

Tools of the Trade:

The Math Graduate (and Undergraduate) Student's Toolbox

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Department of Mathematics and Statistics
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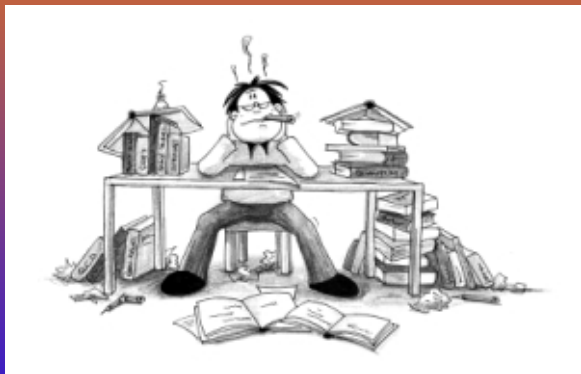
The Mathematician's Tools

So You Want to be a Mathematician

- ▶ What do you really need to know (what tools do you need)?



Literature Search



Math Databases

- ▶ **MathSciNet** - Mathematical Reviews (MR) provides “information on articles and books that contain new contributions to mathematical research”. “The MR Database, containing MR information back to 1940, is now maintained electronically”. <http://www.ams.org/mathscinet>
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- ▶ **Mathematics Genealogy Project** - “The intent of this project is to compile information about ALL the mathematicians of the world.” A service of the NDSU Department of Mathematics, in association with the American Mathematical Society. <http://genealogy.math.ndsu.nodak.edu>
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- ☐ **MR2542680** (2010i:05076) Rodger, C. A.; Roy, Meredith Combinatorial group testing in bipartite graphs. *J. Combin. Math. Combin. Comput.* 70 (2009), 247–252. (Reviewer: Xiao Dong Hu), [05B30](#)
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- ☐ **MR2533152** (2010i:05197) Ozkan, Sibel; Rodger, C. A. Hamilton decompositions of graphs with primitive complements. *Discrete Math.* 309 (2009), no. 14, 4883–4888. (Reviewer: Matthew Johnson), [05C45](#) ([05C70](#))
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- ☐ **MR2533125** Andersen, Lars Døvling; Rodger, Chris Preface [Special issue: Graphs and designs in honour of Anthony Hilton]. *Discrete Math.* 309 (2009), no. 14, 4661–4662, [01A70](#) ([05-06](#))
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- ☐ **MR2486895** (2010d:05014) Huang, Wen-Chung; Rodger, C. A. A decomposition of $(\lambda K_v)^+$ with extended triangles. *Math. Slovaca* 59 (2009), no. 2, 155–176. (Reviewer: Magdi H. Armanious), [05B07](#) ([05C70](#))
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- ☐ **MR2489422** (2010a:05106) Dinavahi, Chandra; Rodger, C. A. Diagonally switchable 4-cycle systems revisited. *Australas. J. Combin.* 43 (2009), 231–236, [05C38](#) ([05C70](#))
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Zanati, Saad I.	Foust, G. M.	Fu, Chin Mei	Fu, Hung-Lin	Grant, Carrie
Hamm, Rose C.	Hilton, Anthony J. W.	Hoffman, Dean G.	Huang, Wen-Chung	Jarrell, Sasha Logan
Johnson, Matthew	Johnson, Peter D., Jr.	Küçükçifçi, Selda	Leach, C. D.	Leonard, Douglas A.
Lin, Yuqing	Lindner, Charles Curtis	Logan, S. L.	McCauley, L.	McGee, J. W.
Meszka, Mariusz	Miller, Mirka	Newman, Nick	Ozkan, Sibel	Phelps, Kevin T.
Quattrocchi, Gaetano	Raines, Michael E.	Roy, Meredith	Salman, A. N. M.	Sarvate, Dinesh G.
Seberry, Jennifer R.	Smith, Todd B.	Spicer, Erin R.	Stinson, Douglas R.	Stubbs, Sidney
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MR2473095 (2009m:05016)
Lindner, C. C.(1-ABRN); Quattrocchi, Gaetano(I-CATN); Rodger, C. A.(1-ABRN)
Embedding Steiner triple systems in hexagon triple systems. (English summary)
Discrete Math. 309 (2009), no. 2, 487–490.
05B07
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Summary: "A hexagon triple is a graph consisting of the three triangles (triples) $\{a, b, c\}$, $\{c, d, e\}$, and $\{e, f, a\}$, where a, b, c, d, e , and f are distinct. The triple $\{a, c, e\}$ is called an inside triple. A hexagon triple system of order n is a pair (X, H) where H is a collection of edge disjoint hexagon triples which partitions the edge set of K_n with vertex set X . The inside triples form a partial Steiner triple system. We show that any Steiner triple system of order n can be embedded in the inside triples of a hexagon triple system of order approximately $3n$."

References

1. C.J. Colbourn, A.C.H. Ling, G. Quattrocchi, Minimum embedding of Steiner triple systems into $(K_4 \setminus e)$ -designs, *Discrete Math.*, in press (doi:10.1016/j.disc.2007.09.038).
2. Lucia Gionfriddo, Two constructions for perfect hexagon triple systems, *Bull. Inst. Combin. Appl.* 48 (2006) 73–81. [MR2259705](#)
3. T.P. Kirkman, On a problem in combinatorics, *Cambridge and Dublin Math. J.* 2 (1987) 191–204.
4. S. Küçükçifçi, C.C. Lindner, Perfect hexagon triple systems, *Discrete Math.* 279 (2004) 325–335. [MR2059998 \(2005m:05045\)](#)

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Rodger, C.A.; Rogers, Julie
Generalizing Clatworthy group divisible designs. (English)
J. Stat. Plann. Inference 140, No. 9, 2442-2447 (2010).

Summary: A neat construction is provided for three new families of group divisible designs that generalize some designs from the Clatworthy table of the only 11 designs with two associate classes that have block size four, three groups, and replication numbers at most 10. In each case (namely, $\lambda_1 = 4$ and $\lambda_2 = 5$, $\lambda_1 = 4$ and $\lambda_2 = 2$, and $\lambda_1 = 8$ and $\lambda_2 = 4$), we have proved that the necessary conditions found are also sufficient for the existence of such GDD's with block size four and three groups, with one possible exception.

MSC 2010
62K10 Statistical block designs
05B05 Block designs (combinatorics)

Keywords
group divisible designs; two associate classes; combinatorial designs

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The Mathematics Genealogy Project – Christopher Rodger

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Mathematics Genealogy Project

Christopher Andrew Rodger

[MathSciNet](#)

Ph.D. University of Reading 1982 

Dissertation: *Embedding Problems for Latin Squares*
Mathematics Subject Classification: 05—Combinatorics

Advisor: [Anthony J. W. Hilton](#)

Students:
Click [here](#) to see the students listed in chronological order.

Name	School	Year Descendants
Atif Abueida	Auburn University	2000
David Ashe	Auburn University	2000
B. Ann Cox	Auburn University	1994
Michael Daven	Auburn University	1999
Saad El-Zanati	Auburn University	1991
George Fount	Auburn University	1998
Carrie Grant	Auburn University	1997
Sasha Jamell	Auburn University	2004
Charles Leach	Auburn University	2002
James McGee, III	Auburn University	2000
Sibel Ozkan	Auburn University	2007
David Pike	Auburn University	1996 1
Michael Raines	Auburn University	1997
Erin Spicer	Auburn University	1995
Sidney Stubbs, IV	Auburn University	1986
Evan Wantland	Auburn University	1994

According to our current on-line database, Christopher Rodger has 16 [students](#) and 17 [descendants](#).
We welcome any additional information.

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$\sqrt[n]{\frac{1}{N-3}}$

$\frac{\alpha}{\gamma}$

$\tilde{\text{t}}(\beta)$

$\text{hbox}\{PE\}$

$h_{(S)}=\frac{1}{2}$

"epsilon" AND "2pi"

"\bar{\delta}_q" OR "\frac{dw}{dz}"

SAMPLE RESULT

Self-intersections of random walks on lattices

Acta Mathematica Hungarica (2002) 96:187-220, August 01, 2002

$P\left(E_n^{(d)}, \text{i.o.}\right) = 0 \text{ or } 1$

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$$P\left(\left\{E_n^*\left\{\left|d\right|\right\},\left\{\text{i}\right\}\left\{\text{o}\right\}\left\{\text{t}\right\}\right\}\right. \\ \left.\left|d\right\} = 0\right) = 0 \text{ or } 1$$

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Journal of Thermal Spray Technology (2009):728-752, December 01, 2009

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3 results

Magneto-hydrodynamic Effects on Insulating Bubbles and Inclusions in the Continuous Casting of Steel

Metallurgical and Materials Transactions B (2010):1-7, August 12, 2010

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$\nabla^2 \Phi_{\text{int}} = \nabla \times \mathbf{B}_1$

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$\nabla \times (\nabla \times \mathbf{B}) = \nabla (\nabla \cdot \mathbf{B}) - \nabla^2 \mathbf{B}$

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1 result

The Use of Steady Electromagnetic Fields to Control the Columnar Solidification of Binary-Metal Alloys

Metallurgical and Materials Transactions B (2009) 40:317-327, May 27, 2009

$\mathbf{j} = \frac{1}{\mu_0} \nabla \times \mathbf{B}$

EXACT View LaTeX Code

1 result

Evaluation of signal space separation via simulation

Medical & Biological Engineering & Computing (2008) 46:923-932, August 29, 2008

$\nabla \times \mathbf{B} = \mu_0 \mathbf{J} \quad \nabla \cdot \mathbf{B} = 0$

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J.W. Haverkort and T.W.J. Peeters



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Abstract

The magneto hydrodynamic effects associated with a magnetic field perpendicular to the movement of insulating inclusions or bubbles in a conducting liquid are investigated in this article. An increase in drag coefficient as a result of the presence of a magnetic field is argued to have a significant effect on their terminal rise velocity. Inside a continuous steel caster, this lower terminal velocity has a potentially negative effect on the removal rate of unwanted inclusions, degrading the steel quality. Simulations of an insulating rigid sphere moving in the presence of an electrical current show an electromagnetophoretic force per unit volume of $-\psi \mathbf{J} \times \mathbf{B}$, with a shape factor $\psi = 1.0$. Numerical fluid and dispersed gas phase simulations of the flow inside a submerged entry nozzle show that, because of this force, inhomogeneous magnetic fields can cause nonuniform gas distributions in accordance with a theoretical analysis. In particular, the magnetic field can be tailored to increase or decrease the amount of gas near the side

Mathematics Research Tools



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Computer Algebra System (CAS)

Proprietary

- ▶ Magma
- ▶ Maple
- ▶ Mathematica
- ▶ MuPad (part of Matlab)

Computer Algebra System (CAS)

Open Source

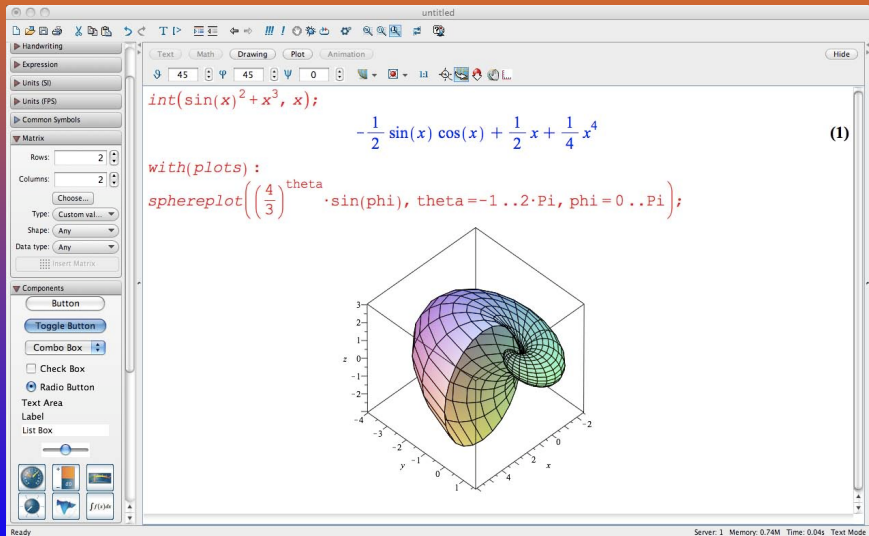
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Computer Algebra Systems

http://en.wikipedia.org/wiki/Computer_algebra_system

<http://www.symbolicnet.org>

- ▶ Symbolic algebra package
- ▶ Programming language
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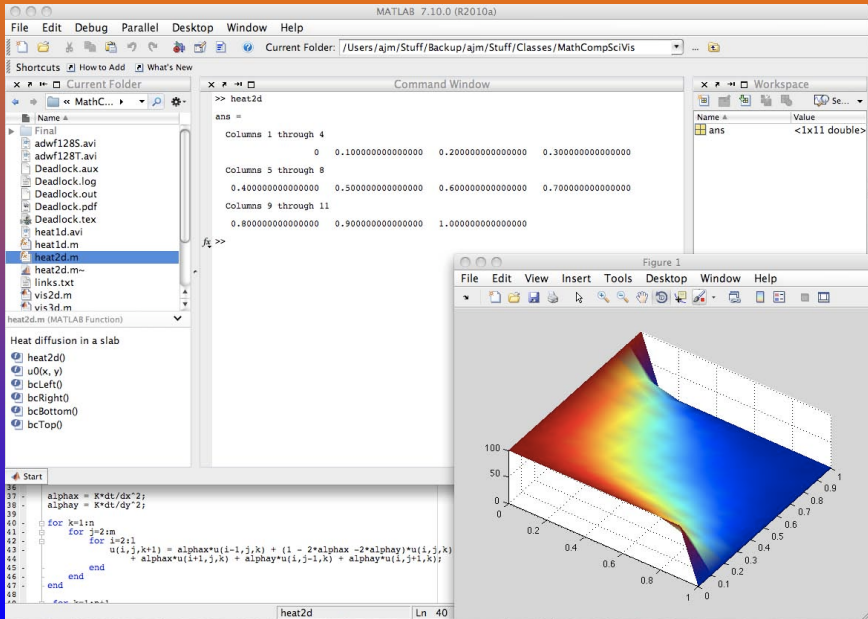
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- ▶ SciPy <http://www.scipy.org>

Numerical Analysis Software http://en.wikipedia.org/wiki/List_of_numerical_analysis_software

MATLAB

- ▶ Matrix laboratory
- ▶ Programming language designed for mathematical computation, analysis, visualization, and algorithm development
- ▶ Integrated development environment
- ▶ Applications include: prototyping, graphics, data analysis, GUI development
- ▶ “MATLAB The Language of Technical Computing”
- ▶ “MATLAB and companion toolboxes provide engineers, scientists, mathematicians, and educators with an environment for technical computing applications”



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- ▶ Minitab
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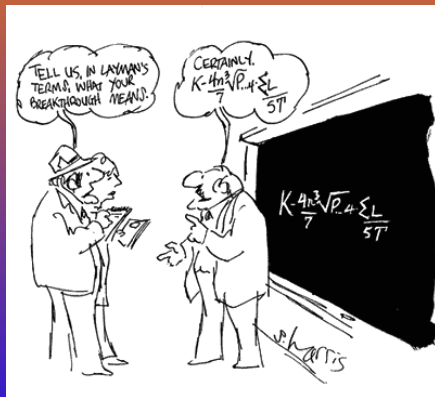
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- ▶ L^AT_EX is a comprehensive set of markup commands (macros) used with the typesetting program T_EX
- ▶ In the public domain, cross platform
- ▶ Simplify the use of T_EX

The Comprehensive TeX Archive Network <http://www.ctan.org>
The TeX Users Group <http://www.tug.org>

Typographical Markup vs. Logical Markup

T_EX - Typographical Markup

He took a **bold step** forward

He took a bold step forward

html

He took a {\bf bold step} forward

TeX

Typographical Markup vs. Logical Markup

L^AT_EX - Logical Markup

Logical Markup

`<h1>Logical Markup</h1>`

html

`\title{Logical Markup}`

LaTeX

He took a *bold step* forward

He took a `<em>bold step</em>` forward

html

He took a `\emph{bold step}` forward

TeX

Examples

A displayed equation

$$b(t) = \int_{-\infty}^{\infty} k(t, s) a(s) ds$$

```
\begin{displaymath}
b(t)=\int_{-\infty}^{\infty}
k(t, s) a(s) ds.
\end{displaymath}
```

An inline equation $b(t) = \int_{-\infty}^{\infty} k(t, s) a(s) ds$

```
$b(t)=\int_{-\infty}^{\infty}
k(t, s) a(s) ds$
```

Examples

$$f_n = \sum_{m=-\infty}^{\infty} k_{n-m}g_m = (k \star g)_n \quad (1)$$

Recall equation (1)

Examples

$$K = \begin{bmatrix} k_0 & k_{N-1} & \dots & k_1 \\ k_1 & k_0 & \dots & k_2 \\ \vdots & \vdots & \ddots & \vdots \\ k_{N-1} & k_{N-2} & \dots & k_0 \end{bmatrix}_{N \times N}$$

```
\begin{displaymath}
K = \left[ \begin{array}{cccc}
k_0 & k_{N-1} & \ldots & k_1 \\
k_1 & k_0 & \ldots & k_2 \\
\vdots & \vdots & \ddots & \vdots \\
k_{N-1} & k_{N-2} & \ldots & k_0
\end{array} \right]_{N \times N}
\end{displaymath}
```

Examples

Table 7.4: Plant data for both units.

	Unit 1	Unit 2
Fresh feed flow rate, kg/s	16.782	13.476
Recycle HCO flow rate, kg/s	2.108	2.111
Combined feed ratio, CFR	1.1256	1.1566
Air feed temperature, K	436.	433
Hydrogen in coke, wt%	4.17	6.79

Examples

Table 7.4: Plant data for both units.

```
\medskip

\begin{tabular}{@{}lr@{.}lr@{}}\hline
~&\multicolumn{2}{c}{\quad$ Unit 1} &
\multicolumn{2}{c}{\quad$ Unit 2}\\
\hline
Fresh feed flow rate, kg/s & \quad$
16&782 & \quad$ 13.476\\
Recycle HCO flow rate, kg/s
& 2&108 & 2.111\\
Combined feed ratio,CFR&1&1256&1.1566\\
Air feed temperature, K&436&~&433\\
Hydrogen in coke, wt\%&4&17&6.79\\
\hline \end{tabular}
```

- ▶ Presentations, colors, transitions
- ▶ Output formats pdf, ps
- ▶ Graphics
- ▶ Charts, tables, and diagrams
- ▶ Processors, viewers/previewers, and front-ends, device drivers
- ▶ Style files, journal specific style files, book publishers
- ▶ Environments
 - ▶ T_EXShop - <http://pages.uoregon.edu/koch/texshop>
 - ▶ T_EXWorks - <http://tug.org/texworks>
- ▶ Bibliographic Database Managers
 - ▶ BibDesk - <http://bibdesk.sourceforge.net>
 - ▶ JabRef - <http://jabref.sourceforge.net>

TeX Environments

TeXShop

The screenshot displays the TeXShop application interface with three main windows:

- GradSeminar2010.pdf:** A presentation slide titled "TeX/LaTeX Add-Ons" with a blue header and orange body. It lists several categories of add-ons:
 - Presentations, colors, transitions
 - Output formats pdf, ps
 - Graphics
 - Charts, tables, and diagrams
 - Processors, viewers/previewers, and front-ends, device drivers
 - Style files, journal specific style files, book publishers
- GradSeminar2010.tex:** The source code file, showing LaTeX commands for a presentation. It includes a combined lead table, a list of items, and a frame structure. The code is as follows:

```
670 Combined lead table, LFPH&1725&1.155b%
671 Air feed temperature, K&436&-&433%
672 Hydrogen in coke, wt%&4&17&6.79%
673 \hline \end{tabular}%
674 \end{verbatim}%
675
676 \fill
677 \end{frame}%
678
679
680 \begin{frame}%
681 \framestyle{TeXXLaTeX Add-Ons}%
682
683 \begin{itemize}%
684 \item{Presentations, colors, transitions}%
685 \item{Output formats pdf, ps}%
686 \item{Graphics}%
687 \item{Charts, tables, and diagrams}%
688 \item{Processors, viewers/previewers, and front-ends, device drivers}%
689 \item{Style files, journal specific style files, book publishers}%
690 \end{itemize}%
691
692 \fill
693 \end{frame}%
694
695
696 \begin{frame}%
697 \framestyle{TeXX Environments}%
698 \framesubtitle{TeXX Shop}%
699
```
- GradSeminar2010 console:** The console window showing error messages and a warning. The messages are:

```
Underfull \vbox (badness 10000) has occurred while output is active [52]
Underfull \vbox (badness 10000) has occurred while output is active [53]
Underfull \vbox (badness 10000) has occurred while output is active [54]
Underfull \vbox (badness 10000) has occurred while output is active [55]
[56] (./GradSeminar2010.aux)

LaTeX Font Warning: Size substitutions with differences
up to 1.0pt have occurred.

(see the transcript file for additional information)>/usr/local/texlive/2008/te
xmf-dist/fonts/type1/bluesky/cw/cwss18.pfb->/usr/local/texlive/2008/te
xmf-dist/fonts/type1/bluesky/cw/cwss12.pfb->/usr/local/texlive/2008/te
xmf-dist/fonts/type1/bluesky/cw/cwss8.pfb->/usr/local/texlive/2008/te
xmf-dist/fonts/type1/bluesky/cw/cwss9.pfb->/usr/local/texlive/2008/te
xmf-dist/fonts/type1/bluesky/cw/cwss19.pfb->/usr/local/texlive/2008/te
xmf-dist/fonts/type1/bluesky/cw/cwss18.pfb->/usr/local/texlive/2008/te
```

TeX Environments

LyX

LyX: ~/example.lyx (changed)

File Edit Insert Layout View Navigate Documents Help

Standard

We can now refer back to the picture as figure 1. Let's now add a small table:

Rocks	Minerals
Granite	Mica
Sandstone	Quartz

Now we come to one of LyX's real strengths: mathematical equations. The most beautiful equation in mathematics is $e^{i\pi} + 1 = 0$. Ugly equations as the integral of $1/x$ can be written as

$$\int \frac{dx}{x} = \ln|x| + C$$

Footnote:
according to some mathematicians -- I'm just a dumb scientist.

Font: Default

file:/tmp/lyx/lyx_tmpdir5639du1seM/lyx_tmpbuff/example.tex - KViewShell

Date: 2007-07-07 10:10:10 Seite zu Bearbeiten Einstellungen Hilfe

125%

Figure 1: This is a picture of a platypus.

2 Other Stuff

The following is the famous platypus EPS file:

We can now refer back to the picture as Figure 1. Let's now add a small table:

Rocks	Minerals
Granite	Mica
Sandstone	Quartz

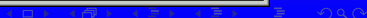
Now we come to one of LyX's real strengths: mathematical equations. The most beautiful equation in mathematics¹ is $e^{i\pi} + 1 = 0$. Ugly equations as the integral of $1/x$ can be written as

$$\int \frac{dx}{x} = \ln|x| + C.$$

¹according to some mathematicians -- I'm just a dumb scientist.

2

Seite 2 von 2 | 125% | DIN A1/Modformat



Bibliographic Databases

BibDesk

The screenshot shows the BibDesk application window with the title bar "MathTools.bib". The interface includes a toolbar with icons for Action, New, Edit, Delete, and TeX Preview. A search bar labeled "Search Bibliography" is present. On the left, a sidebar shows "GROUPS" with "Library" (38) selected, and other options like "EXTERNAL", "Web", "SMART", "STATIC", and "KEYWORDS". The main area displays a list of publications with columns for Keyword, BibTeX, Cite Key, and Title. The selected entry is "What Is New in \LaTeX? I. Breaking Free" by George Grätzer. A detailed view of this entry is shown at the bottom, including the author, journal, year, volume, number, and pages.

Keyword	BibTeX	Cite Key	Title
article	Ronald1998		Reviews: handbook of writing for the mathematic...
book	Gillman1987		Writing Mathematics Well: A Manual for Authors
book	Goossens1...		The LaTeX Web Companion: Integrating TeX, HT...
book	Goossens2...		The LaTeX Graphics Companion
book	Gratzer2007		More Math Into \LaTeX
article	Gratzer2009a		What Is New in \LaTeX? I. Breaking Free
article	Gratzer2009b		What Is New in \LaTeX? II. \TeX Implementations...
article	Gratzer2009c		What Is New in \LaTeX? III. Formatting References
book	Griffiths1997		Learning \LaTeX
article	Hefferon2009		The TEX Family in 2009
article	Hersh1997		Math Lingo vs. Plain English: Double Entendre
book	Higham1998		Handbook of writing for the mathematical sciences

Gratzer2009a
What Is New in \LaTeX? I. Breaking Free (article)
Author George Grätzer
Journal Notices Amer. Math. Soc.
Year 2009
Volume 56
Number 1
Pages 52--54

38 publications

Bibliographic Databases

BibDesk

The image shows two windows from the BibDesk application. The top window, titled "What Is New in LaTeX? I. Breaking Free", displays a BibTeX entry with the following fields:

- Cite Key:** Gratz2009a
- Author:** George Grätzer
- Title:** What Is New in LaTeX? I. Breaking Free
- Journal:** Notices Amer. Math. Soc.
- Year:** 2009
- Volume:** 56
- Number:** 1
- Pages:** 52--54
- Month:**
- Keywords:**
- Url:** <http://www.ams.org/notices/200901/tx090100052p.pdf>

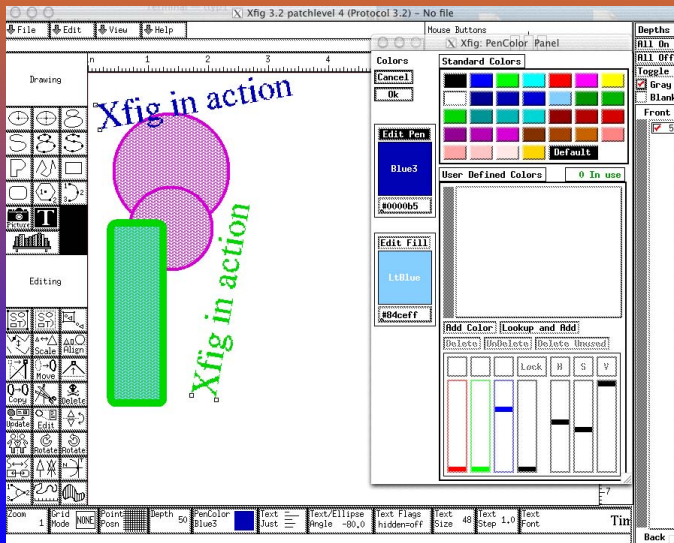
On the right side of the window, there is a PDF icon and the URL <http://www.ams.org/noti...>. Below the icon, the author's name "G. Grätzer" is visible. At the bottom of the window, there are fields for "Rating" and "Read".

The bottom window, titled "LaTeX Preview", shows a preview of the document. It contains a single footnote:

[1] G. Grätzer. What is new in LaTeX? I. Breaking free. *Notices Amer. Math. Soc.*, 56(1):52–54, 2009.

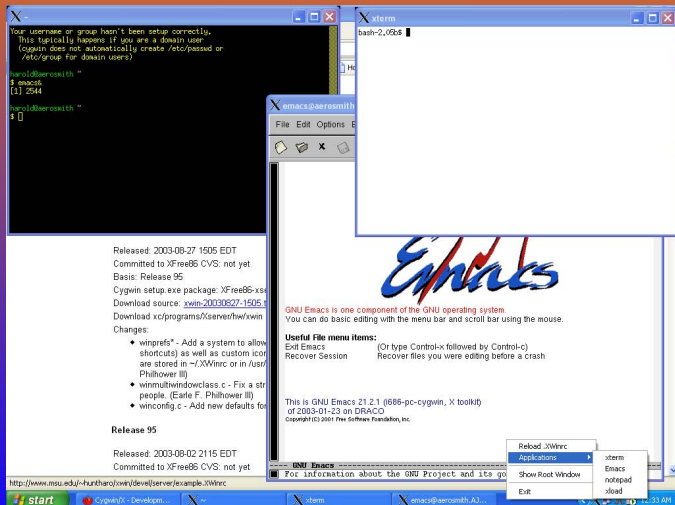
Drawing Environments

Xfig



Unix-Like Environments

Cygwin



Virtual Software Delivery

“COSAM is using advances in virtualization technology to help it manage software better and to facilitate the delivery and instructional use of software to the faculty, staff, and students in the college.”

For information see:

<http://www.auburn.edu/academic/cosam/departments/it/software>

<http://www.auburn.edu/academic/cosam/departments/it/software/appv>

<http://www.auburn.edu/academic/cosam/departments/it/software/vmwareviewer>

Virtual Software Delivery

The screenshot shows a web browser window displaying the Auburn University Instructional Technology website. The browser's address bar shows the URL <http://www.auburn.edu/academic/cosam/departments/it/software/>. The website has a blue header with the Auburn University logo and the text "Instructional Technology College of Sciences & Mathematics". Below the header is a navigation bar with links: Academic Departments, Student Services, Alumni, Research, Outreach, and Diversity. The main content area is titled "Software" and contains the following text:

COSAM is using advances in virtualization technology to help it manage software better and to facilitate the delivery and instructional use of software to the faculty, staff, and students in the college. Instead of physically installing the software on the physical computers, the preferred method is to make software available via virtualization as described below.

Instructional Classrooms

The COSAM IT group has implemented changes to most of the technology classrooms in the college. The rooms affected are Reuse 112, Chemistry 134, 151, 156, SCC 115, 118, 122, SCA, all Parker Hall (with the exceptions of 126 and the physics labs), and the conference room SCC 202. We reinstalled the operating system on all the computers and changed the delivery system for the software. The software installed on any of the classroom computers is limited to basic PowerPoint and word viewers. All other software that a faculty member is licensed to use is delivered via virtualization regardless of the classroom they are teaching in. This change will better allow us to manage the software that is available to the faculty and graduate teaching assistants. It will also give a more consistent user environment.

Instructors will find most of the software they are authorized to use in the programs folder under the folder named app-v. All classroom computers also have the VMware view client on the desktop. Clicking on this will launch a virtual machine which may be necessary to run some software as many classroom computers have limitations.

Files stored on the local desktop, favorites, and my doc. of any classroom computer or the virtual computer will be available to each user regardless of the computer used or its COSAM location for the duration of the semester. This includes both the physical computers and the virtual computers. The instructor will have a choice of using either the local physical computer or launching a virtual computer depending on what works best for them.

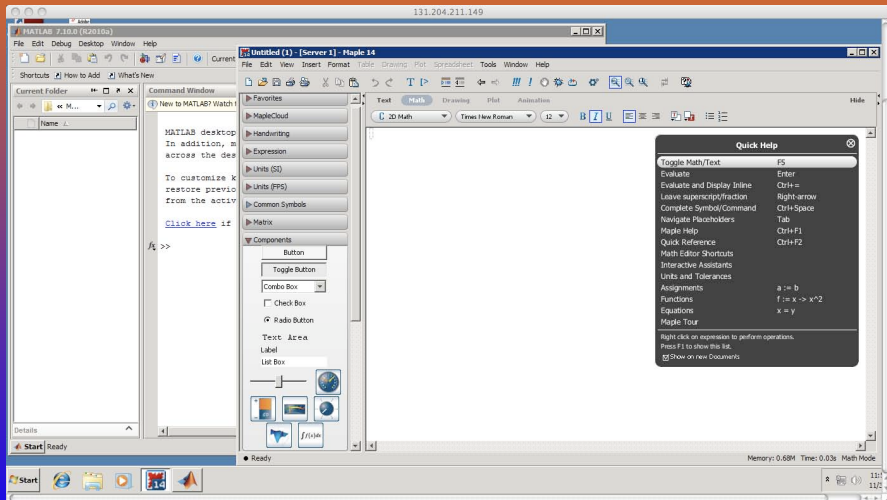
Faculty and Staff

The faculty/instructor will be able to install VMware View client on their office desktop/laptop so they can connect to the virtual computer (i.e. Class pool) from outside the classroom to prepare for class. Faculty can copy material (files, programs, etc.) to the virtual computers desktop or my docs and they will appear in the same place on their classroom computer when they log in. If the user is off campus then a VPN connection is required. Faculty running a Windows OS may also want to install the Virtual Application client (App-V client) on their office desktop/laptop to access the

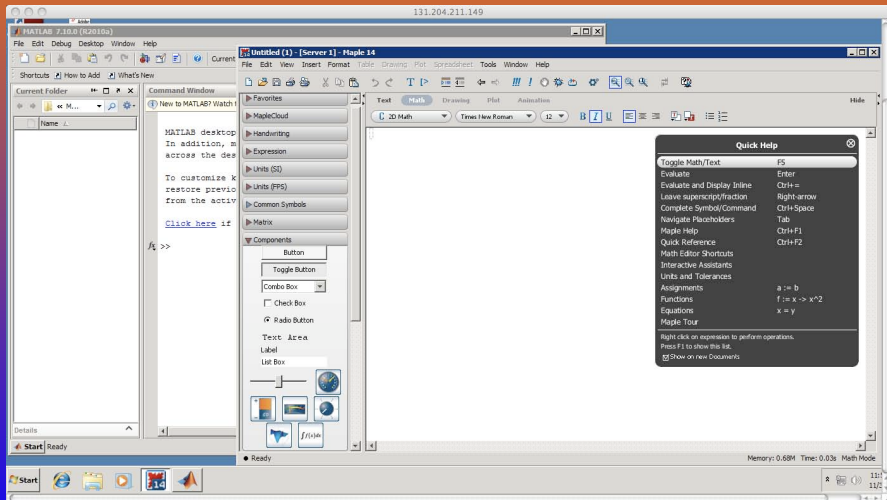
The left sidebar of the website contains a navigation menu with the following items:

- COSAM
- Departments
- Instructional Technology
- Software
- Application Virtualization (App-V)
- VMware Viewer
- Sophos
- Cisco VPN Client
- Fetch FTP Client (Mac)
- MS Office 2008 (Mac)
- Available Software

Virtual Software Delivery



Virtual Software Delivery



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