Australia-New Zealand collaboration and eTeaching with pdf

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Australia − New Zealand collaborative teaching via Access Grid

The Kiwi Advanced Research and Education Network (KAREN) facilitates collaboration in research and education across a network of Access Grid Rooms (AGRs) in New Zealand universities. Almost all Australian universities have access to an AGR. The Australian Research Collaboration Service (ARCS) supports video collaboration via AG (see http://www.arcs.org.au/products-services/collaboration-services/video). For a brief AGR overview, see [1]. Since the time zone differences between our two countries are small, opportunities for Australia and New Zealand collaborations abound.

I have had several communications and interactions with the University of Canterbury and the University of Auckland, including the participation of the University of Canterbury in the official opening of the RMIT University AGR on 6 December 2007. Both of the Universities of Auckland and Canterbury have expressed an interest in the International Centre of Excellence for Education in Mathematics (ICE-EM) program of collaborative teaching of Honours mathematics. ICE-EM is the education arm of the Australian Mathematical Sciences Institute, and AMSI is an affiliated organisation of the New Zealand Institute of Mathematics and its Applications (NZIMA). As members of NZIMA, the Universities of Auckland and Canterbury were invited, in November 2008, to participate in the ICE-EM collaborative programs (of AG Honours courses and seminars). Wider participation with the other New Zealand universities is welcome and will hopefully follow.

The University of Auckland has confirmed it will offer two courses via AG in semester two, 2009. The Department of Mathematics at the University of Auckland is unique (for Australia and New Zealand) in that it offers Masters courses in Mathematics Education. They are always offered in the evening (so teachers can take them) so the timing is good for Australia. One of these courses that is quite mathematical will be offered via AG:

> **MATHS 712 Mathematics and Learning, Semester 2, 2009**
> Course description: Recent theoretical perspectives on the teaching and learning of school and university mathematics are linked to the learning of either calculus or algebra. The focus is on the mathematics content, applications,

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and effective learning at school and university. The topic in 2009 is calculus. Lecturer: Associate Professor Mike Thomas (moj.thomas@auckland.ac.nz).

The other course to be offered via AGs, in Applied Mathematics:

MATHS 798 Non-linear PDEs, Semester 2, 2009
Course description: see http://www.math.auckland.ac.nz/wiki/MATHS_789
Lecturer: Mike Meylan.

Further details and updates can be found at http://www.ice-em.org.au/index.php?option=com_content&task=view&id=51&Itemid=1.

eTeaching with pdf

Mathematicians are increasingly using computer projection for their presentation in lectures and seminars. LaTeX is usually preferred for preparation of pdf notes. This is often augmented by a separate physical whiteboard where handwriting is used for asides, worked examples and responses to questions. Laser pointers are useful for highlighting the current point of interest in a standard lecture theatre, but laser pointers are not effective in AGRs. With distributed multi-nodal remote collaborative teaching via Access Grid, handwriting and highlighting needs to be provided electronically. Student work can even be done by hand; but submitted, marked and returned electronically, in the form of pdf files. This is especially attractive for remote students undertaking a course delivered over the AG.

Using LaTeX to produce pdf slides

Notes prepared as a pdf file can be displayed using AdobeReader and the pages can be just scrolled down. More effectively, a slideshow can be produced by adjusting the page so that each page fills one screen. For instance, beamer is a new class in LaTeX that produces a slideshow with many features, including the stepped uncovering of a slide. Many recent installations/editors of LaTeX, including WinEdt, will automatically use beamer: otherwise some extra files need to be downloaded, see [2] for files and examples.

Although beamer includes the package multimedia to run movies, it can be used to provide an extra feature which is very attractive (especially if only one projection screen is being used). First, include \usepackage{multimedia} in the LaTeX preamble, and then:

```
\begin{frame}
To (temporarily) exit to different software, click on the region:
\movie[width=8cm,height=2cm,externalviewer]{This is the Maple demo here}
{Christoffel-symbols.mw}
\end{frame}.
```

This code produces a single slide (the frame) with the text 'To (temporarily) ...' followed by a region with the specified dimensions, followed by the text within the curly brackets. With the externalviewer option for the movie, a mouse click in the region prompts interrogation of the file extension and opens the specified file with its associated software. Exit from that software (whether Word, Maple ...)

produces a return to the slideshow. This is very useful since the main presentation can be prepared from LaTeX, with correct mathematical typesetting: the slideshow is suspended while software demonstrations are run, and when completed the slideshow is resumed. Note that the 'exit' from the slideshow could be to software that supports Digital Ink: that is, electronic handwriting and sketching.

TabletPC

The use of a TabletPC (with the tablet version of the Windows operating system) is highly recommended: the monitor is touch sensitive and the pen/stylus can be used for easy and natural handwriting. For a discussion and comparison with using cheaper tablet devices in teaching undergraduate mathematics, see [3]. The Microsoft products Word, Excel and PowerPoint all have an extra menu for handwriting when using a TabletPC. Annotating (or highlighting) any of these files is very easy and natural and the annotation is saved as part of the file. The annotated file can be read and printed from the standard versions of the software.

Janal and PDF annotator

The very attractive annotation features provided for the Microsoft products when using a TabletPC are not available for other software. However Jarnal [4] is open source software that provides many annotation capabilities for pdf files (and faxes and other non pdf documents). PDF Annotator [5] is a commercial package that costs about US$70. Both Jarnal and PDF Annotator are excellent and easy to use for annotations: both have more features than are required for straightforward annotations. Jarnal has more features than PDF Annotator and it's free! However Jarnal has an old-fashioned computer science feel about it: it's invoked by running a command script. A pdf file can be opened, as background, with jarnalannotate and the annotated file is a .jar file (which is saved with the .jar extension). When finished, the 'Export to PDF' option can be used to produce a pdf file. This is a bit clumsy, but people with programming experience are not likely to have problems with this. Thus Jarnal is recommended for use by staff and advanced students (particularly those with programming experience).

PDF Annotator comes at a cost, but it is very easy (and obvious) to use. Installation is also easy since there is an installation wizard. The pdf file to be annotated is opened directly and is saved directly as a pdf file. This software is more natural to use and would be especially appealing for users who had not had much programming experience; for example, for undergraduate students undertaking a 'service' mathematics course remotely from the campus.

An elementary example is given in Figure 1: LaTeX has been used to state the question with proper typesetting. This example has been worked by hand using PDF Annotator: for pedagogical reasons, some lecturers would want to show some 'live' mathematics rather than have all material prepared and type set before the lecture.

Student work can be obtained as pdf files and submitted electronically. Students can work by hand on a worksheet and then scan to pdf for submission: the lecturer

Figure 1. A worked example, or marked student work, using PDF Annotator.

with a TabletPC can mark using the annotation software and return the pdf file without any need for printing a hardcopy. This is particularly appealing when students are remote (as some are with an AG course).

The presenter can open the pdf slideshow from the annotation software: the slideshow can be run and any slide annotated. A start with this approach has been made by Andrew Stacey and Yousong Luo in their Applied Functional Analysis AG Honours course (followed by Andrew Eberhard in his Optimisation course) from the RMIT University AGR in 2008. Note that, if the pdf slideshow is run from the annotation software, then the \movie command with the externalviewer option cannot be used to exit (temporarily) to other software (as described above). Preliminary student feedback seems to indicate that students prefer that worked examples, detailed asides and sketches be separate from the original pdf file rather than incorporated in the main pdf file.

Many AGR presenters like to be able to work with two screens. One screen is used for the main presentation (pdf slides, say) and one screen for demonstrations (using software such as Maple, MATLAB, . . .) or for Digital Ink. AGRs typically provide at least one interactive whiteboard, such as a SMART Board. At RMIT, PDF Annotator is installed in the AGR and so can be used from a SMART Board: for the slide show (enabling annotations) and/or for the provision of Digital Ink on a second screen (which is recommended).

Digital Ink provided in an AGR uses propriety software of the Interactive Whiteboard, usually Mimeo or SMART Board. This can be used for worked examples and then exported to pdf. However, note that this form of Digital Ink is a separate overlay — it does not become part of the original document. This need not be a problem: Digital Ink could be used so that worked examples are developed on a blank page, separate from the main presentation.

Conclusion

Collaborative teaching of advanced mathematics across Australia via the Access Grid is expanding with the participation of New Zealand. For many mathematicians, pdf files produced using LaTeX are convenient for electronic presentations and teaching since the mathematics is properly typeset. The recent advent of the

beamer class to produce pdf slideshows and the comprehensive annotation software Jarnal and PDF Annotator have provided excellent tools for the eTeaching of mathematics, both locally and remotely such as via AGRs.

Acknowledgement

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Bill Blyth is Associate Professor (Adjunct) of computational mathematics at RMIT University and was Head of the Department of Mathematics for $6\frac{1}{2}$ years. He is Chair of the Engineering Mathematics Group of Australia, a Center Affiliate at the International Centre for Classroom Research (at the University of Melbourne), led the design, construction and initial delivery phases of the RMIT University AGR and is currently at The Australian Mathematical Sciences Institute, AMSI, as the national coordinator of AMSI's Access Grid Room project. His PhD was in theoretical physics at Imperial College, London. He has an unusually broad range of research interests in mathematics education (in technology-rich classrooms) and the numerical solution of differential and integral equations. He has published more than 60 refereed papers.