On the Road with USBTEX and Friends

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With apologies to Socrates. . .

All college students should use technology to present their work
Mathematics majors are college students

Mathematics majors should use technology to present their work

Criteria: software for Mathematics presentation

- Ability to produce standard mathematical notation
- Ability to include graphics
  - "Hand-drawn"
  - Computer-generated
- Multi-platform: Linux, Mac OS X, and Windows
- Used by professional mathematicians
- Extensive support: web, books, etc.
- Available anywhere
- Free, when possible

All roads lead to LATEX!

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Why a USB stick?

- Portability: works anywhere on campus or elsewhere
- Ubiquity: reasonably commonplace
- Cost: relatively inexpensive ($\approx$ \$20)
- Capacity: 1–2 Gb typical capacity

Image source: http://en.wikipedia.org/wiki/USB_flash_drive

USBTEX and friends: portable software applications

- USB memory stick — not simply for data!
- Provides a uniform TEX environment
- Uses components that run under Linux, Mac OS X, and Windows†
- Very easy to install: download, unzip, save to USB stick

†USBTEX is intended for Windows, although it uses components that run on other systems and have the same "look and feel" everywhere.

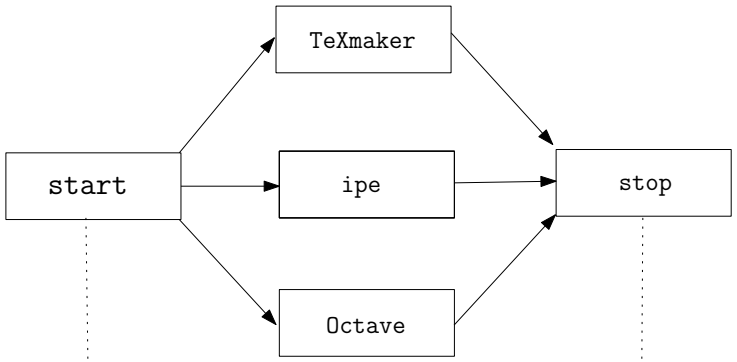
What's included?

TEX engine	USBTeX
LATEX editor	TEXmaker
PDF viewer	Sumatra PDF
Graphics editor	IPE
Spell checker	GNU Aspell
Numerical computation	Octave†

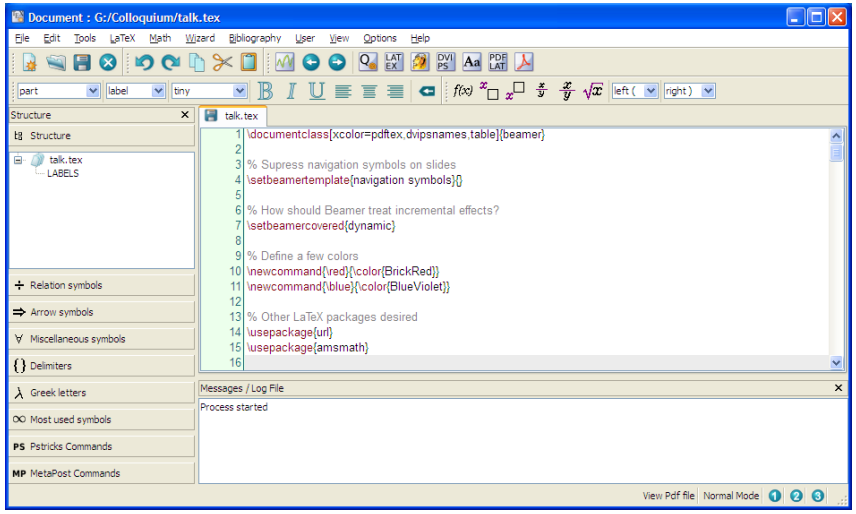
We assembled and customized freely available software and made it available to our students

†Similar to MATLAB.

Workflow



Live demonstration: Texmaker



Template Provided to Students
Mathematics 2800
Page 150
Problems 1, 2a, 3, 4, 5ac, 6ab

1 Describe some of the partitions of the set of students at the university.

Solution:

2a Describe the partition for the following equivalence relation: For $x, y \in \mathbb{R}$, xRy iff $x - y \in \mathbb{Z}$.

Solution:

3 Let $\{-i, -1, -i, 1\}$, where i is chosen so that $i^2 = -1$. The relation R on C given by xRy iff $xy = \pm 1$ is an equivalence relation on C. Give the partition of C associated with R.

Solution:

4 Let C be as in exercise 3. The relation S on $C \times C$ given by $(x, y)S(u, v)$ iff $xy = uv$ is an equivalence relation. Give the partition of $C \times C$ that is associated with S.

Solution:

5ac Describe the equivalence relation on each of the following sets with the given partition.

(a) $\mathbb{N}$, $\{\{1\}.\{2, 3\}, \{4, 5, 6, 7\}, \{8, 9, 10, 11, 12, 13, 14, 15\}, \ldots\}$.

(c) $\mathbb{R}$, $\{(-\infty, 0)\{0\}, (0, \infty)\}$.

Solution:

6ab For each $a \in \mathbb{R}$, let $A_a = \{(x, y) \in \mathbb{R} \times \mathbb{R} : y = a - x^2\}$.

(a) Sketch a graph of the set A_a, for $a = -2, -1, 0, 1$, and 2.

(b) Prove that $\{A_a : a \in \mathbb{R}\}$ is a partition of $\mathbb{R} \times \mathbb{R}$.

Solution:

Mathematics 5100 Problem Set 7 March 20, 2008

Student Solutions — A Sample

- **Problem 3.1, page 124**

  Prove that a commutative ring R has a unique 1.

  Solution:
  Lets assume that there's another multiplicative identity, say $1'$.

  $$1 = 11' = 1'$$

  So $1 = 1'$. Therefore, the multiplicative identity is unique.

- **Problem 3.5, page 124**

  Show that $U(\mathbb{Z}_n) = \{[k] : (k, n) = 1\}$.

  Solution: Assume [k] $\in U(\mathbb{Z}_n)$ where k is an integer.
  By Proposition 3.9, $\exists$j $\in \mathbb{Z}$ with [j] $\in U(\mathbb{Z}_n)$ such that [k][j] = [1].
  So jk $\equiv$ 1 (mod m). Then m | jk - 1. So $\exists$ t with tm = jk - 1.
  Then 1 = jk + (-t)m. This implies that the gcd of k and m is 1.

- **Problem 3.8, page 124**

  (i) If R is a domain and S is a subring of R, then S is a domain.

  (ii) Prove that $\mathbb{C}$ is a domain, and conclude that the ring of Gaussian integers is a domain.

  Solution:

  (i) Assume R is a domain ($1 \neq 0$ and cancelation holds) and S is a subring of R. S can't be the zero ring because R is a domain. By Proposition 3.3, S is a commutitive ring. Since R is a domain (meaning that it has no zero divisors) then by Proposition 3.5, S is a domain.

  (ii) After working with complex numbers for a while, I know that under addition they are commutative, associative, an additive identity 0 = 0 + 0i exists as well as additive inverses. Therefore, by definition of an abelian group, the complex numbers under addition are an abelian group.
  I've also learned that under multiplication the commutative and associative properties hold true as well as there is a multiplicative identity 1 = 1 + 0i.
  The distributive property also holds true as well.
  Since the above properties hold, this makes the complex numbers a commutative ring by definition.
  Since zero divisors do not exist in the complex numbers (ab = 0, for some a,b $\in \mathbb{C}$ if and only if a = 0 or b = 0), by Proposition 3.5, the $\mathbb{C}$ are a domain.

MAT 3570: Homework 3

Aaron Flach

January 28, 2008

Results

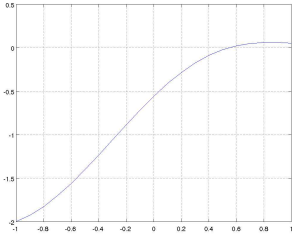


Figure 1: Graph 1: $y = 4\sin(x) + \sin(2x)\cos(x) - \sin(3x) - 6\sin(x)\sin(8x) + 3\sin(2x)\sin(7x) + 3\sin(x)\cos(13x) - 2(\cos^3(7x))$

MATLAB details

Plotting the graphs

```
Figure 1:
x = 0.0:0.01:+0.2;
y = 4.*sin(x) + sin(2*x).*cos(x) - sin(3*x) - 6.*sin(x).*sin(8*x) + 3.*sin(2*x).*sin(7*x)
```

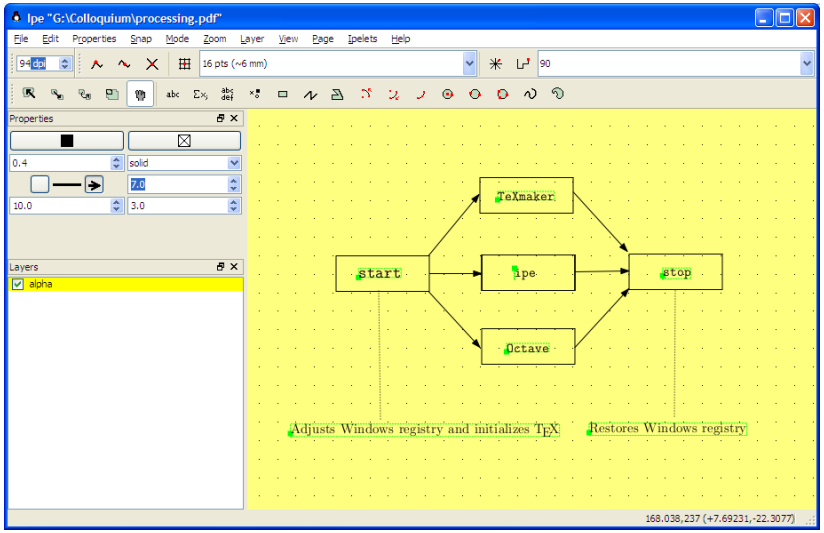
MAT 3702: Problem Set 3 1 Jed Shumaker & Tim Russell

10.42 We can use the *Factorization Theorem* here to show that $\overline{X}$ is a sufficent estimator of θ.

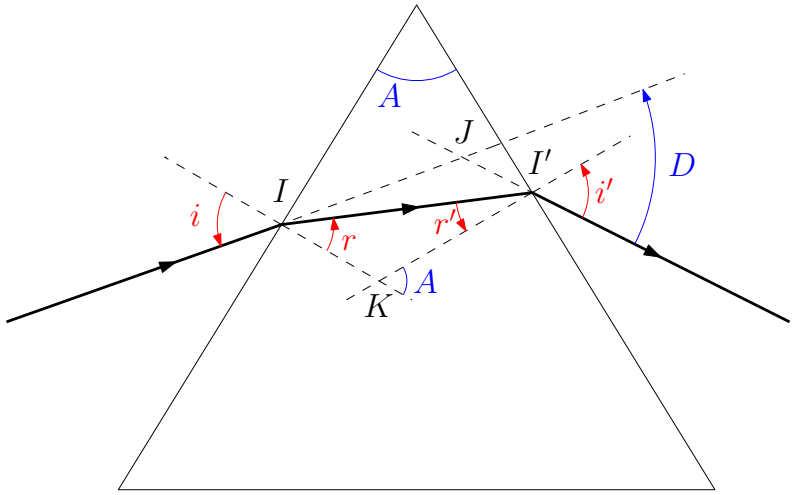
$$\begin{aligned} g(x_1, x_2, \ldots, x_n; \theta) &= \Pi_{i=1}^{n} g(x_i; \theta) \\ &= \Pi_{i=1}^{n} \frac{1}{\theta} e^{-\frac{x_i}{\theta}} \\ &= \left(\frac{1}{\theta}\right)^n e^{\sum_{i=1}^{n} -\frac{x_i}{\theta}} \\ &= \theta^{-n} e^{-\frac{1}{\theta}\sum_{i=1}^{n} x_i} \\ &= \underbrace{\theta^{-n} e^{-\frac{n\overline{x}}{\theta}}}_{g(\overline{x},\theta)} \cdot \underbrace{1}_{h(x_1,\ldots,x_n)} \end{aligned}$$

Thus, by **Theorem 10.4**, $\overline{X}$ is a sufficient estimator of θ.

Live demonstration: IPE

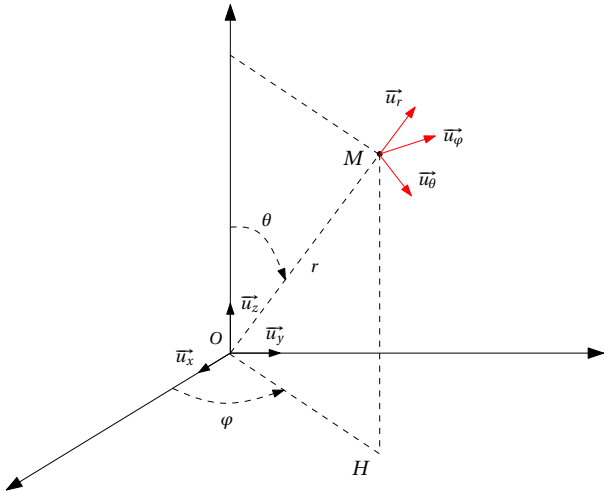


IPE showcase



Source: http://melusine.eu.org/lab/ipe

IPE showcase



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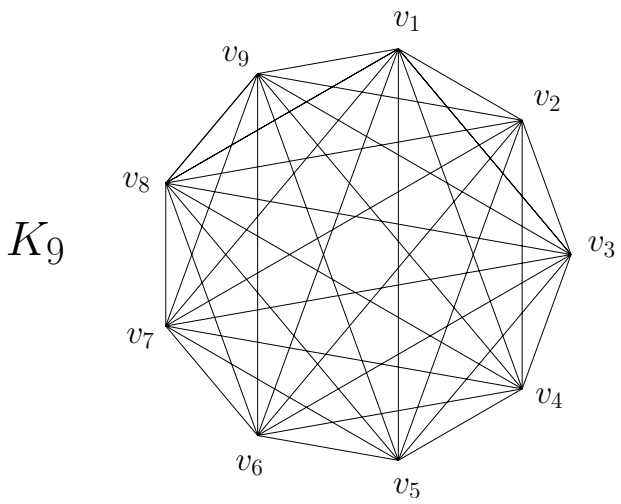
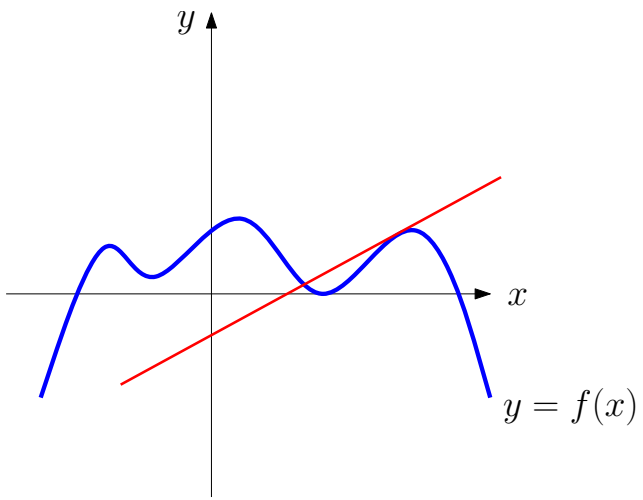
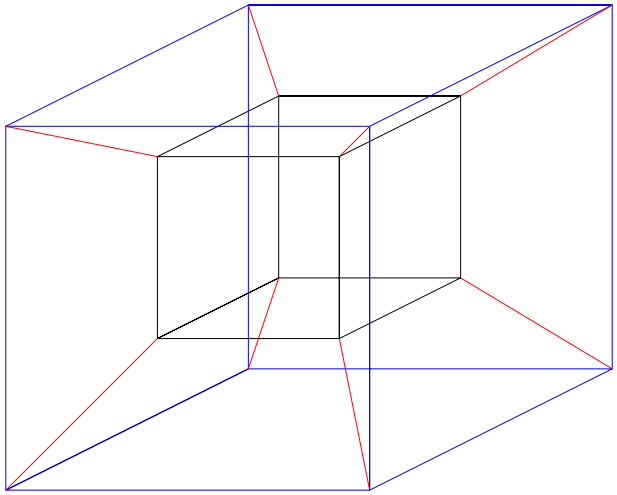
IPE showcase



IPE showcase



IPE showcase



URLs

Individual components:

USBTEX	`www.exomatik.net/LaTeX/USBTeXEnglish`
Texmaker	`www.xm1math.net/texmaker/`
Sumatra PDF	`code.google.com/p/sumatrapdf/`
IPE	`tclab.kaist.ac.kr/ipe/`
Aspell	`aspell.net/`
Octave	`www.gnu.org/software/octave/`

Our packaging, with customizations:

`www.ux1.eiu.edu/~dmbroline/LocalGuide`