AUSTRALASIAN

WHEELS

for the mind

- **Seeding grants flowering nicely**

  Recent changes to AUC and AUDF structures are seeing membership numbers skyrocketing and developers flocking to the AUC's new programs

- **Photosynthesis pracs... without lab equipment**

  Multimedia is helping University of Wollongong science students overcome problems with inexpensive equipment that just wasn't producing the right results

- **UWA's virtual second campus**

  Distance learning is finally becoming a reality in Western Australia, thanks to some ingenious use of Internet multimedia

- **Online Italian, Kiwi accent**

  Developing a hybrid multimedia-and-Internet course has allowed the University of Auckland to add 37 new Italian students – and most of them have never met

Getting a bit Nervous?

Maybe you should talk to researchers at the University of Tasmania, who are using Macintosh technology to help treat arachnophobia and other common anxiety disorders.

VOLUME 2 NUMBER 3 NOVEMBER 1999

PRODUCT Round UP

LASER PRINTING ON ANY DESKTOP

If you're sick of queueing up to print on the big office printer, you may want to look at Lexmark's latest entry-level laser, the Optra E310. It's rated at up to 8 pages per minute with time-to-print of under 17 seconds, prints at up to 600x600 dots per inch at 1200-dpi quality, and includes both parallel and USB interfaces so it's easy to hook up to virtually any recent Macintosh (MacOS 8.6+) and Windows system.

The E310, which has a small enough footprint to fit comfortably on or under your desk, includes 75 scalable fonts; supports Postscript Level 2, PPDS, and PCL XL and 5e; includes a 150-sheet paper feeder; and can print on the usual assortment of paper sizes, transparencies, envelopes and other media.

University pricing for the Optra E310 is $685 with the standard one-year warranty, or $776 with a three-year warranty.

Contact: Lexmark on 1300 362 192 or www.lexmark.com/printers/laser/Optra/E310tech.html.

SUPER FLOPPY: STORAGE TO GO

Iomega brought removable storage into the mainstream with the launch of its Zip drive several years back, and the drive's newest incarnation will prove even more useful for those of us that regularly work with large files such as videos, detailed images and other multimedia.

The Zip 250 uses a USB interface to plug directly into Windows PCs, iMacs and other USB-compatible Macintosh systems (running MacOS 8.1 or higher), and can be easily moved between computers as necessary. This will prove particularly effective for people with both desktop and notebook computers, who can use it to quickly transfer large files between the systems.

The $399 drive supports new 250MB disks as well as the 100MB disks used by previous drives, and comes with a power supply and software including the IomegaWare utilities, RecordIt audio recording and QuikSync backup software. A 10-pack of 250MB disks costs an estimated $379, and users of Windows 95/98-based notebooks can forego the power supply by connecting the drive with an optional PCMCIA connector (available in a $469 drive-and-cable bundle).

Contact Iomega on (02) 9925 7700 or www.iomega.com.

250 MEGABYTES STILL NOT ENOUGH?

Drawing on the legacy of once-dominant removable storage vendor SyQuest, Castlewood's ORB is a high-speed removable storage system that packs 2.2 gigabytes of data onto a 3.5-inch disk. With prices comparable to those for the Iomega Zip 250, the ORB is an excellent option for those making heavy use of large video and audio files. Given the explosion in size of desktop PCs recently, the ORB is also far more practical than the Zip 250 for use as a backup drive.

Its data transfer rate of 12.2 megabytes per second means you can play videos off the drive in real time, which makes it perfect for video preproduction and CD-ROM mastering. Castlewood plans to increase ORB capacity to around 5GB within the next few months, and 10GB within eighteen months.

ORB uses a SCSI connector and comes in $399 internal and $449 external versions. A USB version is expected around the beginning of 2000. Each ORB disk costs $79.

Contact Business Bits on (02) 9279 2420 or Castlewood at www.castlewood.com.

iMAC GOES TO THE MOVIES

Unless you've been living in a cave for the past year, you will know all about the iMac and are — more likely than not – using one or ten of them. Last month, Apple launched a new family of iMacs that combine the computers' now legendary ease of use with a host of added features that position them as an excellent digital video editing platform as well as superior all-around computers.

The new iMacs all include PowerPC G3 processors, 64MB RAM, Rage 128 VR 2D and 3D graphics, 15-inch monitor, slot-loaded CD-ROM drives, dual USB ports, and support for Apple's inexpensive 11 megabit-per-second AirPort wireless networking. In addition, the new iMac DV and DV Special Edition (in graphite colouring) also include a DVD-ROM drive; dual 400 megabit-per-second FireWire ports for easy interfacing with external disk drives and digital camcorders; and iMovie, new software from Apple that delivers powerful video editing capabilities to the desktop.

Contact Apple on 133 622 or www.apple.com.au/imac.

editorial

FROM THE EDITOR'S DESKTOP

Welcome to the Summer 1999 edition of Wheels for the Mind. In this edition you will find more exciting articles describing the work that is underway in AUC Universities across Australia and New Zealand. It is work that is progressive and representative of a teaching environment that is continually testing the boundaries in search of more efficient methods to deliver teaching and learning.

And if the articles do not provide you with enough inspiration to consider new ways to use technology in education, I would encourage you to consider attending the next AUC Academic Conference that is being held at the University of Wollongong in April 2000. A special feature article on page six provides full information about the conference and how the AUC is providing funds to help you get there.

Also in this edition, we have given special attention to the AUC's Development fund and how $100,000 is being used to help fund some very special IT projects. These are projects that promise to deliver benefits to the entire AUC membership, not just the member institution that has been provided the funding. Full information on the projects can be found on page five.

Do you have trouble receiving *Wheels for the Mind*? If so, why not subscribe to our mailing list and receive it free hot off the press. From December 1999 you can do this from our web site at: http://auc.uow.edu.au/. Incidentally, at this site you will also find back issues of *Wheels for the Mind.*

Peter Sharpe
Editor
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contents

AUC MEMBER UNIVERSITIES

AUSTRALIA
The University of Sydney
University of Technology Sydney
The University of Wollongong
University of Western Sydney
The University of New England
Macquarie University
The University of Melbourne
The University of Tasmania
The Australian National University
The University of Adelaide
The Flinders University of SA
The University of South Australia
The University of Western Australia
Curtin University
Edith Cowan University
Central Queensland University
The University of Queensland
University of Southern Queensland

NEW ZEALAND
University of Auckland
University of Cantebury
Massey University
University of Otago
Victoria University
Waikato University

AFFILIATED UNIVERSITIES
Australian Defence Force Academy
University of Canberra

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Apple University Consortium: http://auc.uow.edu.au
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Cover photograph: The *argiope* spider is harmless to mankind, but that doesn't prevent it from causing anxiety in many people

What's NEW in the AUC

Seeding Grants flowering nicely

By Tony Maguire, Program Manager, Apple University Consortium

"Let one hundred flowers bloom and one hundred schools of thought contend…"

Little did Mao believe that a poetry recitation might provide inspiration for the radical transformation of the AUDF Grants Programme, but half a century later these words well describe the changes we have been going through.

The Grants Programme was undoubtedly one of the key benefits for members of the AUC. During its existence, hundreds of thousands of dollars had been allocated to a broad range of projects. It remained, however, one of the few national tertiary grants programs that seemed to have challenges in allocating all of its available funds.

After a great deal of analysis and consideration, the AUC Executive committee sought to rebuild the framework of the AUDF grants programme to be more flexible and get funds to those people who are able to put them to best use.

At the AUC's general meeting in February, the Chair of the AUC, Stephen Young, proposed a new three-tiered grants program that sought to better support developers and academics at various levels. After Stephen's detailing of the scheme, the membership enthusiastically embraced, and voted to implement, this model.

The new model includes a Major Grant Program, which was developed with an aim to sponsor flagship projects of AUC members. Successful projects receive funding of between $25,000 and $30,000 for the purchase of Apple and third-party products, services and software.

A second level of sponsorship, called the Pilot Grant Program, was also initiated t proof-of-concept projects by staf students of AUC member univers Successful applicants typically rec initial funding up to $10,000 for Ap and third party products, services ar software.

While these two grants offere support for established academics and developers, the executive identified that there had been a decrease in the number of introductory tertiary programming courses utilising Macintosh tools. As Stephen Young put it, the executive had a desire to "remove barriers to those who wished to develop for the Mac" and strengthen its popularity amongst young developers.

Hence, the Seeding Grants Program was born with a specific focus on fledgling programmers. It provides one hundred seeding grants for programmers in universities who don't currently develop on Macintosh systems, giving them Metrowerks' CodeWarrior Professional – a leading environment for developing software on the Mac. Recipients also receive study materials and access to a moderated seeding developer mailing list. Students of member universities are also enrolled in the Apple Student Developer Program.

To be eligible for this grant scheme, applicants must be a staff member or student of an Australian AUC University, provide a letter of support from their relevant Head of Department, and have use of an appropriate Macintosh computer. Applications are assessed to determine the extent to which they meet the following two criteria:

University Support. Preference is given to applications that are accompanied by a letter of support from the appropriate department or faculty head, detailing the extent to which the university is prepared to support the project.

Defined Deliverables. Applications should define what the results of the project will be, when it will be completed, and how specified deliverables will be made available to interested users.

Interestingly, there are no reporting or rmance requirements. Even better, e who do develop and publish nething are advantaged in future pplications for Pilot or Major rants. As a finale to the process, a $1000 prize is awarded to the programmer "judged to have produced and shared the best product."

So amid much support, the reinvigorated AUDF Grants Program has drawn its first breath. The first round of the AUC Seeding Grants has ttracted terrific support. The ogram is still open to anyone ning to be a 'late bloomer'; are available online at uc.uow.edu.au/.

1999 AUDF GRANT Winners

September was an anxious month for the sponsors and designers of the many projects that applied for funding through the Apple University Development Fund's annual Grant Program. After evaluating submissions from a highly competitive field of applicants that was larger than last year's, the AUC awarded two Major Grants and six Pilot Grants for a total value of $100,000.

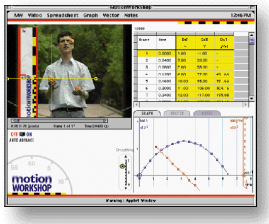
The grants will fund a range of ambitious new undertakings, which cover a spectrum of educational endeavours at AUC member universities across Australia. Some of the grants will fund the cost of developer labour, while most will involve the purchase of some amount of new Macintosh and related hardware – something that is possible with AUDF grants but disallowed by most other forms of grant assistance. All were chosen because the AUDF committee believed they hold significant potential for enhancing the delivery of tertiary education to Australian students.

The winners are:

Dr Ashley Aitken, School of Information Systems, Curtin University of Technology
Major Grant. Topic: Teaching Java with WebObjects

Like it or not, students tend to hack their way to solutions when developing applications within Java programming courses. Hoping to reduce students' tendency to build applications by continually jumping between coding and compiling, this project will ultimately produce a complete Java integrated development environment (IDE) based on WebObjects. The IDE will not only allow students to build Java applications, but will monitor their development work and force them to learn and follow the discipline of Humphrey's Personal Software Engineering development methodology in order to produce far better programmers.

Mr Jon Pearce, Department of Information Systems, University of Melbourne
Major Grant. Topic: Online video analysis using QuickTime for Java



Learning the physics of motion requires students to master a wide range of theories that are much better conveyed when combined with practical experiments involving observation of moving objects. Videotapes of moving objects – for example, a runner coming off the starting blocks – are an excellent way to learn Physics concepts, but analysing such videos becomes much easier with the aid of a computer.

Pearce's grant will support further development, and possible commercialisation, of a Java applet that allows students to analyse motion within a recorded video. The applet allows them to mark specific points in the video and monitor the movement of those points through repeated clicking. The collected data is then loaded into a built-in spreadsheet and presented in graphical form to help students better understand the concepts being illustrated. AUDF funds will cover purchase of a FireWire digital video camera to facilitate video capture, enlisting of a Java programmer, and other expenses.

Dr Connie Price, School of Physiotherapy, Curtin University. Pilot Grant. Topic: QuickTime for clinical skills teaching

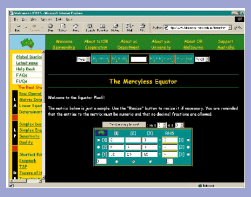
Learning new therapy techniques can be difficult for students, who often only see new techniques demonstrated once during a lecture. Even then, students must fight to get a good enough vantage point to see exactly how a technique is performed. This project will resolve these difficulties by using QuickTime streaming video to play and synchronise multiple video clips of physiotherapy techniques, each taken from different angles. This will be combined with supplementary x-rays, animations and text that further enhance students' learning of new concepts.

Dr Robert Di Nicolantonio, Department of Physiology, University of Melbourne.
Pilot Grant. Topic: QuickTime Virtual Reality for virtual organs

Visual representations of internal organs are essential for properly learning anatomy, but this project will take traditional visualisation to a new level by using a commercial 3D rendering engine from the creators of games such as Myth, Marathon and Halo (pictured) to create fully interactive walkthroughs of internal organs. Students will be able to use the application over the Internet, and will use the Net for collaborative problem-solving and roleplaying to let them learn by doing. They will be able to walk between virtual tutorial rooms and travel through representations of actual organs.

Dr Heiko Daniel, School of Rural Science and Natural Resources, University of New England
Pilot Grant. Topic: Web-based interface to University administrative systems

Universities now offer a wide variety of online resources for students, ranging from enrolment information to library databases. But to access the systems, students typically need to log onto multiple systems – a repetitive and potentially difficult task, if multiple passwords must be remembered. This project will use WebObjects and the WebCT online course delivery platform to provide a single interface from which students can seamlessly access a broad range of information with one logon – regardless of the types of systems that information is stored on.



Drs Angelina Byrne and Moshe Sniedovich, Department of Mathematics and Statistics, University of Melbourne. Pilot Grant. Topic: Web-based maths tutorial

Operations Research, the mathematics of decision making, underscores many decisions about how resources can be most effectively allocated. Learning OR theory, however, is a complex process that is significantly enhanced through use of interactive tutorials. This grant will continue development of a series of 40 Web-deliverable modules illustrating OR concepts, which will ultimately provide the basis for second and third-year mathematics, statistics and economics students to learn OR through hands-on experimentation.

Pilot Grants were also awarded to

Dr Terry Judd, Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne. Pilot Grant. Topic: Evaluation tests using QuickTime 'Screentest'

Dr Helen Ritchie, Department of Biomedical Sciences, University of Sydney. Pilot Grant. Topic: QuickTime animations of joint movements and muscle functions in the foot

AUC conference welcomes new Millennium

By Tony Maguire, Program Manager, Apple University Consortium

Now in its tenth year, the AUC's flagship gathering – the Apple University Consortium Academic and Developer Conference 2000 – will be held at The University of Wollongong, New South W ales, Australia, from the 25th to the 28th of April next year.

Themed 'New Millennium, New Technology, New Worlds of Learning', the 2000 Academic and Developer conference is intended for academics, senior management, administrators and developers alike. There, they will meet to exchange information, ideas, philosophies, and practical advice on technology innovation, integration and implementation in the higher education environment. Attendees will be able to take home the ideas they see on show at the conference, and implement them in their own environment.

There will be three major streams to next year's conference:

- **DreamWorld:** showcasing what's possible or becoming possible through the use of technology
- **RealWorld:** sharing actual experiences of what's worked and what hasn't
- **UnderWorld:** focusing on the world of the software developer, who burns the midnight oil to create great software for the rest of us

Presenters at the conference will include:

- **David Rokeby.** David is an interactive sound and video installation artist based in Toronto, Canada. He has been creating interactive installations since 1982, focusing on interactive pieces that directly engage the human body or which involve artificial perception systems. His works explore time, perception, intelligence (both human and "artificial") and the relationships between humans and interactive machines. One of his interactive systems, Very Nervous System, is enabling a paralysed man to speak and write. It is also currently being used by composers, video artists, and medical facilities across the world.

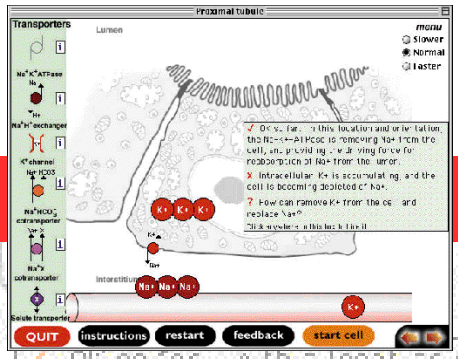
  David's works have been exhibited extensively in the Americas, Europe and Asia, and he was awarded the first Petro-Canada Award for Media Arts in 1988 and the Prix Ars Electronica Award of Distinction for Interactive Art (Austria) in 1991 and 1997.

- **Peter N Lewis with Andrew Tomazos.** Peter is the world renowned author of Anarchie, NetPresenz, Assimilator and co-author of Internet Config. Since graduating from the University of Western Australia in 1990, Peter spent the last nine years in Perth, creating Macintosh Internet software that is used by over 800,000 people in the USA, Japan, Europe and elsewhere. Peter was awarded a MacWorld Eddy for his efforts in 1994 and founded Stairways Software Pty Ltd in 1995.

  Andrew has coordinated development and deployment of all Stairways products since 1997, and previously worked as an Internet commerce consultant to large Perth companies such as Argyle Diamonds and BankWest. Like Peter, Andrew studied Computer Science at the University of Western Australia, where he remained as a tutor for many years.

- **Professor Peter Coaldrake** has served as Deputy Vice-Chancellor of the Queensland University of Technology since July 1994, and previously spent four years as Chair of the Public Sector Management Commission (PSMC). A political scientist, Professor Coaldrake was originally appointed to the then Queensland Institute of Technology in 1987 as Head of the School of Management. He was Dean of the School of Administration at Griffith University between 1984 and 1987 and during 1980-1981 was a Fulbright postdoctoral fellow based at George Washington University, Washington DC. In 1995, Professor Coaldrake was a member of the Higher Education Management Review (Hoare Committee).
- **Paul Velleman.** Based out of Cornell University in New York, USA, Paul is particularly excited about ActivStats (www.datadesk.com/ActivStats), which provides a multimedia version of the introductory statistics course. He has done a great deal of work focussing on design of multimedia for instruction and development environments on the Mac. At the conference, he will be discussing the resultant work and the issues he faced porting it to Windows to make a hybrid CD-ROM.

Build your own **cells**



In terms of the sheer volume of information that must be assimilated, few academic areas would rival the study of medicine. While careful memorisation and long hours studying allow students to absorb what they need to pass, however, the concepts behind that information are often lost in the push to complete examinations.

At the University of Melbourne, students in the Faculty of Medicine, Dentistry and Health Sciences are getting an interactive way to understand the process of cell formation through a series of multimedia packages being developed under the auspices of Professor Peter Harris, a professor of physiology and the faculty's assistant dean of information technology and multimedia.

Three years ago, Harris' six-person team of developers began constructing the first package in the series – called Gastric Acid Secretion – as a way of enhancing students' understanding of key concepts in that area. Focused on teaching students about the many components involved in the formation of a cell, the program presents students with a number of cellular building blocks – including DNA, proteins and other pieces – and challenges them to assemble the pieces in the right places so as to enable the growth of a variety of different functional cells.

There are 230 possible arrangements of the components and only one correct solution, which can quickly frustrate students that spend more than an hour or so attempting the puzzle. Recognising that frustration can quickly push many students to shift to a more trial-and-error approach, Harris' team has designed the program with enough intelligence to provide feedback as students work. This intelligence – which was created using MetaCard's object-oriented programming capabilities on an AUDF-funded G3 Macintosh – catches 70 common mistakes, explaining why each one is incorrect and giving the student a hint towards the correct solution.

"Students can all reproduce diagrams and faithfully pass exams, but what's more difficult is to get them to pass on the concept to the world," says Harris. "A lot of people are out there buying computers to put on the [lab] bench for students, but there's still not that much high-quality, challenging content. This approach increases the engagement of the student with the material, and we've targeted those areas that we know are conceptually difficult."

"The modules are intellectually challenging, so rather than passively absorbing the text from a Web site or CD, the student is required to understand the concepts and move from one stage to the next. We're trying to produce something that reaches out to the student, grabs their interest, and encourages a more active process by challenging them to construct the mechanism that will solve a problem."

Gastric Acid Secretion is now being used by around 2000 medical students, physiotherapists, optometrists and science students at the University of Melbourne, and is being evaluated at eight universities across Denmark, Germany, North America and Asia. Given the success of the module, Harris' development team is now working furiously on a number of additional modules addressing epithelial constructions in other parts of the body.

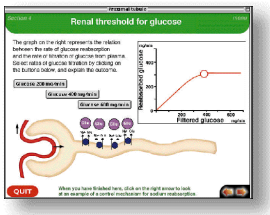
As well as providing a virtual sandbox in which students can work at building the relevant cells, the multimedia modules also keep detailed statistics about students' usage patterns. These are consolidated centrally and processed, with generated graphs – showing the time taken on each problem, for example – clearly showing lecturers which parts of the curriculum are giving students the most trouble.

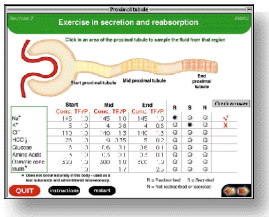
This constant feedback approach allows lecturers to provide far more useful information that addresses students' actual needs. In one module, for example, it became clear that students were stumbling over a particular concept.

"We gave students a playground module where students could play around before trying the real thing," says Harris, "but we found that students were not able to produce the mechanism as it was explained. They were stumbling over a concept because they never understood basic thermodynamics – which was taught in the first week. For most students, the first week is a total blur. We went back and produced reinforcement modules, which explain how these things operated and the basic physics behind them."

The proximal tubule of the kidney, which is involved in the handling of glucose and other materials filtered by the kidneys, is the subject of the second package in the series. There are around 1400 different possible combinations of components in this module, which will be followed by other units covering other kidney epithelia, sweat glands, salivary glands, the pancreas, the intestine and specific disease-related symptoms. Ultimately, Harris envisions the modules being bundled into a collection that students will keep with them throughout their academic and professional careers.

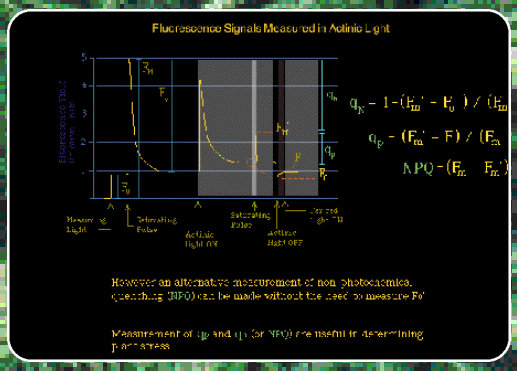
"We're moving our medical curriculum, as many schools are, to a more learning-in-context or situated learning environment," he explains. "Students are already saying that these are things they couldn't have learned any other way. The advantage [of the multimedia CD-ROMs] compared with a one-off practical class, however, is that students can use these as a cumulative resource that is available to them through their course and as part of their lifelong learning."

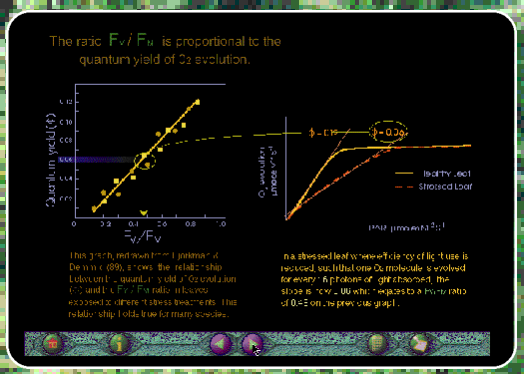




Contact Dr Harris at p.harris@physiology.unimelb.edu.au

Virtual lab equipment better than the **real thing**





Every teacher has faced the challenge of trying to provide as valuable an educational experience as possible without blowing budgets out of the water, a task that becomes even more difficult when good-quality laboratory equipment costs hundreds or thousands of dollars per student. But when Biological Sciences students at the University of Wollongong's Faculty of Science began getting completely inaccurate practical results due to their use of poor-quality alternatives, one team of developers decided it was time to see whether computers couldn' t perhaps make things easier on everyone.

The problem arose several years ago, when third-year Comparative Physiology students studying plant photosynthesis – the process by which plants convert light to energy – were given inexpensive plastic filters which, at just a few dollars apiece, were far more practical for the 400 students than glass filters costing around $400 per set. The filters are used for testing the effect of differently coloured light on the rate at which photosynthesis occurs.

After students began using the plastic filters for their experiments, however, they began getting results that were exactly the opposite of what they should have been. "We had this group of hundreds of students completely confused," recalls Biological Sciences lecturer Dr Sharon Robinson. "We know they'll get the best results using red and blue filters, for example, but [with the cheap filters] red and blue were giving the least photosynthesis."

"It's a very difficult topic for students, and one of the most complex parts of biology; there's a lot for students to get their heads around. However, in terms of the concepts it was hopeless. We spent a lot of time trying to convince them what they'd seen wasn't right."

As an alternative to purchasing hundreds of expensive and breakable glass filters, Robinson headed a development team that used an AUDF-funded Power Macintosh 7600 running Macromedia Director, PhotoShop 4 and a digitising tablet to create an application that simulated the use of the filters. Colleagues Andrew Neverwood, Wendy Russell and a host of graduate students assisted with the application's design, authoring and stress testing.

Using the application, students choose differently coloured filters which are then held over a virtual plant. As in the lab, this plant is shown underwater to facilitate easy counting of the bubbles that indicate the presence of photosynthesis. The application includes a random measure of error that ensures students get different results every time, yet that they will not be struggling to make sense of completely nonsensical data.

With students having used the application in a laboratory setting, Robinson says it has markedly improved the situation. "It's really helped in students' understanding because they don't have this confusion," she explains. "We have them write up the results as though they were doing an experiment, and in the past – because they'd based those on what they'd done – the writeups were all over the place."

The program has been so successful that it has become the primary laboratory tool for students studying photosynthesis. "At first, I envisaged the program as something they would do alongside the experiment," says Robinson. "But now, the program has replaced doing this for real; we have a large setup on the bench so they can go check that it really works the way they've done it onscreen. They've got the concept. It's just a much stronger tool."

The photosynthesis module is now one of around a half-dozen multimedia applications, covering related topics, that are eventually expected to make their way into the curriculum. In particular, one already-completed module has helped 45 third-year students make better use of the two $20,000 chlorophyll fluorimeters that are necessary for an important new research technique for measuring plant health.

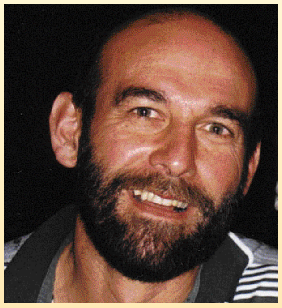
"We use it as a way of supplementing the equipment and giving them the information they need to use the equipment," says Robinson. "It's just impossible to demonstrate the procedure on the equipment itself, because we don't have enough of them and they're too expensive to buy. In the past it's been quite difficult because of juggling the numbers and trying to move people through. But this allows every student to have access to the equipment so they know how to make best use of it."

Students using the new application have begun delivering far better academic results, Robinson continues. "The chlorophyll fluorescence methodology is very complicated, but it's a topic that's been poorly covered in most textbooks because it's a very new method. That was one of the problems I had: I would give lectures but there was no backup material. But with this program, the results of the exam in terms of comprehension have improved dramatically. The quality of student essays is much better, and the other thing is that the program is there all the time. If students want to go back and look at it again, it's right there."

Other modules still in development cover topics such as oxygen evolution in gas exchange, using other expensive pieces of equipment, comparing the physiology of sun and shade-loving plants, and the effects of excess light on plants. Another particularly complex module relies heavily on animated sequences to illustrate the movement of electrons during key processes of plant physiology.The multimedia approach "is making these things easier to understand," says Robinson. "We're trying to bring textbooks to life."

Contact Dr Robinson at sharonr@uow.edu.au.

Sure time is **MONEY**... but how much?



Luca: students lack timekeeping discipline

By David Braue

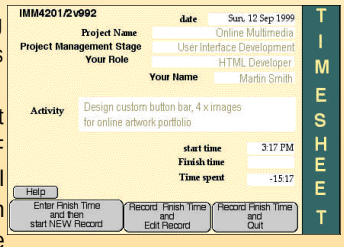
It's one thing to teach students how to write a great program or develop a stunning multimedia presentation, but technical skills are only part of the game in the real world. While universities ar e churning out computer science graduates by the hundr eds, feedback from employers suggests that most students are sadly lacking in equally impor tant business skills such as project management, time budgeting and accounting, and the like.

At Edith Cowan University in Perth, however, students in the Department of Multimedia are getting a healthy dose of real-world skills through the enforced use of a new time and project accounting application developed by Faculty of Communications and Multimedia lecturers Joe Luca and Alistair Campbell.

Careful accounting of time spent on a project is crucial for producing regular invoices and monitoring overall project expenditures, says Luca, yet a demanding courseload meant that most students were finding it hard to learn the discipline required for effective timekeeping."

"A problem identified with running this [project management unit] over the past four years was that students were required to perform many new tasks [which] caused cognitivie overload and confusion," says Luca. "These assessable tasks included learning project management methodology, being a team member and being assessed by peers, contributing to a Listserv, preparing team and individual written assignments, recording and analysing timesheet data and developing a multimedia product. Each of these items was assessable."

"This left little time for students to carefully collect, record and analyse timesheet data," he continues. "Also, many students found it difficult to collect timesheet data in the first few weeks of project start-up, as the team had not formalised a timesheet recording procedure. Ask anyone how they do it and they'll have a different system – and a lot of them are very inefficient, paper-based procedures. This resulted in timesheets being less accurate as students generally relied on their memories to complete timesheets at a later stage. So that students realise that time is money, we've told them that they should be collecting time, analysing where it goes and where it's squandered."



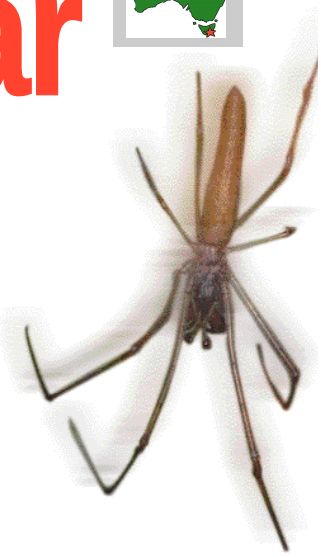
Working with equipment obtained through AUDF funding, Luca and Campbell have developed an application that runs in the background of students' computers while they're working. When students start and finish a particular task – such as going to a meeting, creating a graphical image, designing a Web page or whatever else they're doing – they just click on the icon and the time they spend on that task is automatically recorded.

When deployed across a team of developers, data from individual developers can be collated by a single project manager and used to generate itemised invoices listing the time spent at each stage of the project. The application can also be used to track the amount of time spent on developing content such as animations, allowing project managers to set appropriate prices that reflect the actual cost of creating such content.

The program is now being used by final-year students within the university's Interactive Multimedia course, who as part of their assessment are required to project-manage a development project as preparation for real-world work. Although many students are still finding the concept hard to get used to, Luca hopes that continued use of the program will help students develop the disciplined time management skills they'll need in the real world.

Contact Luca on j.luca@cowan.edu.au

Loosening the grip of Fear

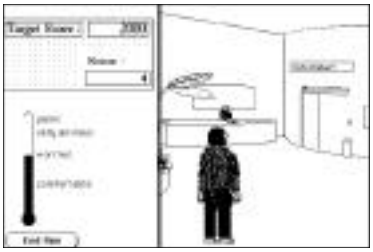


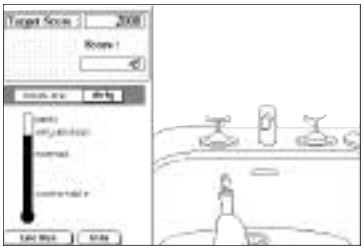
Exposure therapy – curing people of debilitating fears by gradually introducing them to the things they fear most – is a long-established and well-proven part of psychiatric treatment. But despite its wide adoption, an estimated 90 percent of people with such fears never take the initiative to undergo formal tr eatment.

A group of researchers in Tasmania hope to change that statistic with the development of a computer-based exposure therapy program that could ultimately treat people wherever they are.

"There are a number of standard treatments for anxiety disorders which involves exposure to things the patient is afraid of until the anxiety passes," says Dr Ken Kirkby, a Professor of Psychiatry at the University of Tasmania and head of the long-running research effort. "Although these anxiety disorders appear in up to 10% of the adult population, most of them haven't had treatment even though there are well-established treatment methods available. The delivery and cost of this treatment are clearly an issue, and we felt that computer-aided treatment would help."

The research team has used HyperCard and AUDF-funded Power Macintoshes to design a video game-style, first-person program in which patients manoeuvre a cyber-character through a variety of anxiety-producing scenarios. Players score points based on how low they can keep the character's anxiety level while confronting the thing that is causing the anxiety – for example, leaving their hands dirty or touching a spider in a jar.





By distancing patients from the stressor, they come to relate with the virtual character and, in so doing, subconsciously develop coping skills that can help them overcome their anxiety. So far, the team has focused on three common fears: simple phobias such as spiders (held by 6% of the population), agoraphobia (found in 4% of women and 1% of men) and obsessive-compulsive disorder (OCD, afflicting 1.5% of Australians). "Using computers to present interactive simulations of

have to actually think about what to dc someone else. In doing that, they learr can apply to themselves."

Kirkby's research team has run ten the application – five on arachnophobes and several each on OCD and agoraphobic patients. Ir each trial, groups of 30 to 45 peop used the program on Macintosh SE30 which recorded the subjects' progress six seconds through 45-minute treatment session. A custo was then used to and model the subjects' behavioural patterns.

Although the program was not as successful as formal anxiety disorder treatment, Kirkby concluded that it did provide moderate reductions in anxiety – at far lower cost and heightened convenience compared with traditional treatment methods. OCD subjects, for example, lowered their scores on two of the three anxiety tests given before and after the treatment, while third-test scores showed statistically significant reductions.

"The programs produce improvements, and they're certainly better than no treatment," says Kirkby. "They're probably intermediate between live exposure and these inert conditions, but they're much more easily distributed and for some people they provide very good treatment and a staged first step [into more formal treatment]. They also let us free up the human element [therapists] for the things they're best at – which isn't necessarily working through highly structured treatment, but instead tending to patients' needs."

Ultimately, Kirkby sees computer-aided phobia desensitisation as an introduction to more formalised treatment programs – eventually into other problems such as substance abuse. It is also e extended over the Internet, so patients can get access nent from home or work.

e see this as a broad field," he says. "There's a broad pplicability to mental health oriented things, not just nxiety problems. Many of these fears are evolutionarily ased and no longer necessary, yet they're particularly ommon in children. Because you can do non-verbal treatment and because kids like to play with computers, we see this as an opportunity for getting them started early; using this technique we could potentially treat whole school populations."

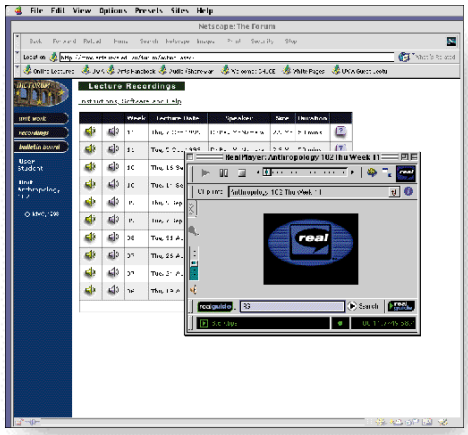
Contact Dr Kirkby at ken.kirkby@utas.edu.au.

UWA's virtual second campus

The concentration of students in Perth, as well as the immense distances between Western Australia's major population centres, have long prevented the University of Western Australia (UWA) from establishing satellite campuses or even offering distance learning courses. That has all changed this year, however, as 30 students in the southern city of Albany near the end of their first year attending UWA using an ingenious new way of delivering course content over the Internet.

In late 1998, the university was considering ways in which it could bridge the 400 kilometres between Perth and Albany so as to provide high-quality education to students at a new satellite campus. It became clear quite quickly that delivery of Perth lectures would be a critical requirement for this to happen.

Many Arts Faculty lecturers had recorded their lectures for years, but audio tapes were only available to students that could physically travel to the UWA library in Perth. Acknowledging the growing use of the Internet to deliver streaming music and voice, UWA strategists began planning a way to allow the lectures to be piped to students located far from the metropolitan campus.



By the end of 1998, developers had built a system that consists of a half-dozen networked Macintosh L6475 PCs, each of which is connected to a tape recorder. When a lecturer completes her lecture, she hands the audio tape off to the department's receptionist – who then inserts the tape into the recorder, enters a few relevant details into the computer and starts the tape playing.

Under control of a custom-designed AppleScript, the lecture is digitised in real-time and sent to a central RealAudio server, which compresses the spoken words into an 8KHz streaming audio file. Using this technology, a 45-minute lecture typically occupies less than three megabytes of disk space. Lecture files and affiliated notes are stored in a FileMaker database, which is queried using Lasso and served across the Internet using the WebSTAR Web server.

Around 60 different courses have been using the system since it began operating full-time at the beginning of this year, and lectures are now added to the eight-gigabyte Real Audio server at the rate of up to 80 hours every week. Many students in Perth also use the growing online lecture archive, either from home or from UWA's on-campus iMac labs. The server now logs more than a thousand student-hours weekly, a good portion of which are delivered to the students at the new Albany branch.

By finally allowing Albany-based students to access lectures held at the Perth campus, the system has enabled UWA to begin evaluating potential ways to offer its lectures in new cities without having to build and staff physical campuses. UWA could end up selling distance learning courses to interstate and overseas students, and could even offer lectures to people from offices rented in small towns across the state.

Indeed, UWA can now have a campus anywhere the Internet reaches. Even disabled students will benefit, since Internet delivery allows them to continue attending lectures even if they can't physically travel to Perth. Students can communicate directly with their tutors and peers by posting questions and comments in online bulletin boards, and participating in community chat rooms.

"The people in Albany are wildly enthusiastic" about the new system, says Dr John Kinder, academic director of UWA's Arts Multimedia Centre. "It's a small beginning, but it's certainly going to grow massively in the next year or two. We've never gone into distance learning at all before, but people are now realising that the distinction between on-campus and distance education is breaking down. Students in Albany have access to the same sorts of services as students in Perth, apart from the face-to-face contact with the professor."

RealAudio delivery will underscore UWA's plan to expand the number of courses taught at Albany from four this year to 17 next year. The university is also looking into ways to expand the coverage of lectures – firstly, through an automated system that will post overhead projector notes onto the Internet, and eventually by broadcasting streaming videos of lectures online. The overhead system, which will consume minimal bandwidth by only refreshing itself every five or ten seconds, will go live in February.

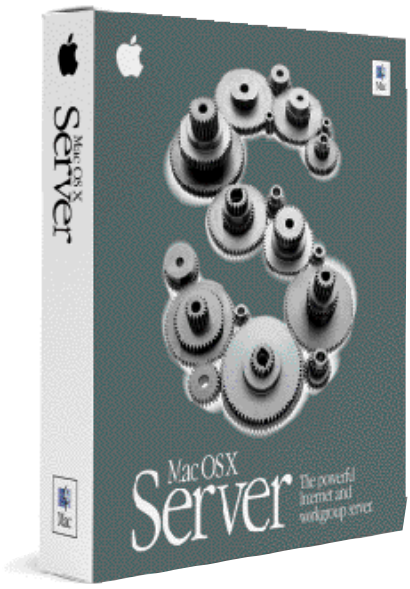
Although the RealAudio project is very much tied to UWA's physical expansion across the state, similar technology is also changing the way students learn on campus. In UWA's language laboratories, for example, students use iMacs to record themselves speaking languages such as French, German, Japanese or Chinese. They then hear the digitised voice played back along with a professional speaker saying the same sentence, allowing students to assess the quality of their pronunciation.

Another project has seen UWA develop a Macintosh-based multimedia authoring environment, which assists students in compiling the multimedia assignments that are increasingly being expected by lecturers.

"It's part of a whole push for flexible teaching and learning," says Kinder. "The student population is diversifying, students want to be able to do things in a flexible way, and this is one way of helping them do it. We're essentially eclectic: we'll look at any technology that does the job. It's all allowing us to do things that we couldn't do before, and that's the main thing for us."

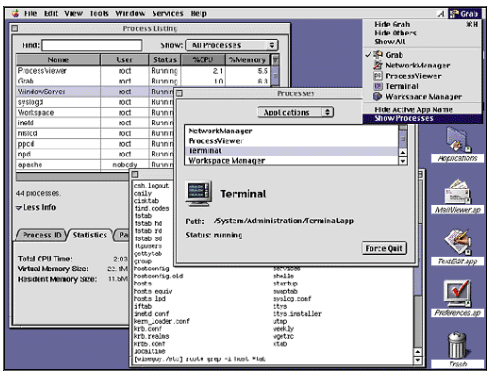
Dr Kinder can be contacted at john.kinder@uwa.edu.au

OS X heralds a new, open era



Apple's next-generation operating system, OS X Server, has generated significant enthusiasm from customers, developers, analysts and competitors alike since its launch earlier this year. With Apple' s commitment to release portions of the operating system into the open source community now well-advanced, the system has quickly secured its place in the panoply of high-end Internet and application server platforms.

Among its many benefits, OS X includes the industrial-strength features that analysts have long believed Apple needed to complement its easy-to-use MacOS. It incorporates several core technologies, including the Mach 2.5 microkernel, BSD 4.4 Unix operating system, and a JDK 1.1.6-compliant version of the Java Virtual Machine. It also has an implementation of POSIX (Portable Operating System Interface) APIs – allowing many Unix applications to be easily ported to OS X – and version 1.3.4 of Apache, the full-featured Web server that powers 55% of the sites on the Internet.



These key platforms are, in turn, integrated with OS X's preemptive multitasking and protected, dynamically-allocated memory to provide a rock-solid environment for hosting Internet and workgroup application services. OS X Server also includes NetBoot technology, a server-side application hosting environment that eases software upgrades and system maintenance by letting PowerMac G3 and G4 systems function as thin clients. This makes it just as easy to deliver the same application to a hundred desktops as to a single user.

In magazine tests, OS X has been benchmarked as three times faster than a comparable Sun Solaris environment and seven times as fast as Windows NT, confirming its eminent suitability as a host for Internet services and applications. OS X Server's considerable power has won it significant interest amongst the developer community, particularly from Australian members of the AUC.

"OS X is going to blast the Mac OS into the new millennium with a rock solid and powerful core operating system (Mach), absolutely incredible object-oriented libraries (Cocoa), and – I'm sure – an equivalently amazing new interface that is both familiar and revolutionary," says Dr Ashley Aitken, lecturer in Object-Oriented Software Engineering in the School of Information Systems at Curtin Business School in Perth's Curtin University of Technology.

Funded by an AUDF Pilot Grant, Aitken is currently designing tools to help programmers develop a disciplined software development process for OS X Server that is based on Watts Humphrey's Personal Software Engineering Process (PSP). He was also recently awarded an AUDF Major Grant for a project to teach students to program in Java, using WebObjects, within a Web browser.

"I'm looking forward to developing some outstanding Cocoa (desktop) and WebObjects (Web-based) applications in the most elegant and powerful development environment around," he says. "The only pity is that these applications won't run on Wintel systems too."

Although the performance and capabilities of OS X Server have made it a hit with developers, Apple's decision to release many of its components

APPLE'S PUBLIC SOURCE LICENSE

Apple's Public Source License lays out the terms and conditions under which developers can use Darwin and related open-source code. The text of the whole license can be found at www.publicsource.apple.com/apsl.html, but here are some of its key clauses.

Section 2.1 allows you to use, copy, modify and distribute Darwin code (in its original or modified form) for internal research and development, provided that you preserve Apple copyright notices and the terms of the Apple Public Source License and carefully document modifications you make – including specific references to identify the original code that has been modified.

Section 2.2 allows you to deploy the code you develop as long as you offer your modifications publicly via the Web, and keep that code available for at least twelve months from the date it is initially deployed. You must also log those modifications with the Apple Public Source site so other users can find them, and if distributing compiled code must direct others where they can find the source code for that code.

Section 3 allows Apple to use, reproduce, modify, distribute and deploy any modifications you make to Darwin under this license, which also gives Apple a "non-exclusive, worldwide, royalty-free, perpetual and irrevocable license" to the modifications you have made. This allows them to build particularly useful functions you design into their own operating systems and products, then resell those products through their own channel without having to pay you royalties.

Section 4 gives you permission to include open source code into your own larger projects – open source or not – as long as you continue to identify the open source code as such. This will prove to be a boon for software developers wanting to integrate QuickTime, NetInfo or other key features into their own products.

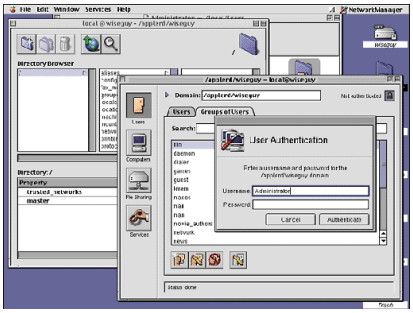
Section 8 says that Apple will not accept any liability for, or provide support for, the products of the Darwin project, regardless of whether incomplete or poorly written code inadvertently causes data loss. In other words, you – and your users – are on your own.

to the open source community has been even more widely acknowledged as a bold and important step.

So far, a variety of components have been released under the terms of the Apple Public Source License, with a growing developer community collaborating via the Apple Public Source Web site (www.publicsource.apple.com) to improve key Apple technologies.

The initial release of the operating system – known as 'Darwin' and offered in mid-March – included the Mac OS X Server foundation layer, enhancements to the Mach 2.5 microkernel and BSD 4.4, AppleTalk, HFS+ file system and the NetInfo distributed database. In April, an open source version of QuickTime – called QuickTime Streaming Server – was also released to the open source community, while May saw the release of OpenPlay, an open-source platform for networked multiplayer games.

So far, the strategy has paid off handsomely. More than 160,000 copies of Darwin were downloaded in the first month, and the third version of the open source OS was posted online at the end of August. In July, Apple announced that the open source community had managed to double the performance of QuickTime Streaming Server, as well as porting it to Linux. Improvements across virtually every area of Darwin have confirmed the viability of the open source project, and in June Apple was formally welcomed into the open source community by the Berkeley Software Distribution group, the development community behind BSD.



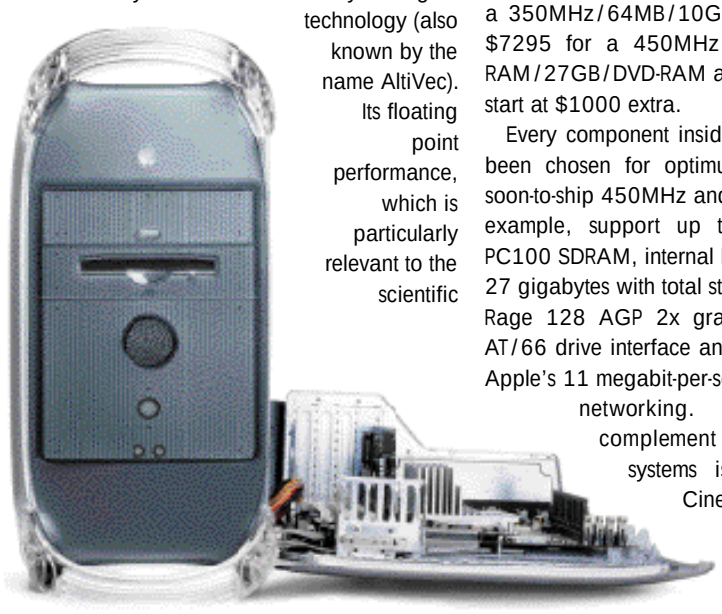
The pending release of the OS X client desktop early next year – a successor to the just-released MacOS 9 – will further add to this success by combining key elements of the OS X platform with the Macintosh's easy-to-use interface and powerful features.

With the full support of the open source movement behind it – complementing the collective expertise of Apple's best developers – the future looks bright for OS X indeed. Apple's OS X Server homepage is at www.apple.com/macosx/server.

G4: a supercomputer on your desk

The continuing battle to develop faster desktop processors got a lot hotter on August 31, when Apple introduced the long-awaited G4 CPU, a high-end chip that is the first commodity processor to deliver more than a gigaFLOP (1 billion floating point operations per second) of computing performance.

In comparative tests, the PowerMac G4 has been demonstrated to run Adobe Photoshop as much as twice as fast as a 600MHz Pentium III Windows PC, thanks in part to its revolutionary 128-bit Velocity Engine technology (also known by the name AltiVec). Its floating point performance, which is particularly relevant to the scientific applications that it will benefit most – is so fast that the US government has banned export of the servers to certain hostile countries under a law originally designed to prevent export of supercomputers.



Fortunately, neither Australia nor New Zealand are on the list of prohibited countries, so users in this region will be able to start taking advantage of them from later this month while Apple lobbies the US government to allow G4 exports to the countries in question. Desktop PowerMac G4 prices range from $3295 for a 350MHz/64MB/10GB/CD-ROM system to $7295 for a 450MHz model with 256MB RAM/27GB/DVD-RAM and Zip drive Monitors start at $1000 extra.

Every component inside the G4 systems has been chosen for optimum performance. The soon-to-ship 450MHz and 500MHz servers, for example, support up to 1.5 gigabytes of PC100 SDRAM, internal hard drives from 10 to 27 gigabytes with total storage of up to 100G, Rage 128 AGP 2x graphics card, an Ultra AT/66 drive interface and optional support for Apple's 11 megabit-per-second AirPort wireless networking. Also designed to complement the PowerMac G4 systems is the $8595 Apple Cinema Display, a 22-inch flatscreen monitor in a 1600-by-1024 pixel letterbox format that will ship locally next month.

The fast performance of the PowerMac G4 has already convinced many AUC members to get out their chequebooks. Chris Steward, lab manager in The University of Melbourne's Department of Mathematics and Statistics, says the department is planning to buy more than a dozen of the new 450MHz machines.

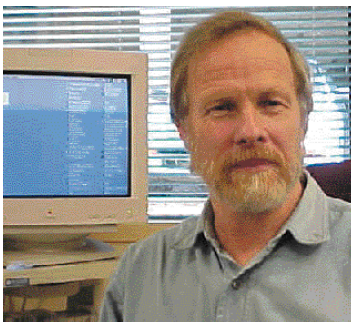
"For people writing code that use floating point instructions, the G4 will be much more useful than the G3," he says. "Its FPINT performance is certainly a lot better than the Pentium III, and marginally better than AMD's Athlon. We're waiting and hoping for more applications that use the Velocity Engine; the main thing for us, in terms of number crunching, is getting compilers that have support for it. What we would also like is for Linux to run on the G4."

As well as providing faster desktops for power users, the G4s may also be utilised outside of work hours to join the department's cluster of 82 iMacs, which have been linked together using Linux to collectively pore through the massive amounts of data involved in complex applied mathematics problems (see **Wheels**, June 1999).

Apple's G4 homepage is at www.apple.com.au/powermac/processor.html.

AUC in the Pacific

Learning Italian – at a distance



Robinson: Net video still not enough

Until recently, distance education was a relatively isolated activity, with students working through textbooks and doing exercises on their own time – and more or less separated from the other students in the class. But for the Department of Italian at the University of Auckland, combining traditional CD-ROM materials with a full-fledged Internet development project has proved to be an excellent way of bridging the distance between distance learning students and their peers.

Looking for a way to increase enrolment numbers and provide a more flexible means of delivering its language courses, last year the university's Department of Italian set about considering how the Internet could best be used as a platform for delivering language courses to students that couldn't physically come in to attend classes. Although technologies now exist for delivering streaming video and audio over the Internet, it was felt that reworking existing CD-ROM based multimedia materials to the restrictions of those technologies would compromise the quality of the students' experience.

"The Department has quite a lot of experience using multimedia in labs for teaching Italian," explains Bruce Robinson, Arts Faculty technical coordinator at the University of Auckland. "Initially we looked at whether or not it was feasible to offer the whole thing over the Net and do away with the CDs, but the bandwidth was just not there for such an intensive application."

Instead, the Department began pursuing a hybrid approach and used MetaCard to develop Parliamo!, a comprehensive series of multimedia lectures spanning four interactive CD-ROMs. Arranged in a week-by-week format to match the content of the real-world course, three of the CD-ROMs are packed with over an hour of video, ten hours of audio and hundreds of images of Italian scenes that form the basis of the multimedia lessons. The fourth CD, called Lezioni Pribate, includes a range of assessment materials that the students complete at the end of each week's lessons.

While students use both the multimedia CD-ROMs and a textbook to learn the content at their end, the Internet is also integral to the course's structure. Part of the development project included using Claris HomePage to design front ends for a variety of FileMaker databases, which have been given an online interface to give students access to a variety of community-building online areas.

Chat rooms, e-mail correspondence with other students and the tutor, links to other relevant Web resources, and other collaborative features allow students to participate in online discussions that bring them together in a virtual classroom environment. Just as in the classroom, students can also submit written materials for feedback from their instructor.

The hybrid approach has been tested for the first time this semester, and has already received an encouraging response. Limited advertising within New Zealand netted more than 200 enquiries about the course – from as far away as Norway, India, Brazil, Cyprus and Hong Kong. Ultimately, 37 students signed up for the course – including one each from Spain and Chicago – many of whom were attracted by the ability to continue the course via the Net during planned trips to Italy.

"In teaching language we are always talking about establishing students as lifelong learners," says Nebojsa Radic, a senior lecturer within the Italian Department and the tutor leading the online course. "That's always been more of a metaphor, however, since we didn't give them the instruments to do that. Now I realise we're getting out of the metaphor and onto the Web. We have a tool now to keep people involved with the language and culture of Italy, and where they can get advice and translation during and after the course."

Radic: Distance multimedia course producing excellent Italian speakers

Although students primarily stay in touch through the department's Web site, Radic also holds five oral interviews with each student throughout the semester. Students reserve a block of time using a FileMaker-driven scheduling application on the Web site, and at the appointed time Radic calls them for a conversation to catch up on their progress. So far, he says, the distance learning students have shown an amazing ability to pick up the language.

"Last time, I gave students the task of reading a passage from the book that they have never heard read before," says Radic. "It's amazing that around twenty of them made only two reading mistakes. To me, this is surprising; my students on campus would do more than that, even if they'd heard me read it first. Although I wouldn't expect students online to be as good in some things – such as face-to-face conversation – they aren't exposed to [incorrect] language from their peers on campus. As a model, they only get the native speakers' pronunciation."

Given the success of the pilot test, Radic is already planning to develop a second online course that will serve as a follow-on to the introductory program now on offer. Other language departments – particularly low-enrolment courses such as Dutch and Swedish looking to bolster student numbers — are watching the pilot test with interest, and Radic is making plans to promote the program far more broadly across the Internet for the 2000 academic year. The department is also lobbying the university to reduce the cost of the program for overseas participants, who are now charged around four times as much as internal students. Given its popularity, however, it's likely that this type of distance learning course will become a permanent feature of language teaching at the University of Auckland.

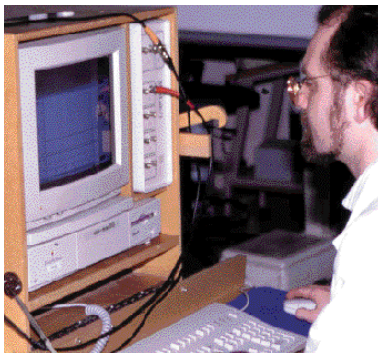
"I don't dare say the students are better [than their peers on campus] but they're close," says Radic. "I think the reason for that is that they are highly motivated. This is quite new, and people have been quite enthusiastic about it as well as being patient while we worked out some early technical problems. We have people in their 60s, even, who are very comfortable, enthusiastic and motivated, and they're really good students. There's a lot of positive energy coming back."

Contact Radic on n.radic@auckland.ac.nz

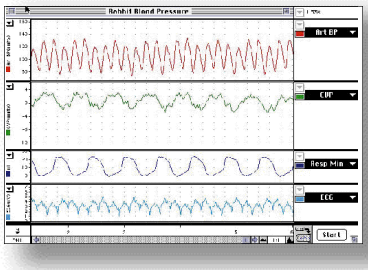
Dissecting animals without the blood

Although it provides an extremely rich and informative method of learning, the venerable animal dissection practical has come under fire in recent years as students increasingly questioned the need to slaughter animals en masse for experimental purposes. This presented a particular conundrum for veterinary education, which obviously requires significant experimentation with animals – both whole and in pieces such as muscles, intestines, hearts and organs.

New Zealand's Massey University has, however, found a much better alternative, using Macintosh technology to deliver 'virtual pracs' that are proving to be far more educationally rewarding – while at the same time minimising the need for animal dissection.



For the past two years, students in the university's Institute of Veterinary, Animal and Biomedical Sciences have been making use of a laboratory consisting of a dozen Macintosh 6100s. Each PC is linked to MacLab, a multi-channel analogue-to-digital converter from Analogue Digital Instruments (ADI) that enables the digitisation of signals from analogue instruments such as oscilloscopes, blood pressure sensors, and voltage sensors that trace the firing of a nerve or contraction of a particular muscle.



By networking the systems, practical laboratories can now be carried on in realtime by trained tutors working at the front of the room. A closed-circuit video camera lets students see exactly what is being done, and data from the tutor's probes and other instruments is relayed to the students in real time through the MacLab boxes. Data from up to eight sensors can be received at the same time, allowing students to monitor many different physiological factors without having to worry about whether a sensor is working correctly.

"We're able to deliver, in a very co-ordinated fashion, results to a class of twelve workstations," says Neil Ward, senior technician at the Institute, which is part of Massey's College of Sciences. "Normally they would have to anaesthetise the animal, prepare and dissect it. There was a 50 percent failure rate because some students are novices, and some just don't like doing it. Many students feel they shouldn't be killing animals unnecessarily, and this shows that we're making a real effort to move away from the use of live animals. It's ethically more acceptable than having each student with their own animal."

Students started using the equipment at the beginning of the 1998 academic year, and it has quickly become a popular part of the curriculum. This is not only because it reduces the need to use live animals, but because students get far more accurate and useful results by leveraging the tutor's experience.

"Virtual instrumentation gives students the ability to be more precise in their measurements, and analysis is easier because they can just copy the text into a spreadsheet," says Ward. "We're able to do experiments at a much higher level than you'd expect people to be able to do. And because the tutor has a captive audience, he can deliver a lot of background and tutorial information at the same time. People are quite happy with it, and it's evolving more and more all the time."

Given the success of the equipment so far, the Institute is looking into new capabilities that will further enhance the students' use of the MacLab equipment. Timbuktu, for one, would allow tutors to deliver complementary information on an as-needs basis by taking control of students' computers individually or in groups. The Institute is also considering ways in which the MacLab data can be enhanced for delivery across the Internet, so students can access experimental data and graphical results without having to actually travel into the laboratory.

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