LaTeX: More Than Just Academic Papers and Theses

(first presented at mosc2011)

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Illustration by Duane Bibby

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Contents

PHD Comics by Jorge Cham

Ever Worried about These?

- Is my literature survey strong enough?
- My bibliography/citation formatting got inconsistent.
- My citation and bibliography aren't synchronised!
- My math equations don't display/print correctly.
- Should this discussion go under this section or that?
- What formatting did I use for my subsection headings again?
- Didn't I set that heading to bold and italic 5 minutes ago?
- My section/figure/page numbering's gone all wrong!
- Does this subsection go together with this section?
- Oops, I forgot to update the TOC.
- What results should I put in this table?
- My figure jumped off the page again!
- The application crashed!
- **MY FILE GOT CORRUPTED!!!**

What are TeX and LaTeX, and Friends?

TeX
- From Greek $\tau\epsilon\chi$
- ASCII TeX, /tɛx/, /tɛk/
- A computer typesetting system created by Donald Knuth
- for 'the creation of beautiful books'
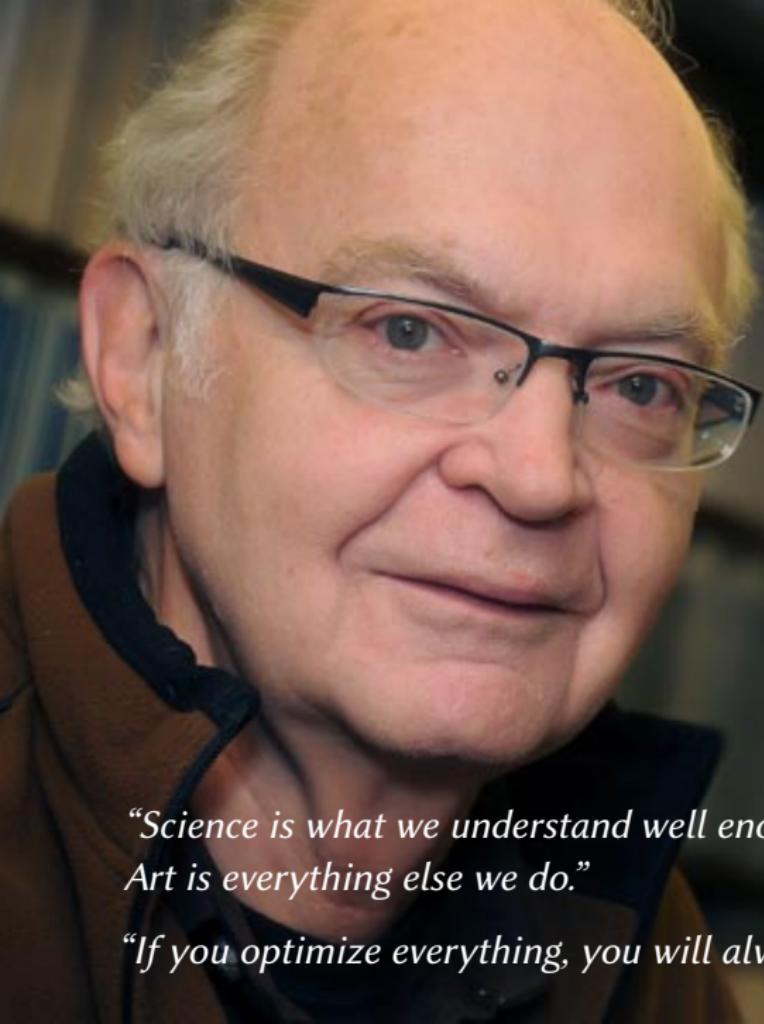
LaTeX
- ASCII LaTeX, /ˈleɪtɛx/, /ˈleɪtɛk/, /ˈlɑːtɛx/, /ˈlɑːtɛk/
- A document preparation system by Leslie Lamport

Binaries
- ε-TeX: additional primitives to TeX
- pdfTeX: additional PDF-related primitives
- XeTeX: native UTF-8 input; can access system fonts
- LuaTeX: includes the Lua scripting engine

Friends
- BibTeX, MakeIndex, METAFONT, METAPOST, …
- http://www.ctan.org/what_is_tex.html

Donald Knuth (1938–)

- American computer scientist, mathematician, and professor emeritus at Stanford University
- Author of the multi-volume work The Art of Computer Programming
- "Father of the analysis of algorithms"
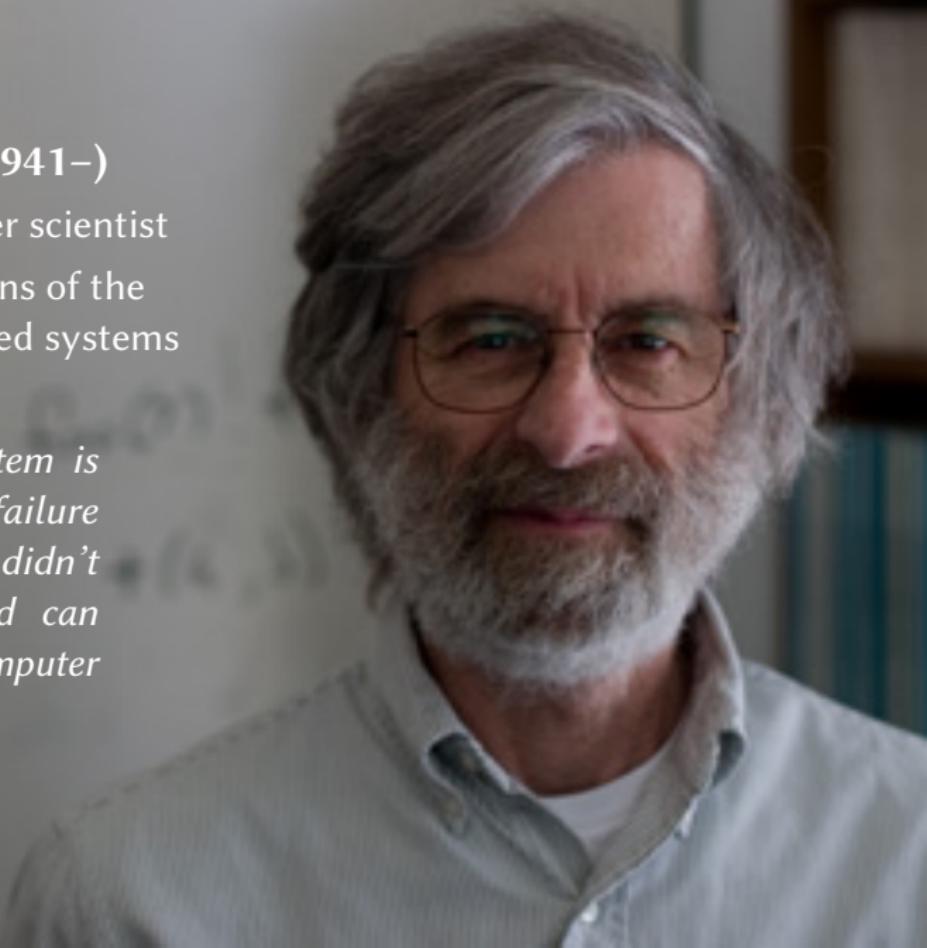
"Science is what we understand well enough to explain to a computer. Art is everything else we do."

"If you optimize everything, you will always be unhappy."

Leslie Lamport (1941–)

- American computer scientist
- Laid the foundations of the theory of distributed systems

"A distributed system is one in which the failure of a computer you didn't even know existed can render your own computer unusable."

Why?
From http://www.ctan.org/what_is_tex.html

Output Quality
- It has the best output.
- It knows typesetting.

Freedom
- It's free.
- It runs anywhere.

Superior Engineering
- It's fast.
- It's stable.
- It's not rigid (extensible).
- Plain text input.
- Many output types.
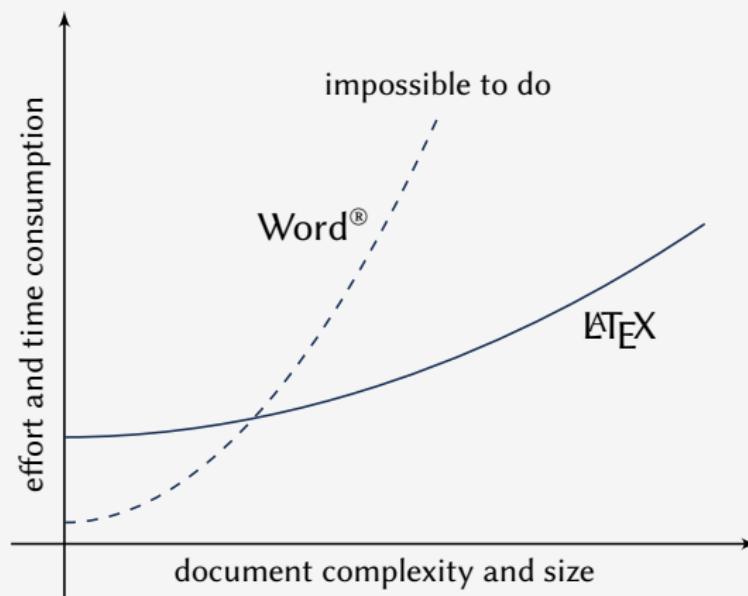
Popularity
- It's the standard (in academia and science).

Typesetting and Word Processing
Apples and Oranges

- Word processors
  - Replacement of mechanical typewriters
  - Word, OpenOffice, AbiWord, …
- Typesetting and Desktop publishing
  - For publication and printing
  - InDesign, QuarkXPress, Scribus…

Scalability

Scalability of LATEX and Microsoft Word® against document size and complexity
(redrawn from Marko Pinteric's original at http://www.pinteric.com/miktex.html)

Professional Typesetting Quality Output

- Typesetting quality and legibility
    - good kerning hinting and correct ligatures
    - inter-word, line and paragraph spacing
    - context-sensitive hyphenation

Table fiery fluffy

This paper outlines an approach to produce a prototype WordNet system for Malay semi-automatically, by using bilingual dictionary data and resources provided by the original English WordNet system. Senses from an English-Malay bilingual dictionary were first aligned to English WordNet senses, and a set of Malay synsets were then derived. Semantic relations between the English WordNet synsets were extracted and re-applied to the Malay synsets, using the aligned synsets as a guide. A small Malay WordNet prototype with 12429 noun synsets and 5805 verb synsets was thus produced. This prototype is a first step towards building a full-fledged Malay WordNet.

Table fiery fluffy

This paper outlines an approach to produce a prototype WordNet system for Malay semi-automatically, by using bilingual dictionary data and resources provided by the original English WordNet system. Senses from an English-Malay bilingual dictionary were first aligned to English WordNet senses, and a set of Malay synsets were then derived. Semantic relations between the English WordNet synsets were extracted and re-applied to the Malay synsets, using the aligned synsets as a guide. A small Malay WordNet prototype with 12429 noun synsets and 5805 verb synsets was thus produced. This prototype is a first step towards building a full-fledged Malay WordNet.

- Correct mathematical typesetting (spacing etc)

$$W_\psi(f)(a,b) = \frac{1}{\sqrt{a}} \int_{-\infty}^{\infty} f(t)\psi\left(\frac{t-b}{a}\right) dt$$

$$W_\psi(f)(a,b) = \frac{1}{\sqrt{a}} \int_{-\infty}^{\infty} f(t)\psi\left(\frac{t-b}{a}\right) dt$$

Where Would I Want to Use LaTeX?

- Beautiful typographic output (OK not everyone cares that much…)
- Documents with complex structures
- Lots of mathematics (or other specific needs)
- When publishers require them
- Batch processing of data into reports, etc.
- Back-end of other applications

This is not a Word Processors vs LATEX debate.

- It's a 'teaser' preview of an alternative tool.
- Some word processors also provide mechanisms to handle same routine tasks (with varying degrees of ease, consistency and stability)
- Use the best tool for the task at hand.
- **You** are the best judge to decide for yourself.

How Do I Use It?

1. Write a plain text LaTeX file (.tex)
2. Run it through pdflatex or xelatex → PDF output
   (or latex + dvips + ps2pdf for DVI + PS + PDF)
3. Run bibtex and/or makeindex to process bibliographies, indices
4. Re-run pdflatex to resolve references and pointers

Example .tex File

```latex
\documentclass[a4paper,11pt]{article}
\author{Lim Lian Tze}
\title{An Introductory Paper}
\date{\today}
\usepackage[english]{babel}

\begin{document}
\maketitle
\tableofcontents

\begin{abstract}
This paper introduces\ldots
\end{abstract}

\section{Introduction}
We consider\ldots

\section{State of the Art}
We look at\ldots

\subsection{Document Formats}
There are many\ldots
\end{document}
```

pdflatex

An Introductory Paper

Lim Lian Tze

June 7, 2011

Contents

1 Introduction 1
2 State of the Art 1
  2.1 Document Formats 1

Abstract

This paper introduces...

1 Introduction

We consider...

2 State of the Art

We look at...

2.1 Document Formats

There are many...

1

Where Do I Get It?

Online	Overleaf (www.overleaf.com)
Windows	MikTeX, TeXLive
Un*x, GNU/Linux	TeXLive
Mac OS X	MacTeX (based on TeXLive)
Installation	Use your OS' package manager (or download manually)
Editors	vi, emacs, Texmaker, TeXworks, Texstudio, TeXshop…
LaTeX Packages	Use MikTeX or TeXLive's package manager
Documentation	(Online) http://texdoc.net/pkg/<packagename> (TeXLive) $ texdoc <package name> (MikTeX) $ mthelp <package name>

Easy to Learn, Hard to Master

- Customising may not be straightforward (vs word processors)
- Intentionally so: Style guidelines should be followed strictly
    - Publisher/organisation provides document class or style files
    - Use these to take care of formatting and styling, focus on the content
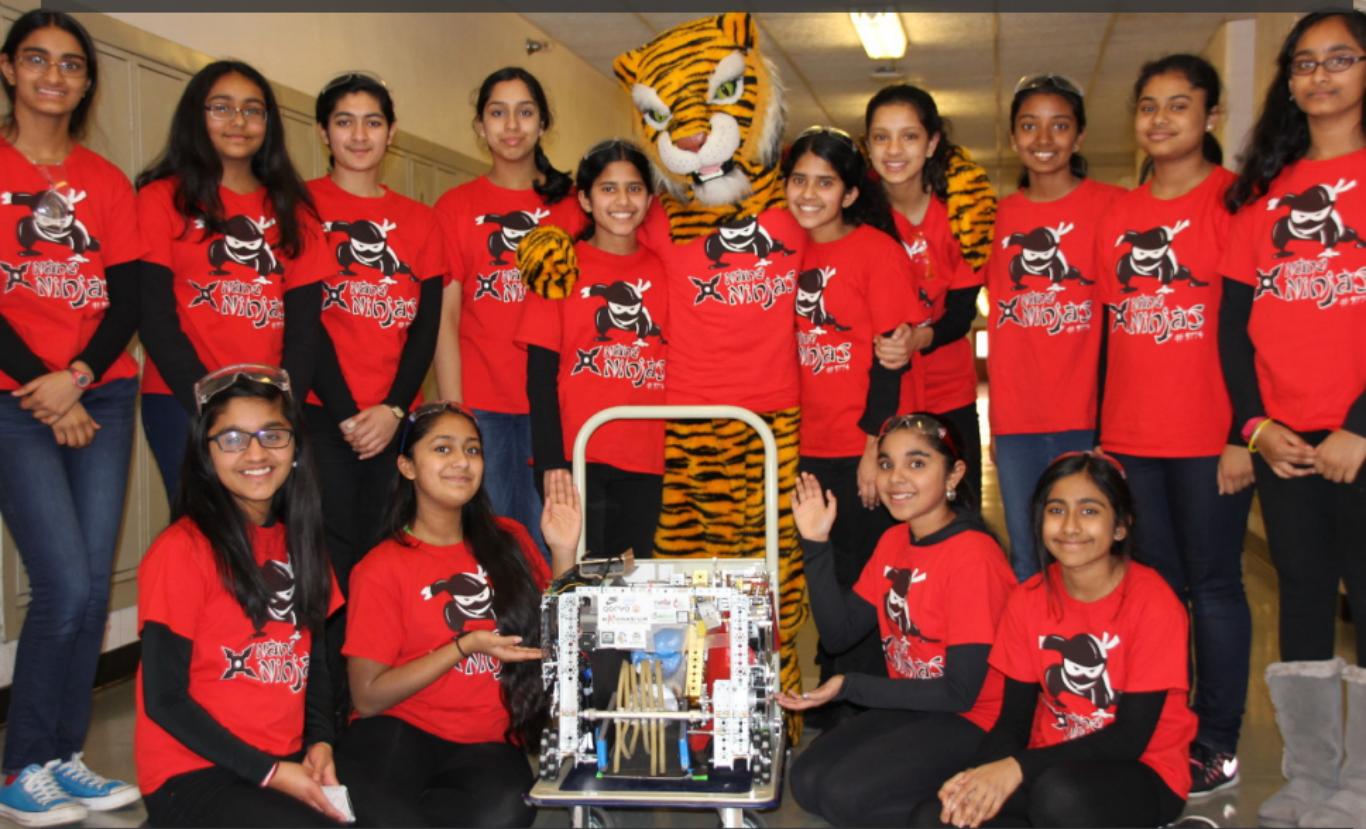
Too hard, only for engineers/mathematicians?

- I once guided a student in the humanities to learn authoring Chinese LATEX documents entirely through e-mail
- Recently a 75-year-old user transitioned to LATEX on Overleaf to write a book (with indices, end notes, cross references)
- Professor in Finance at Trinity College transitioned to LATEX successfully (https://www.overleaf.com/blog/299)
- Linguists, psychologists, biostatistics (integrating with R), legal profession...

Prof Brian Lucey, Trinity College, Dublin

Collaboratively wrote an engineering notebook with **300+ pages** in LaTeX as part of their FIRST Tech Challenge win (https://www.overleaf.com/read/hkxzqcncngyv)

So, What Can LATEX Do?

Contents

Basic Types

Books

```latex
\documentclass{book}
\author{...}
\title{...}

\begin{document}
\maketitle
\chapter{...}
\section{...}
...
\subsection{...}
\end{document}
```

Basic Types (cont'd)

Articles

```latex
\documentclass{article}
\author{...}
\title{...}

\begin{document}
\maketitle
\section{...}
...
\subsection{...}
\end{document}
```

Journal and Conference Proceedings Articles

IEEE

`\documentclass{IEEEtran}`

ACM

`\documentclass{sig-alternate}`

LLNCS

`\documentclass{llncs}`

Some Goodies

- Quick language-switching with babel
- Automatic generation of cross-referencing labels:
  \section{Introduction}**\label**{sec:intro}
  ... We saw in section **\ref**{sec:intro}...
- Automatic generation of lists:
  \tableofcontents, **\listoffigures**, **\listoftables**
- Automatic generation of bibliographies and indices:
  \cite{Knuth:1976}...**\bibliography**{references.bib}
  ...the Linux kernel**\index**{Linux!kernel}... **\printindex**
- Fully hyperlinked PDF with bookmarks: **\usepackage**{hyperref}
- Inclusion of selected pages from other PDFs
  (while inserting new page headers/footers!)
  \usepackage{pdfpages}
  \includepdf[pages={1,3-5,8},pagecommand=**\thispagestyle**{plain}]{file.pdf}

Multilingual LᴬTEX

X∃LᴬTEX, LuaLᴬTEX Unicode input

LᴬTEX Various packages (sometimes with transcriptions: `nan^ri`, `salAm`)

University Theses

Universiti Sains Malaysia **\documentclass**{usmthesis}

Highly Configurable Documents

`memoir` and KOMA-Script Classes
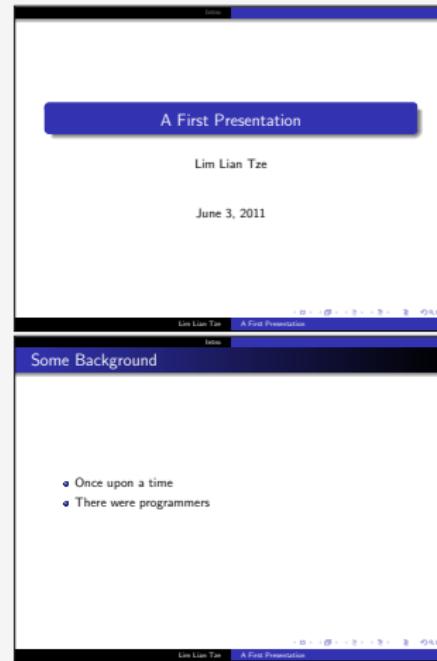
- Sectional headings
- Running headers and footers
- Good font, colour and illustration choices
- http://latex-my.blogspot.com/search/label/bookdesign

Presentation Slides

- This presentation was made with LaTeX!
- Many possible classes: powerdot, beamer

```
\documentclass{beamer}
\usetheme{Warsaw}

\author ...

\begin{document}
\titleframe

\section{Intro}

\begin{frame}
\frametitle{Some Background}
...
\end{frame}
\end{document}
```

Oversized Posters

- Many possible solutions:
  sciposter, flowfram, beamerposter, tikzposter

```latex
\documentclass{beamer}
\usepackage[orientation=portrait,
↪ size=a0]{beamerposter}
\usetheme{...}
\author ... % Meta-information

\begin{document}
\begin{frame}
... % Poster contents goes here
\end{frame}
\end{document}
```

Leaflets

- `leaflet`: arrange contents into 6 pages on a foldable double-sided sheet
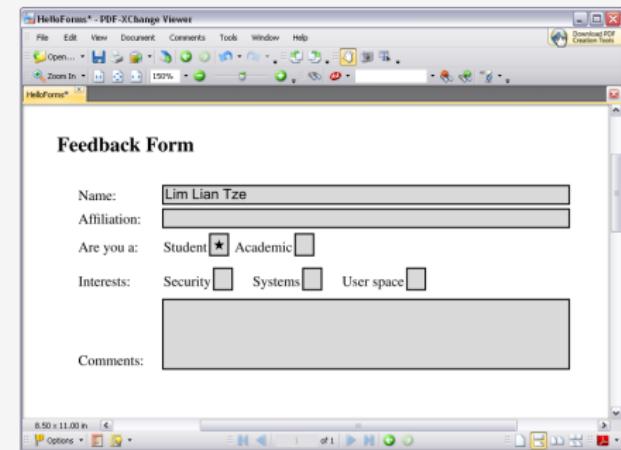
```
\documentclass[foldmark,a4paper]
{leaflet}
\author ... % Meta-information

\begin{document}
\maketitle
\section ...
... % Leaflet contents
\end{document}
```

Fillable PDF Forms

```latex
\usepackage{hyperref}
... % various settings skipped
\TextField{Name:}\\
\TextField{Affiliation:}\\
\ChoiceMenu[radio=true]
{Are you a:}{Student, Academic}\\
Interest:
\CheckBox{Security}
\CheckBox{Systems}
\CheckBox{User space}\\
\TextField[multiline=true]
{Comments:}\\
```

Fillable PDF Forms (cont'd)

Use with caution!
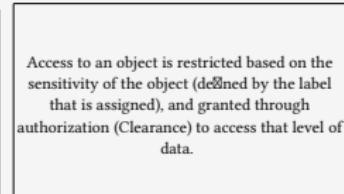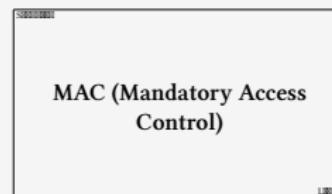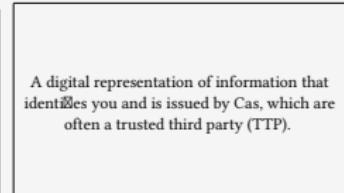
- `poppler`-based viewers (`evince`, `xpdf`, `okular`)
    - Problem displaying and saving radio/check boxes correctly
    - Saved forms can't be opened by other viewers
- Adobe Reader
    - Cannot save filled form as PDF unless Acrobat is installed
    - Only as field-and-value text file
    - Can provide "Submit" button for submission to a URL
    - Or print hard copy of filled form!
- PDF XChange Viewer
    - Best freeware for filling and saving LATEX-created forms
    - Windows only
    - Not OSS

Flash Cards

```latex
\documentclass[avery5388,frame]
{flashcards}
\cardfrontstyle{headings}
\cardfrontfoot{Linux}

\begin{document}
\begin{flashcard}[Security]
{Certificate}
...
\end{flashcard}

\begin{flashcard}[Security]
{MAC ...}
...
\end{flashcard}
\end{document}
```

Certificate	A digital representation of information that identifies you and is issued by Cas, which are often a trusted third party (TTP).
MAC (Mandatory Access Control)	Access to an object is restricted based on the sensitivity of the object (defined by the label that is assigned), and granted through authorization (Clearance) to access that level of data.

Examination Paper

```latex
\documentclass{exam}
...
\begin{questions}\printanswers
\question[5]
What is Paul McCartney's middle name?
\begin{oneparchoices}
\choice John \CorrectChoice Paul
\choice Ringo \choice James
\end{oneparchoices}

\question[10] What was the Beatles' first
↪single in 1962?
\begin{solution}Love Me Do\end{solution}

\question
\begin{parts}
\part[5] What was George's inspiration for
↪`While My Guitar Gently Weeps'?
\begin{solution}
He opened a random book and saw the words
↪``gently weep''.
\end{solution}
...
\end{questions}
```

1. What is Paul McCartney's middle name?   (5)
   A. John   **B. Paul**   C. Ringo   D. James

2. What was the Beatles' first single in 1962?   (10)

   > **Solution:** Love Me Do

3. (a) What was George's inspiration for 'While (5)
   My Guitar Gently Weeps'?

   > **Solution:** He opened a random book
   > and saw the words "gently weep".

   (b) Who guest-performed for the song and why? (5)

   > **Solution:** Eric Clapton; he wanted a
   > spiffy guitar solo.

Contents

Mathematics
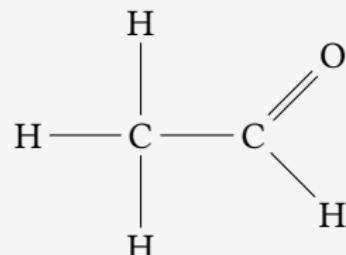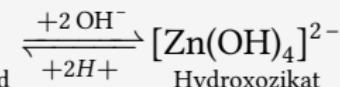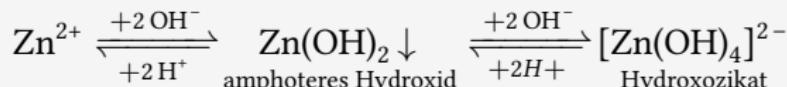
(1) relates the golden ratio and the Fibonacci series.
Recall that the golden ratio, $\varphi = \frac{1}{2}(1 + \sqrt{5})$.

$$\varphi = 1 + \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{F_n F_{n+1}} \tag{1}$$

```
\eqref{eq:gratio} relates the golden ratio and the Fibonacci series.
Recall that the golden ratio, $\phi = \frac{1}{2} (1 + \sqrt{5})$.

\begin{equation}\label{eq:gratio}
\phi = 1 + \sum^{\infty} _{n=1}
               \frac{ (-1)^{n+1} }{ F_n F_{n+1} }
\end{equation}
```

Chemical Equations and Molecules

$$Zn^{2+} \xrightleftharpoons[+2\,H^+]{+2\,OH^-} \underset{\text{amphoteres Hydroxid}}{Zn(OH)_2 \downarrow} \xrightleftharpoons[+2H+]{+2\,OH^-} \underset{\text{Hydroxozikat}}{[Zn(OH)_4]^{2-}}$$


```
\usepackage[version=3]{mhchem}    % sufficient for chemical equations
\usepackage{chemfig}    % for 2-D molecule drawings
...
\ce{Zn^2+ <=>[\ce{+ 2OH-}][\ce{+ 2H+}]
$\underset{\text{amphoteres Hydroxid}}{\ce{Zn(OH)2 v}}$
<=> C[+2OH-][{+ 2H+}]
$\underset{\text{Hydroxozikat}}{\cf{[Zn(OH)4]^2-}}$ }

\chemfig{H-C(-[2]H)(-[6]H)-C(-[7]H)=[1]O}
```

Linguistics

(1) *%*Wen liebt seine Mutter?*
     Whom loves his mother
     'Who does his mother

```
\usepackage{linguex,qtree}
...
\ex
\begingl
\gla \%*Wen liebt seine Mutter?//
\glb Whom loves his mother//
\glc `Who does his mother love?'//
\endgl
\xe
```

S
NP   VP
Pron   V   NP
He   kicked Det   N
              the   ball
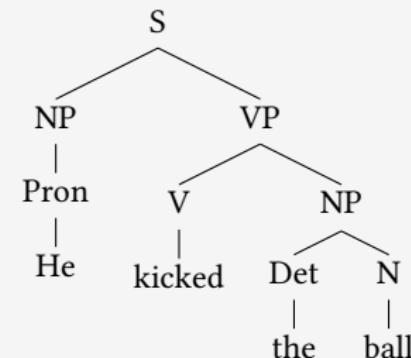
```
\usepackage{qtree}
...
\Tree [ .S [.NP [.Pron He ] ] [.VP
↪[.V kicked ] [.NP [.Det the ] [.
↪N ball ] ] ] ]
```

Program Listings
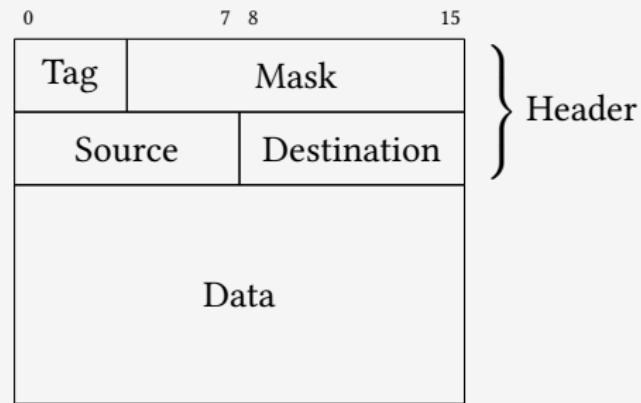
```latex
\usepackage{listings,xcolor}
...
\begin{lstlisting}
[language=C,columns=fullflexible,
basicstyle=\ttfamily,
keywordstyle=\bfseries\color{red},
commentstyle=\sffamily\color{green},
stringstyle=\rmfamily\color{orange}]
#include <stdio.h>
/*
 | Prints "hello world"
 */
int main(void)
{
    printf("hello, world\n");
    return 0;
}
\end{lstlisting}
```

```c
#include <stdio.h>

/*
| Prints "hello world"
*/
int main(void)
{
    printf("hello, world\n");
    return 0;
}
```

Network Protocols

```latex
\usepackage{bytefield}
...
\begin{bytefield}{16}
\bitheader{0,7,8,15} \\
\begin{rightwordgroup}{Header}
\bitbox{4}{Tag} & \bitbox{12}{Mask} \\
\bitbox{8}{Source} &
\bitbox{8}{Destination}
\end{rightwordgroup} \\
\wordbox{3}{Data}
\end{bytefield}
```
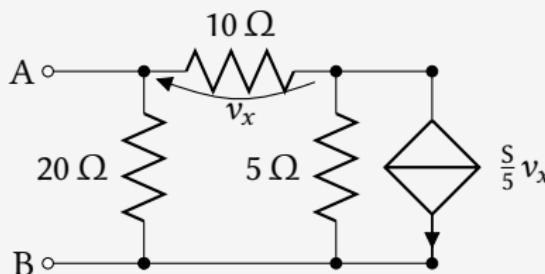
Life Sciences

first case (see text)
↓

```
AQP1.PRO  TLGLLLSCQISILRAVMYIIAQCVGAIVASAIL    112
AQP2.PRO  TVACLVGCHVSFLRAAFYVAAQLLGAVAGAAIL    104
AQP3.PRO  TFAMCFLAREPWIKLPIYTLAQTLGAFLGAGIV    112
AQP4.PRO  TVAMVCTRKISIAKSVFYITAQCLGAIIGAGIL    133
AQP5.PRO  TLALLIGNQISLLRAVFYVAAQLVGAIAGAGIL    105
```

second case (see text)
↑

```latex
\usepackage{texshade}    % for nucleotide and peptide alignments
...
\begin{texshade}{AQPpro.MSF.txt}
\shadingmode{similar}
\threshold[80]{50}
\setends{1}{80..112}
\hideconsensus
\feature{top}{1}{93..93}{fill:$\downarrow$}{first case (see text)}
\feature{bottom}{1}{98..98}{fill:$\uparrow$}{second case (see text)}
\end{texshade}
```

Circuits and SI Units

- 3.45×10^4 V^2 lm^3 F^{-1}
- 40 km/h, 85 km/h and 103 km/h

```
\usepackage{siunitx}
\usepackage[siunitx]{circuitikz}
...
\begin{circuitikz}
\draw (0,0) node[anchor=east] {B}
  to[short, o-*] (1,0)    to[R=20<\ohm>, *-*] (1,2)
  to[R=10<\ohm>, v=$v_x$] (3,2) -- (4,2)
  to[ cI=$\frac{\si{\siemens}}{5} v_x$, *-*] (4,0) -- (3,0)
  to[R=5<\ohm>, *-*] (3,2)
  (3,0) -- (1,0)    (1,2) to[short, -o] (0,2) node[anchor=east]{A}
;\end{circuitikz}

\SI{3.45d4}{\square\volt\cubic\lumen\per\farad}
\SIlist[per-mode=symbol]{40;85;103}{\kilo\metre\per\hour}
```

Meh, What Good is That? Can't Use it Anywhere Else.

Actually, you can.

```latex
\usepackage[active,tightpage]{preview}
\PreviewEnvironment{texshade}
...
\begin{texshade}
...
\end{texshade}
```

- Run pdflatex → cropped PDF containing *only* contents of texshade
- ImageMagick: convert -depth 150 texshade.pdf texshade.png
- Multiple environments → multi-page PDF and multiple PNGs

Bar Codes

ISBN 978-3-86541-114-3
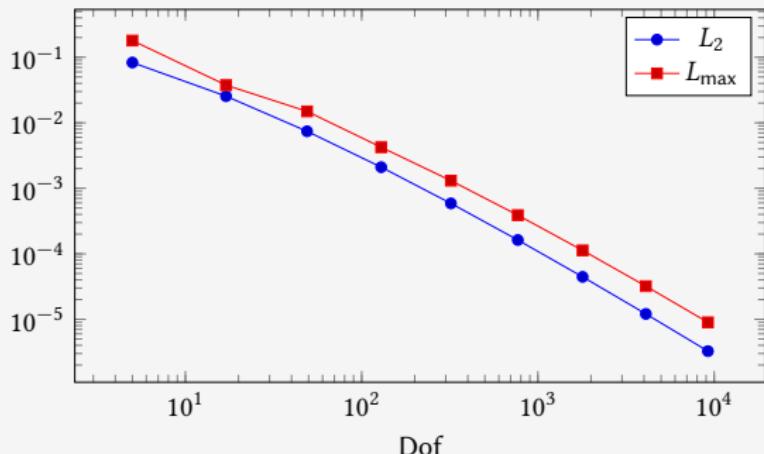
```
\usepackage{auto-pst-pdf}    % Needed if running pdflatex; must use option -shell-escape
\usepackage{pstricks,pst-barcode}

...
\begin{pspicture}
\psbarcode{MECARD:N:Malaysia Open Source Conference...}{eclevel=L}{qrcode}
\psbarcode{9781860742712}{includetext guardwhitespace}{ean13}
\psbarcode{978-3-86541-114}{includetext guardwhitespace}{isbn}
\psbarcode{LE28HS9Z}{includetext}{royalmail}
\psbarcode{^453^178^121^239}{columns=2 rows=10}{pdf417}
\end{pspicture}
```

Graph Plots


```
\usepackage{pgfplots}
...
\begin{tikzpicture}
\begin{loglogaxis}[xlabel=Dof]
\addplot table[x=dof,y=L2]{datafile.dat};  \addlegendentry{$L_2$};
\addplot table[x=dof,y=Lmax]{datafile.dat};  \addlegendentry{$L_\text{max}$};
\end{loglogaxis}
\end{tikzpicture}
```
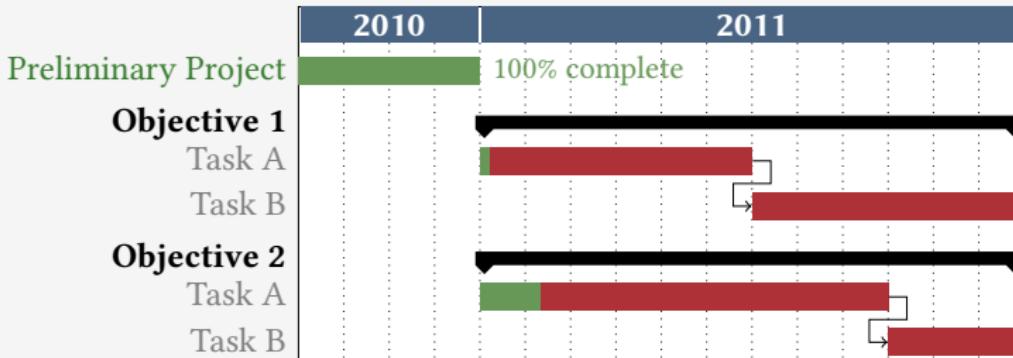
Spreadsheets
(Seriously, use a proper spreadsheet application for complex stuff.)

Year ending Mar 31	2009	2008	2007
Revenue	14580.20	11900.40	8290.30
Cost of sales	6740.20	5650.10	4524.20
Gross profit	7840.00	6250.30	3766.10
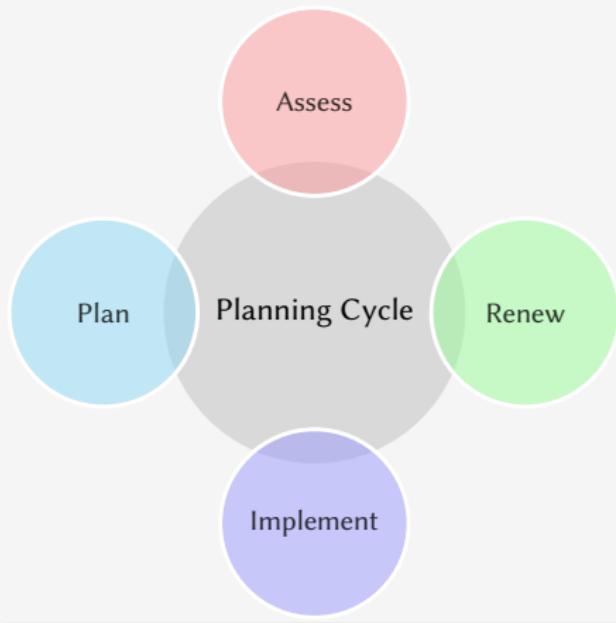
```
\STautoround*{2}
\begin{spreadtab}{{tabular}{l rrr}}
@Year ending Mar 31 & @2009 & @2008 & @2007\\ \hline
@Revenue & 14580.2 & 11900.4 & 8290.3\\
@Cost of sales & 6740.2 & 5650.1 & 4524.2\\ \cline{2-4}
@\emph{Gross profit} & \STcopy{>}{b2-b3} & &\\ \cline{2-4}
\end{spreadtab}
```

Gantt Charts
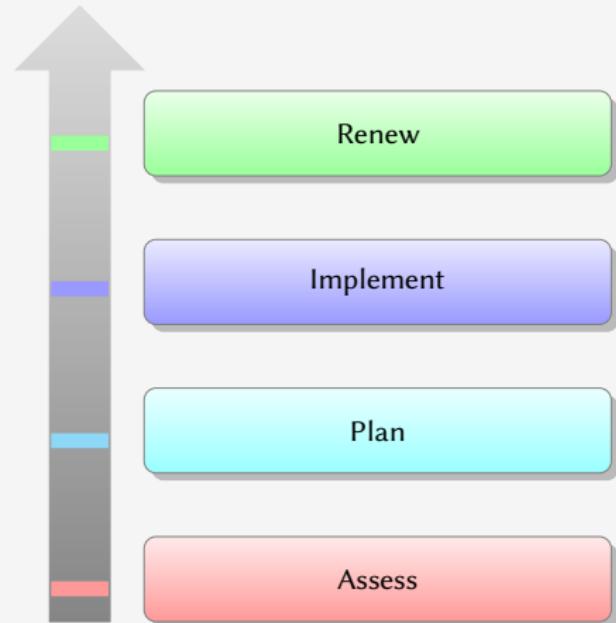

```latex
\usepackage{pgfgantt}
...
\begin{ganttchart}[...settings...]{1}{16}
\gantttitle{2010}{4} \gantttitle{2011}{12} \\
\ganttbar[progress=100]{Preliminary Project}{1}{4} \\
\ganttgroup{Objective 1}{5}{16} \\
\ganttbar[progress=4, name=T1A]{Task A}{5}{10} \\
\ganttlinkedbar[progress=0]{Task B}{11}{16} \\
...
\end{ganttchart}
```

'Smart Diagrams'


```
\usepackage{smartdiagram}
\smartdiagram[bubble diagram]{
  Planning Cycle,Assess,Plan,
  Implement,Renew}
```
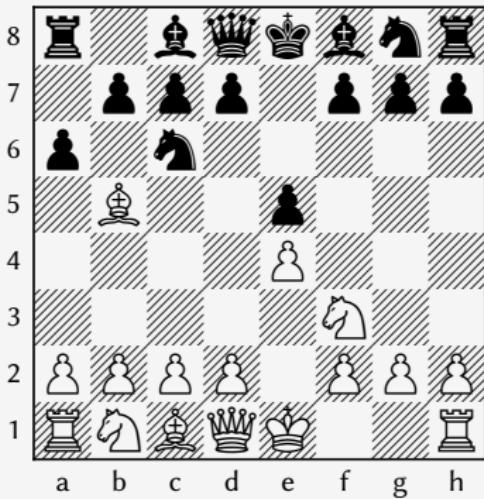
```
\usepackage{smartdiagram}
\smartdiagram
  [priority descriptive diagram]{
  Assess,Plan,Implement,Renew}
```
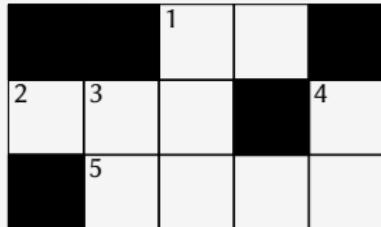
Chess games

1 e4 e5 2 ♘f3 ♘c6 3 ♗b5 a6

```
\usepackage[skaknew]%
{skak,chessboard}
...
\newgame
\mainline{1. e4 e5 2. Nf3 Nc6 3.
↪Bb5 a6}
\chessboard[smallboard]
```

Crossword Puzzles

Across: 1 unit of measure 2 ∗ 5 sectioning unit

Down: 1 η 3 unit of measure 4 nonproportional font

```latex
\usepackage{cwpuzzle}
...
\begin{Puzzle}{5}{3}
|* |* |[1]E|X |* |.
|[2]A|[3]S|T |* |[4]T|.
|* |[5]P|A |R |T |.
\end{Puzzle}
\begin{PuzzleClues}{
\textbf{Across:} }
  \Clue{1}{EX}{unit of measure}
```

```latex
  \Clue{2}{AST}{\(\ast\)}
  \Clue{5}{PART}{sectioning unit}
\end{PuzzleClues}
\begin{PuzzleClues}{
\textbf{Down:} }
  \Clue{1}{ETA}{\(\eta\)}
  \Clue{3}{SP}{unit of measure}
  \Clue{4}{TT}{nonproportional font}
\end{PuzzleClues}
```

Song Books with Guitar Tabs

Country road, take me home, to the place I belong.

West Virginia, mountain momma, take me home, country road.

```
\usepackage{gchords,guitar}
...
\begin{guitar}
\newcommand{\CMaj}{\chord{t}{n,p3,p2,n,p1,n}{C}}
\newcommand{\Amin}...
Country [\CMaj]road, take me [\GMaj]home, ...
\end{guitar}
```

Contents

Summary
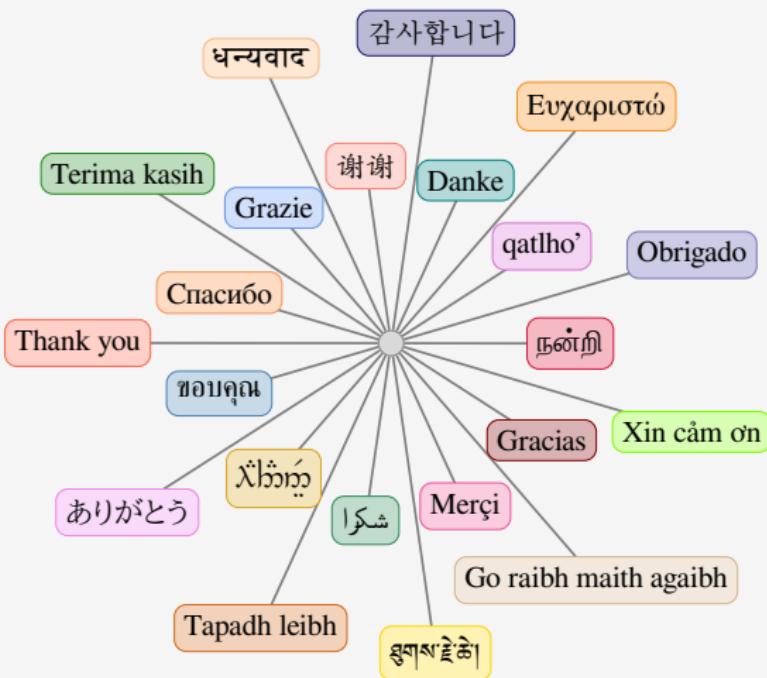
- LATEX
    - a document preparation system
    - professional quality typesetting output
- Output artefacts
    - Academic: papers, theses, books
    - Dedicated document types
    - Domain-specific material
- Usage scenario
    - Direct authoring
    - Automatic generation (via scripts etc)
    - As back-end of other applications

감사합니다

धन्यवाद

Ευχαριστώ

Terima kasih

谢谢

Danke

Grazie

qatlho'

Obrigado

Спасибо

Thank you

நன்றி

ขอบคุณ

Xin cảm ơn

Gracias

ཨ་ཧྥེ་མེ།

ありがとう

Merçi

شكرا

Go raibh maith agaibh

Tapadh leibh

བྱིནས་རྗེ་ཆེ།

Questions? liantze@gmail.com, support@overleaf.com
http://tex.stackexchange.com

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