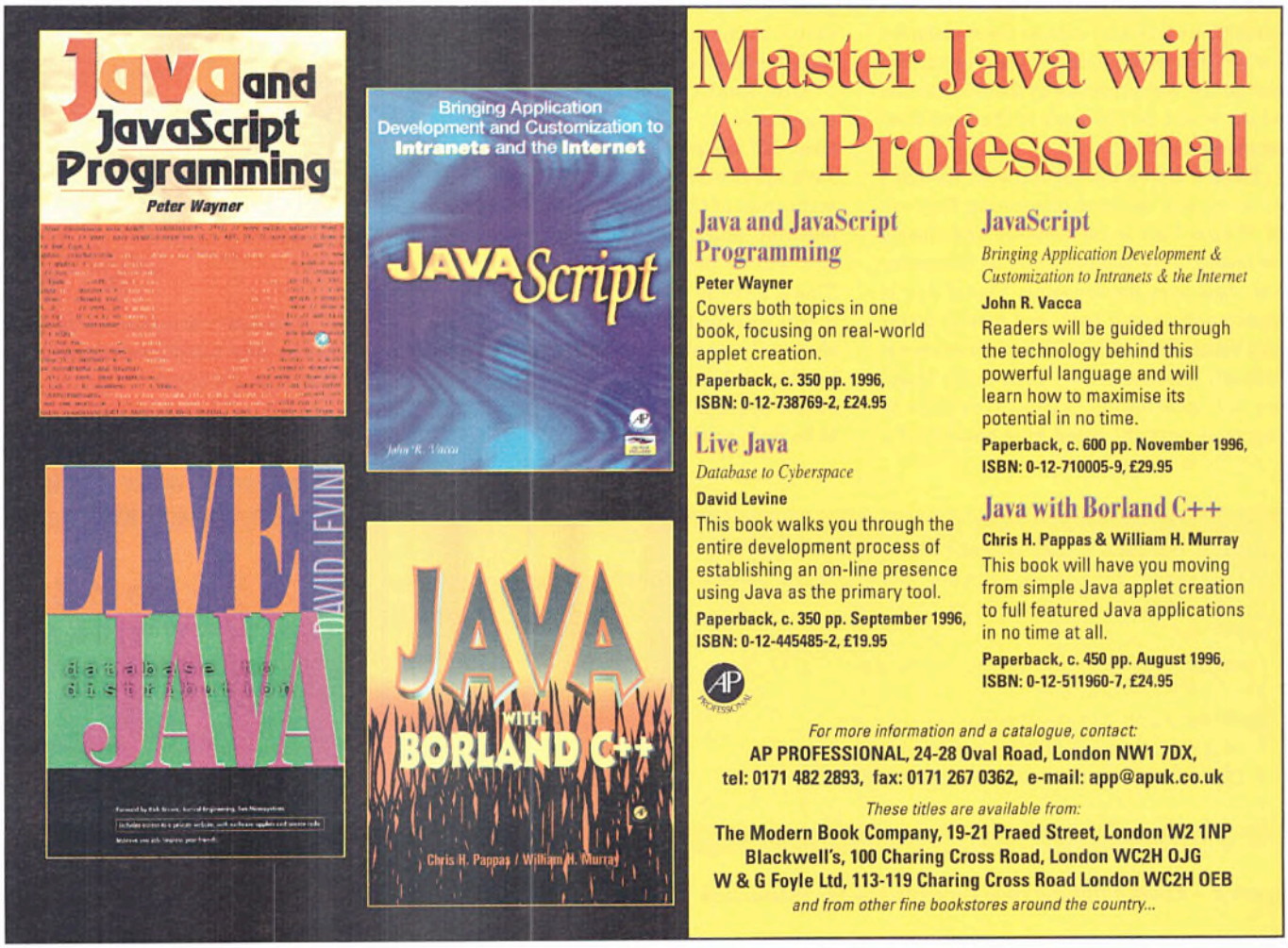
Comic timing

When applied to Visual Café, Watts' Mean Law of Software Lateness predicts that the first really stable version of this product will appear July '97 – and that this will be the third official release. If you are planning to produce a serious Java application – and a recent Sun-sponsored *Sunday Times* supplement contrived to give the impression that no working programmer is thinking of doing anything else in the next 12 months – then you should not plan on picking up a copy of Visual Café tomorrow and finding matters shipshape and VisBas easy. This is an immature product built on some immature technology, and for the time being is fit only for pioneers.

That having been said, even in its incomplete state Visual Café is streaks ahead of the competition from Borland (mostly promises), Microsoft (tell me what the 'Visual' in 'Visual J++' stands for and I may buy you an ice cream; surely this can't be a reference to the hopelessly weedy ResourceWizard?), Sun (that Sun's Java Workshop is itself written in Java, and that this tends to be regarded as a disadvantage, should tell us something) and all other contenders that I have heard of.

Visual Café is an undeniably innovative product, with many nice touches and clever twists, for which Symantec is to be congratulated. If it ever manages to finish it, I recommend you take a look. ■

Symantec says that Visual Café for Windows 95/NT will have an estimated street price of £169, as will the Macintosh version. Upgrades from Café will cost £49. When it is released, Visual Café Pro is expected to cost around £479.
Thanks to Brian of AIS for his Visual C++ implementation of the benchmark.



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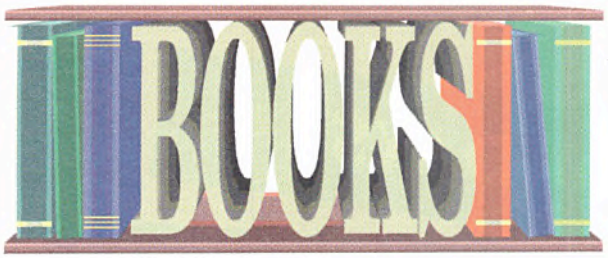
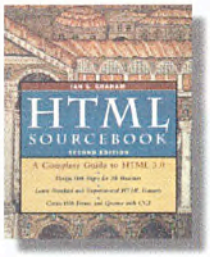


The HTML Sourcebook reviewed by **John Cant**



`</CONCISION>` All concision stops here: we are entering the realm of the computer text. Massed ranks of beached whales gasping for space on groaning bookstore shelves. The paperless office's revenge. Kernighan, where are your riches now?

A currently dominant variety of stranded mammal is the ubiquitous Internet Tome. How to find one less vapid than most? The HTML Sourcebook, a Second Edition no less, advertises itself as the 'Complete Guide to HTML 3.0'. Could this be the book for me?

The book covers at least three bases at once: it's both an introductory guide to creating web sites and understanding client-server communications, and a reference manual of resource information and useful URLs.

The first base is covered exhaustively and exhaustingly in page after page of repetition and homily. I quickly resorted to reading only the 'Lessons from Example X' sections which provide an intelligible condensate of the acres of preceding verbiage. Unfortunately these 'Lessons' come to an end in the second chapter.

Much heavy weather is made of the need to support all sorts of Browsers on all possible platforms. OK, maybe some people out there care about neanderthals scraping over the Net on a teletype; personally I feel they should be left to die in peace.

The existing HTML 2.0 standard is covered in detail, and there is an extensive discussion of the next generation of HTML extensions present in version 3.0. Topics covered include style sheets (support documents which enable authors to separate presentation information from content), mathematical elements and embedded applets.

The second base gives a good introduction to the issues of communication between browsers and servers. The HTTP protocol is examined, as are the Common Gateway Interface (CGI), security issues (including user authentication and encryption), image animation and database access. A number of example server-side programs are discussed, ranging from a simple 'hit counter' to a Web-based noticeboard system.

The remainder of the book covers the third base, consisting of skimmable references on URLs, HTML and Web editors, utilities and tools, Archie, and MIME. Myriad examples and URLs of relevant additional material are scattered liberally throughout the text.

The book misses discussing how best to register sites with the search engines, but is otherwise comprehensive. Had an element of concision (and indeed the author's own criteria for the design of multimedia) been applied to the opening chapters of this book, its enormous size would seem much less daunting and its reading considerably more enjoyable.

`<CONCISION>`

✔ **Verdict: Comprehensive, if verbose**

Title:	*HTML Sourcebook, 2nd edition*
Author:	*Ian S. Graham*
Publisher:	*John Wiley & Sons*
ISBN:	*0-471-14242-5*
Price:	*£22.50*
Pages:	*688*

Core Java reviewed by **Chris Cant**

It may have been a premature judgement, but I warmed to this book straight away when I saw the authors roughly following my preferred indentation style. This was even enough to override my dislike of listing member variables at the end of a class definition. In addition, the authors well know that real programmers type much faster than they mouse, although they do tend to verb nouns like the best of USAns.

Foibles aside, the book is a good guide to the Java language and API for experienced programmers, starting with stand-alone console applications and moving on to the AWT library, applets and finally multi-threading and networking.

Its examples run in Windows 95, and it has copious notes for C++ and VB programmers highlighted by icons in the margin.

As someone who knew Java already, I think it gets the language sections right – I actually picked up a couple of language tips. For example, the section on I/O shows one way to overcome the problems of object persistence. However, at least one minor feature of the language is ignored: synchronised blocks. In addition, it lacks a concise summarisation of the language, which I found to be a useful feature of another book, *Instant Java*.

I most appreciated the book's comparatively full coverage of the JDK's API packages, which taught me a lot. I am going to revise my usage of the `GridBagLayout` class now I understand what on earth all its constraint parameters mean. I also discovered the usage of Unicode Text Format for writing Unicode characters as 1, 2 or 3 bytes to save storage space.

Despite being published in 1996, the book is already slightly dated, in that it only covers version 1.0 of the JDK and refers to Netscape 2.0. The accompanying CD-ROM contains JDK 1.0 (including Mac and Solaris versions), along with Symantec Café Lite. I have been using this for some time, and have found it to be an effective, if basic, environment. The authors prefer WinEdit, and a specially configured version is bundled on the CD. The book also comes with its own `corejava` package of utility functions that may come in handy. The JDK's `javadoc` program, used to produce class documentation directly from Java source, is covered in an appendix to the book.

An errata and additional information not included in the printed version are available at *http://www.mathcs.sjsu.edu/faculty/horstman/corejava.html*. You should check out the page for changes to Java: from the information there, it looks like the `private protected` modifier is going to be removed from the language.

This book covers most things any budding Java programmer will need to know.

✔ **Verdict: Highly recommended**

Title:	*Core Java*
Authors:	*Gary Cornell & Cay S Horstmann*
Publisher:	*SunSoft Press, Prentice Hall*
ISBN:	*0-135-65755-5*
Price:	*£32.95*
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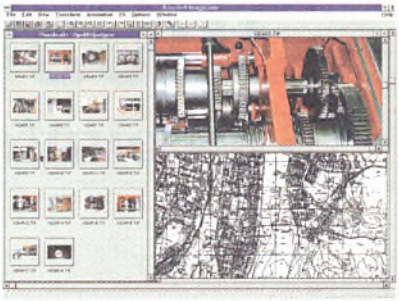

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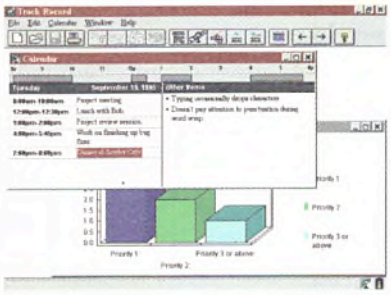

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The Java Language Specification

by James Gosling, Bill Joy and Guy Steel

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Written by the inventors of the technology, this book is the definitive technical specification for the Java programming language and base system. Programmers developing applications and Internet-ready applets will turn to this book as the authoritative source of Java details.

The Java Tutorial

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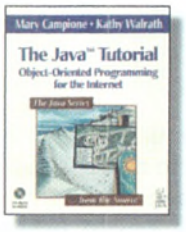

A practical step-by-step guide to writing programs with Java, beginning with the basics of the language and proceeding through more advanced topics such as thread programming, applet programming and designing and implementing graphical user interfaces with AWT. The material is presented as a self-guided tutorial and comes alive when you run the examples from the book at the web site. All supplemental source code and compiled versions of all examples are available on the Web.

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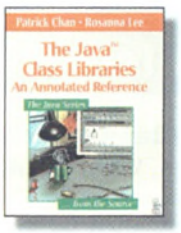

This example driven guide is the perfect companion to the Java Application Programming Interface volumes. Provides coverage of the Java API including the core packages as well as the Window Toolkit and Applet packages. The book is organised in a template-like manner with all classes, methods and interfaces described in a comprehensive and detailed manner. Organised to facilitate easy access and reference, the Java libraries are broken down into classes with each part's functionality thoroughly explained and supported with well annotated examples.

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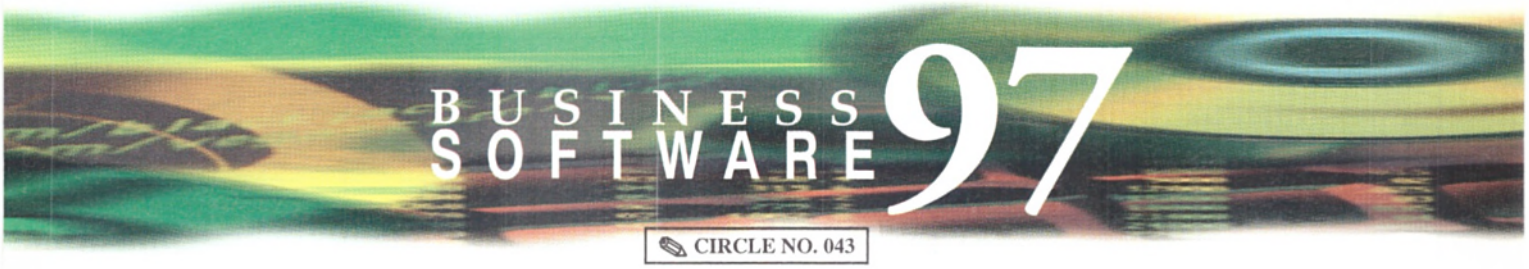

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REAL-TIME

C++/ REAL-TIME
Herts - To £30K

Our client is predominantly a developer of software and a supplier of computer systems and associated support services for retail applications. Candidates should have experience of real-time applications and either two years of 'C' / C++ under UNIX or Visual/Borland C++ in a Windows environment, preferably using the class libraries. You must be able to work well within a team. Ref: CP/1

'C' / C++ REAL-TIME
Bucks - To £22K

Our client develops chips and software for the video conferencing industry. They are searching for candidates with a minimum of two years 'C' / C++ programming, with experience of embedded real-time applications. Applicants must be highly self motivated and a team player. Ref: CP/2

EMBEDDED 'C' / C++
Berks/Avon - £15K - £30K

A range of Software Engineers are required with a minimum of one year's embedded 'C' programming skills to develop software for a variety of projects. Development will be under a motorola 68000 operating system on a PC host. Any UNIX skills would be advantageous. The successful applicants will be working for one of the UK's leading Software Houses which currently is expanding into the European markets. Ref:DE/3

UNIX DEVELOPMENT / SUPPORT

TEAM LEADER
N. Home Counties - To £38K+bens

We are seeking a high calibre Team Leader/Project Manager for a leading supplier of open systems software. Responsible for up to seven people, the successful candidate will be involved in influencing and driving the strategic direction for technology. Candidates should have at least five years computing experience including a year as a Team Leader, two years 'C' programming experience and UNIX to system administration level. Ref: LC/4

X WINDOWS / MOTIF
Cambs - £20K-£30K

Excellent opportunity to develop a leading GUI product for the next century. Candidates should have at least four years post-graduation experience where they gained good 'C' / UNIX programming skills. In-depth knowledge of X-Windows and Motif essential. Ref: DE/5

SOFTWARE TESTER
Herts - £25K - £32K

Our client, a leading supplier of open systems software, is currently seeking an additional Software Tester. For these challenging roles, candidates must have UNIX experience along with a grounding in shell programming and networking. Understanding of 'C' or C++, a knowledge of commercially available tools and familiarity with PC hardware is also required. Ref: LC/6

OO X-TRAIN TO JAVA
Herts - To £40K

This British company is developing networking products for the US market and requires additional software engineers. Candidates should be educated to degree level and have at least four years software development experience including object oriented programming. Our client will be using JAVA for all its development work, so training will be given to the successful candidates. Ref:LC/7

UNIX / SYBASE
C. London - £32K + BB

We require an Analyst Programmer for the financial sector, based in Piccadilly. Working as part of a small team on development and maintenance of the in-house trading system, using Sybase and ideally Powerbuilder, under UNIX. You will assist Fund Managers in identifying system requirements and you will act as project manager for minor projects. Ref:RC/8

SENIOR TECHNICAL SUPPORT
West London - £30K + car

Our client, a software house developing cross-platform client server software. They are seeking a technical support specialist to support developers of the latest generation of 4GL tools for UNIX, MS Windows and OS/2. You will have at least some experience of supporting the above as well as being a high achieving ambitious individual. Ref:JK/9

'C' / UNIX

'C' / UNIX / Device Drivers
Berks - £20K - £35K

Experienced 'C' / UNIX Systems Engineers required for this telecommunications division of a major software company. Positions are available at all levels, for engineers with recent experience of device driver development and/or network management. Rewards include competitive salaries and interesting working environment. Ref:JK/10

SYSTEMS ENGINEER
Herts - £25K - £35K

Systems Engineers are required by this US software products supplier. Suitable candidates should have at least two years 'C' and UNIX experience. Whilst not essential, device driver writing and/or operating systems internals experience (preferably UNIX) will be highly desirable. These positions will appeal to people who enjoy working in a technology strong team environment. Ref:LC/11

'C' / UNIX DEVELOPER
BERKS - To £30K

Our client is a leading supplier of Systems Management software and services for Open Systems. The emphasis is on providing solutions, not just products, with services being a big part of the company's offering. They are looking to extend their development with people who have a practical knowledge of UNIX with design and programming experience in 'C' and Shell Environments. Ref:RC/12

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£17-£35K + benefits — **REF: SC/01/EXE**

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

£18-£40K + benefits — **REF SC/05/EXE**

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

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

£14-£35K + benefits — **REF: SC/06/EXE**

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

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

£16-£28K — **REF: SC/07/EXE**

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Senior Development Engineers — **Analyst Programmers**

To £30K + benefits — **To £27K + benefits**

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

SOFTWARE ENGINEERS-SENIOR SOFTWARE ENGINEERS

Various Client/End Users, Software Vendors and Software Houses dedicated to strategic implementations of leading edge technology and integration of applications across different hardware and operating systems platforms require candidates to degree level with a scientific/technical development bias and 1-3 years experience. There are two main options

TECHNICAL DEVELOPMENT: Continued use of UNIX, VMS, MS-DOS, Windows NT (SDK, NT or X-Windows and Toolkits), Networking and Communications with companies offering technology based careers and management responsibility.

COMMERCIAL DEVELOPMENT: Using technical based skills already developed, but offering opportunities to apply analysis and design skills rather than remain 'a technical guru' in various environments including finance. Please call to discuss your particular career, growth and potential.

£12-£25K + benefits — **REF: SC/09/EXE**

VISUAL BASIC SKILLS MUCH IN DEMAND - PLEASE CALL TO DISCUSS — **REF: SC/10/EXE**

HANTS/LONDON - VIRTUAL REALITY DEVELOPERS - MFC, C++ - to £35K — **REF: SC/11/EXE**

LONDON COMMS SPEC X25, X400 £40-60k — **REF: SC/12/EXE**

C, C++/MFC - Countrywide — **REF: SC/13/EXE**

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BROADCASTING to £30K

These Greater London based companies, both Systems/Software designers for the Broadcast Markets with applications including Interactive and News Room Systems, Broadcast Automation and Digital TV Systems design seek six plus software engineers to expand their development teams.

You will be Degree qualified with a background in either Windows, Embedded or Unix software development gained ideally in a Real Time software design environment.

For Windows positions you will need a minimum of 1yrs post graduate experience of Windows design ideally using Visual C++. For the embedded systems design you will need up to 5yrs experience of 680X0 assembler and for the Unix positions 1yrs+ C/C++ gained in a real time environment ideally with Comms and Sun Platforms.

These companies offer an excellent salary + benefits package with one offering the opportunity to travel/work in Europe and the USA.

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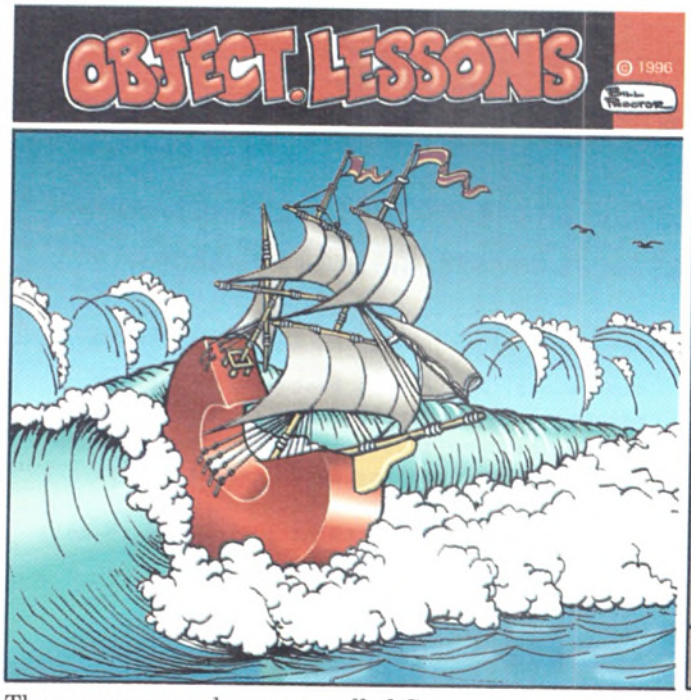
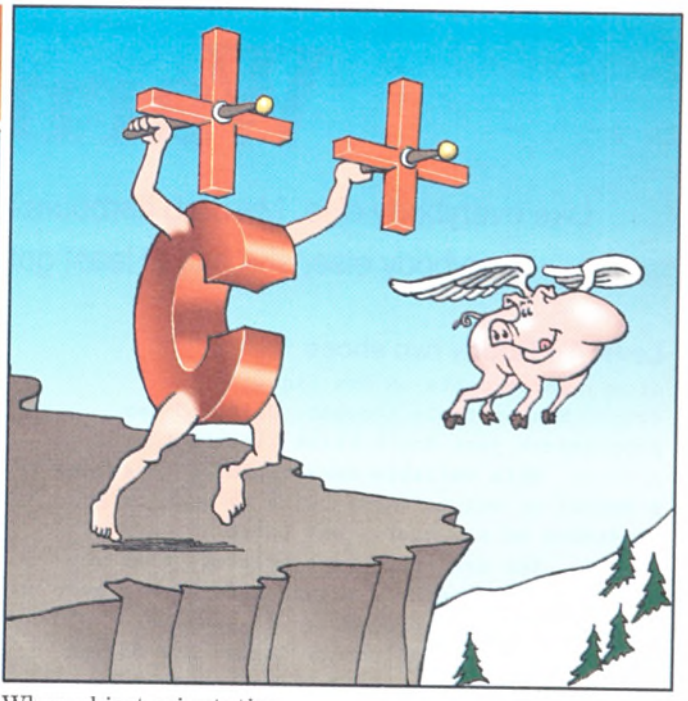
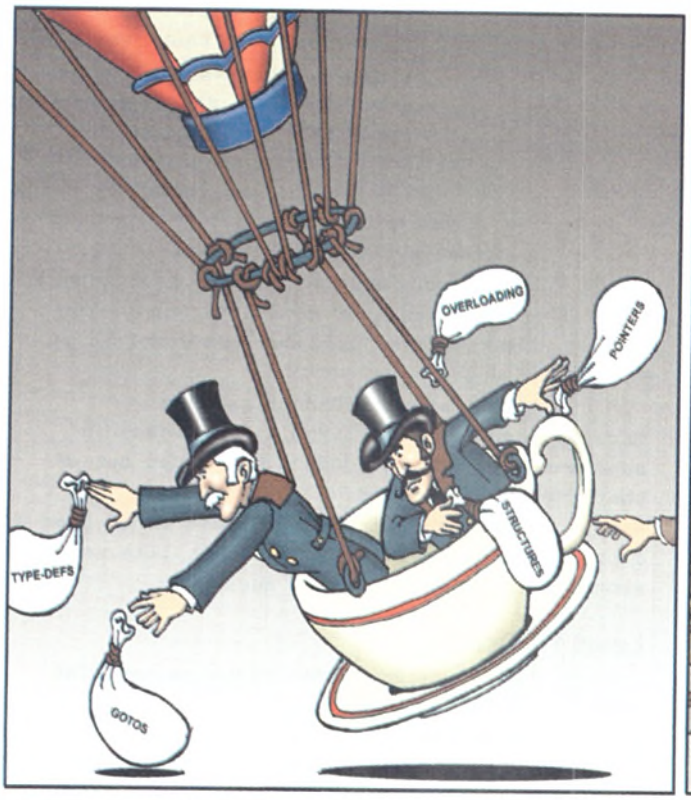


There once was a language called C
That was cryptic as ever could be
To protect their employment
Programmers took great enjoyment
In coding indecipherably



When object orientation
Emerged to widespread elation
With minimal fuss
They embraced C++
To the purist, it was pure consternation



One day some dreamers at Sun
Improved what the others had done
To make it more pure
They used 'less is more'
And Java, the language, was born

They got rid of 'typedefs' and 'gotos'
And pointers, so prone to confuse
The syntax for structures
Was struck from the scriptures
Making Java more natural to use.

Warned off

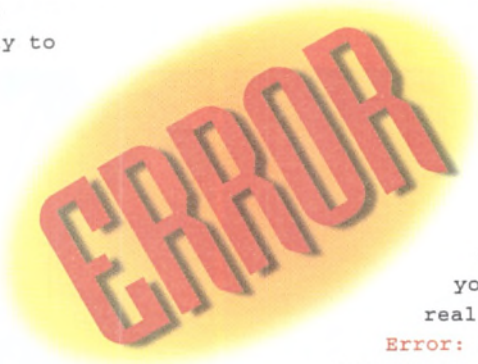
Like everybody else, Ms Stob harbours a secret ambition to write a compiler. Unlike everybody else, she has at least got as far as devising the error messages.

Level 4 – Goody two shoes

Error: Three casts on one line.
Error: Non-portable thought. Unix and Vax programmers just don't think like that.
Warning: This variable name could be construed as a sexist or vulgar word. Quite by whom is a something of a mystery. But there.
Warning: You are using more brackets than you need. I think somebody around here should swot up on his operator precedence.
Error: Code indentation too large. How do you expect me to read this? Just four blocks in and already way over the right hand margin.
Warning: ??? is not a variable name. Not that I wanted a variable name here. It's just that you have no other warnings in this project. This warning serves merely to stop you getting a clean 'make'. Tee-hee.
Warning: This class derivation will produce an unattractive class hierarchy.
Warning: Laughable misspelling in variable or constant name will betray your ignorance, eg 'Pie' for the constant which is near 3.1415.
Error: Unmatched line of *********s, ==========s or ++++++++++++s in comment.
Error: Call to API function you probably don't understand.
Error: Too many conditional symbols. Over-optimistic attempt to keep code compatible with 16- and 32-bit compiler.
Warning: Can't be too careful.

Level 3 – Rather fussy

Warning: Three casts on one line.
Warning: Comment daft by anybody's standards.
Warning: Variable appears to be used before it is assigned. Now the language standard says that I auto-assign such variables when you declare 'em. So this ought to get you thinking.
Warning: Source file directory too deep in folder hierarchy. Tidiness is one thing, anal retentiveness another.
Warning: Array declared with more than four dimensions. Are you in league with the RAM manufacturers, or what?
Error: You have used a goto statement. Please conceal it by recoding as an exception, in accordance with modern practice.
Error: I really don't think you wanted to do that, did you?



Level 2 – About right

Warning: Comment more that four time longer than the bit of code it describes. Are we working to some sort of KLOC metric?
Error: Over ambitious data structure. You'll regret it later. Oh yes you will.
Error: ';' expected. I could have assumed there was one there, or even put one in, but hell! it seemed more fun this way.
Error: First of a large number of pointless and incorrect errors you will always get when you have a real error further up the file.
Error: Attempt to compile manufacturer's library source. Of course it won't. You didn't think we ever used our own compiler in-house, did you?
Error: Linker reports 'Cannot resolve unreferenced thunking fixup limit broken in autogenerated module _00001E.OBJ'. Get out of that one, smarty pants.
Warning: Integer variable with name other than I, J or K used as loop index. We don't like weirdoes around here, thank you very much.

Level 1 – Dead 'ard

Appreciative comment: Three casts on one line. Wow!
Error: One of the base classes may cause an invalid reference when this method is called with these parameters (ie I don't understand this either).
Warning: Variable name length greater than two characters.
Warning: Comment. ■

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Ease of Learning	9.1	7.1
Ease of Use	8.3	7.2
Versatility/Features	10	8.7
Compatibility	6.7	6.5
Speed of API Calls	0.9	1.2
Final Score	**8.5**	6.5

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CIRCLE NO. 044

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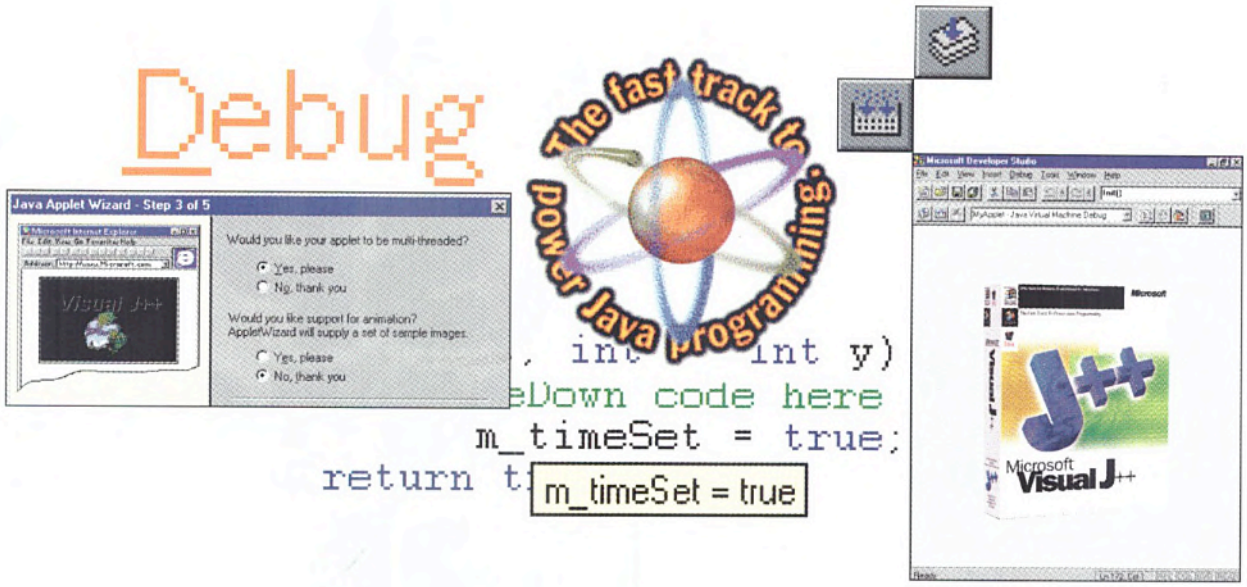

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