Introduction to LaTeX

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  (see *The Beauty of LaTeX* by Dario Taraborelli)

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- Free of charge

Example 1

1. Proof Example

Let $X(t)$ be a Poisson process of rate λ. Independently, define $T \sim \text{Exponential}(\theta)$. We want to find the distribution of $X(T)$.

Proof. The range of $X(T)$ is the nonnegative integers. For $k \in \mathbb{Z}^{\geq}$,

$$
\begin{aligned}
&\Pr\{X(T) = k\} \\
&= E[\Pr\{X(T) = k \mid T\}] \\
&= \int_0^\infty \Pr\{X(T) = k \mid T\} f_T(t)\, dt \\
&= \int_0^\infty \frac{(\lambda t)^k e^{-\lambda t}}{k!} \cdot \theta e^{-\theta t}\, dt \\
&= \frac{\lambda^k}{k!} \int_0^\infty t^k \theta e^{(\theta+\lambda)t}\, dt \\
&= \frac{\lambda^k}{k!} \int_0^\infty \left(\frac{1}{\theta+\lambda}\right)^k u^{(k+1)-1} \frac{\theta}{\theta+\lambda} e^{-u}\, du \qquad (\text{define } u = (\theta+\lambda)t,\ \text{so } du = (\theta+\lambda)\, dt\,) \\
&= \frac{\lambda^k}{k!} \cdot \frac{\theta}{(\theta+\lambda)^{k+1}} \cdot \Gamma(k+1) \qquad (\text{by Ch.I Eq. 6.4}) \\
&= \left(\frac{\lambda}{\theta+\lambda}\right)^k \cdot \frac{\theta}{\theta+\lambda}
\end{aligned}
$$

□

Example 2

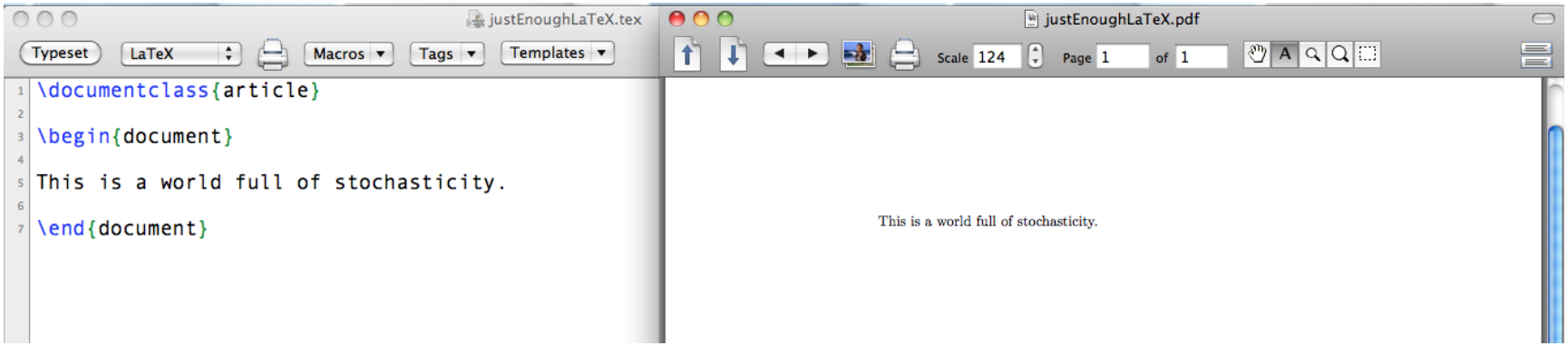
2. Computing Alogrithm

Beaton Sweep Algorithm: Assume that matrix A is $p \times p$. Then to sweep the kth column:

$d \leftarrow a_{kk}$
if $|d| <$ tolerance **then**
  process stops and prints out error message since a_{kk} is approximately zero
end if
for $i = 0$ to $p - 1$ **do**
  $a_{ki} \leftarrow a_{ki}/d$
end for
for $i = 0$ to $p - 1$ and $i \neq k$ **do**
  $b \leftarrow a_{ik}$
  for $j = 0$ to $p - 1$ **do**
    $a_{ij} \leftarrow a_{ij} - b \times a_{kj}$
  end for
  $A_{ik} \leftarrow -b/d$
end for
$a_{kk} = 1/d$

What Is LaTeX?

- LaTeX (pronounced "Lah-tech" or "Lay–tech", no "s") is not WYSIWYG – *What You See Is What You Get*
- Markup language



Installing LaTeX

LaTeX project site: `http://www.latex-project.org/`

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Linux probably has a TeX system including LaTeX; otherwise install TeX Live directly

Mac OS X MacTeX distribution including the program TeXShop

Windows proTeXt system including TeXnicCenter

Typical Writing and Editing Cycle

1. Write LaTeX code
2. Compile
3. View output
4. Return to Step 1 for editing

Basic Rules

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\begin{equation}
x \in \mathbb{R}
\end{equation}
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- Comments in the source file starts with %
- Keys used in a source file:

  a-z A-Z 0-9 + = * / ( ) [ ]

  , ; . ? ! ‘ ’ -

  the space bar, the Tab key, and the Return/Enter key

Special Keys

13 special keys mostly used in LaTeX commands:

```
# $ % & ~ _ ^ \ { } @ " |
```

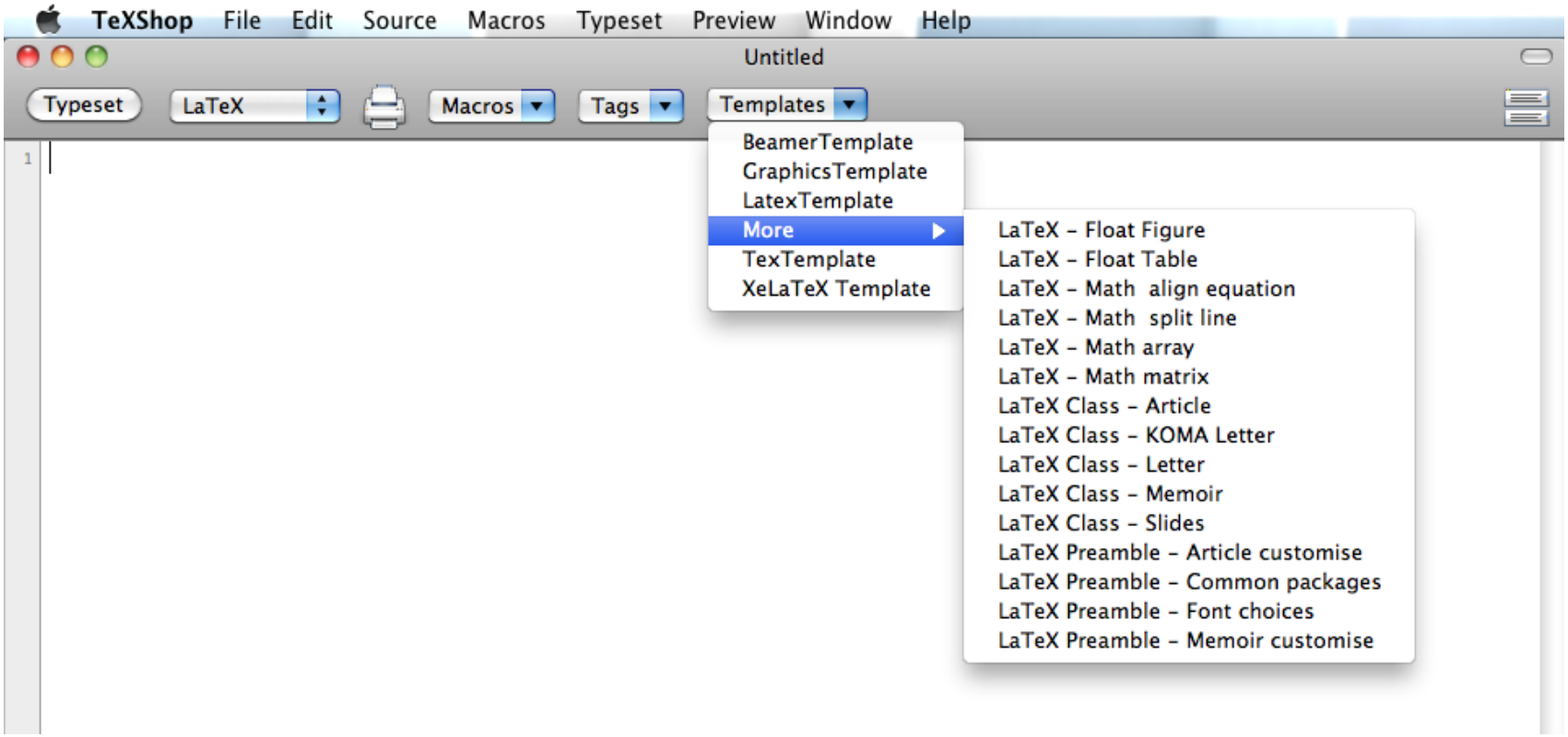
To typeset these characters:

```
\# \$ \% \& \_
```

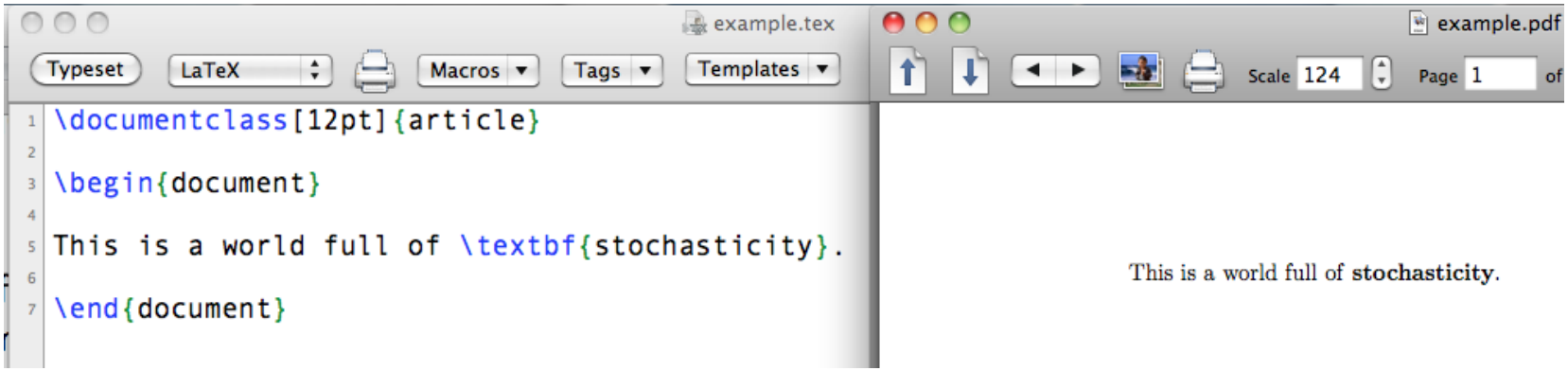
Output:
$ % & _

Creating a Document

Open a new file.
Choose the LaTeX template.



Document Type



Every LaTeX document starts with `\documentclass` command:

```
\documentclass[12pt]{article}
```

Other classes: `letter`, `amsart`, `report`, `book`, `beamer`

General Structure

Packages are loaded at the start of the document using \usepackage.
Put the content between \begin{document} and \end{document} commands:

```
\documentclass[12pt]{article}
\usepackage[letterpaper]{geometry}

\begin{document}
This is a world full of \textbf{stochasticity}.
\end{document}
```

Output:
This is a world full of **stochasticity**.

Title

`\title`, `\author`, `\date` commands

example.tex

Typeset | LaTeX | Macros | Tags | Templates

```
1  \documentclass[12pt]{article}
2  \usepackage[letterpaper]{geometry}
3
4  \title{\LaTeX\ Examples}
5  \author{Angie Zhu}
6  \date{\today}
7
8  \begin{document}
9  \maketitle
10
11 \section{General}
12
13 \subsection{Text}
14
15 This is a world full of \textbf{stochasticity}.
16
17 \end{document}
```

example.pdf

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LaTeX Examples

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1 General

1.1 Text

This is a world full of **stochasticity**.

`\maketitle` within `document` environment

Sections and Subsections

`\section` and `\subsection`

```
\begin{document}
\maketitle

\section{General}

\subsection{Text}

This is a world full

\subsection{Math}
```

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1 General

1.1 Text

This is a world full of **stochasticity**.

1.2 Math

This hierarchy will be numbered automatically.

Spaces

```
This line contains multiple  spaces   between words.

This sentence occupies
multiple
lines.
```

Output:
This line contains more than one spaces between words.
This sentence occupies multiple lines.

Spaces

```
Add vertical space:

\vspace{12pt}

This is another way to break lines \\ other than
a blank line.
```

Output:

Add vertical space:

\vspace{12pt}

This is another way to break lines \\ other than a blank line.

Fonts

Emphasize (italicize) use `\emph{...}` or `{\em ...}` to *emphasize/italicize* word

Boldface use `\textbf{...}` or `{\bf ...}` for **bold** text

Font style use `\texttt{...}` or `{\ttfamily ...}` for `typewriter style` text;
use `\textrm{...}` or `{\rmfamily ...}` for roman style text

Font Sizes

```
{\tiny tiny}
{\scriptsize scriptsize}
{\footnotesize footnotesize}
{\small small}
{\normalsize normalsize}
{\large large}
{\Large Large}
{\LARGE LARGE}
{\huge huge}
{\Huge Huge}
```

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Mathematical Environments

Inline math environments open and close with $, or open with \(and close with with \)

e.g., $x < \infty$ is

```
$x < \infty$
```

Displayed math environments open with \[and close with \], e.g.,

$$\lim_{x \to a} \frac{f(x) - f(a)}{x - a}$$

```
\[
\lim_{x \to a} \frac{f(x) - f(a)}{x - a}
\]
```

Fourier Transform

$$\mathcal{F}(\xi) = \int_{-\infty}^{\infty} f(x) e^{-2\pi i x \xi} dx, \ \forall \xi \in \mathbb{R}$$

```
\[
\mathcal{F}(\xi) = \int_{-\infty}^{\infty}
                    f(x) e^{-2\pi ix\xi} dx,\
              \forall\, \xi \in \mathbb{R}
\]
```

Normal(μ, σ^2) pdf

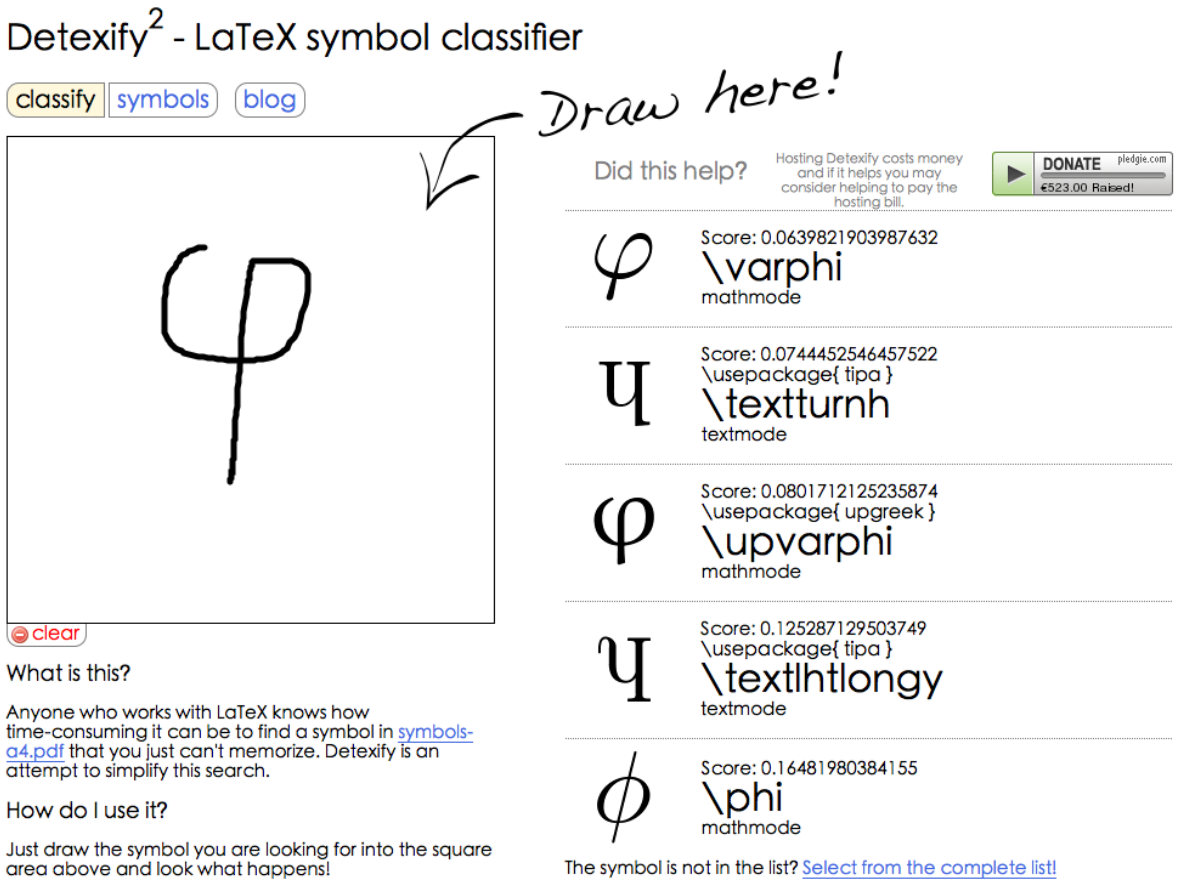
$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2}, \quad -\infty < x < \infty$$

```
\[
f(x) = \frac{1}{\sigma\sqrt{2\pi}}
       e^{-(x-\mu)^2/2{\sigma}^2},\
   - \infty < x < \infty
\]
```

Mathematical Symbols

Detexify^2 - LaTeX symbol classifier:

`http://detexify.kirelabs.org/classify.html`



BibTeX

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- All references in a single plain text file
- Citation referenced using special labeling
- BibTeX tied with LaTeX
- Easy to change the style of the bibliography

Entry

```
@book{t88,
  title={Elements of Statistical Computing},
  author={Thisted, Ronald A.},
  isbn={0412013711},
  year={1988},
  publisher={Chapman \& Hall/CRC},
  address = {New York; London}
}
```

Other entry types: @article, @booklet, @conference, @inbook, @phdthesis, @unpublished, @misc, @manual, @proceedings, etc.

Usage

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```
\bibliographystyle{plain}
\bibliography{myReferences}
```

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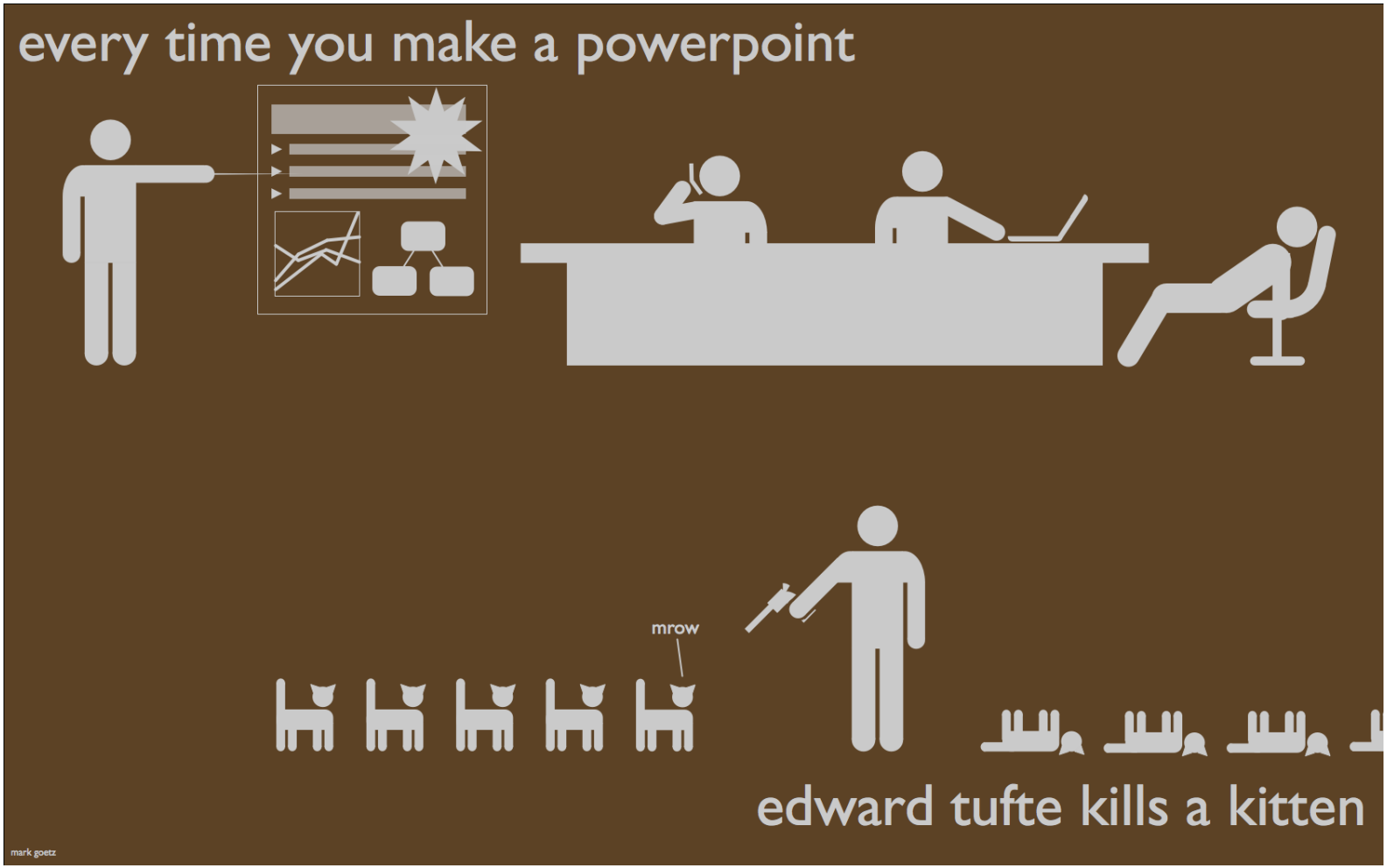
- Compile

Want More?

- MATH 98/198 `http://latex.berkeley.edu/`
- *More Math Into LaTeX* by George Grätzer: highly recommended!
  Examples are available at `http://www.ctan.org/tex-archive/info/examples/Math_into_LaTeX-4/` (containing a short course PDF)
- Tutorials and examples in the Comprehensive TeX Archive Network (CTAN) directory: `CTAN home / tex-archive/ info`
  `http://www.ctan.org/tex-archive/info/`
- WikiBooks LaTeX



LaTeX class `beamer` is great for creating professional presentation slides.