Introduction to LaTeX

David Squire

David.Squire@csse.monash.edu.au

Room 134, Building 75, Clayton
Room 5.23A B Block, Caulfield
9905 8307 (Cl) 9903 1033 (Ca)

Adapted from "The Not So Short Introduction to LATEX2e" by Tobias Oetiker
http://www. ctan.org/tex-archive/info/lshort/english/

Preface

- LaTeX is a *typesetting system* (*not* a word processor)
- It is most suited to producing scientific and mathematical documents of high typographical quality.
- LaTeX uses TeX as its formatting engine.
- This short introduction describes LaTeX2e and should be sufficient for most applications of LaTeX.

Outline

- Things you need to know...
- Typesetting text
- Typesetting mathematics
- Including graphics
- Bibliographies
- Setting up your UNIX account to use LaTeX
- Running LaTeX
- Links to further resources

Things you need to know

- The Name of the Game
- Basics
- LaTeX Input Files
- Input File Structure
- The Layout of the Document

The Name of the Game (1)

- TEX
  - TeX was written by the legendary computer scientist Donald E. Knuth: http://www-cs-faculty.stanford.edu/~knuth/
  - It is intended primarily for typesetting text and mathematical formulae.
  - The "X" stands for the Greek letter *Chi*. TeX is pronounced "Tech" with a "ch" as in the German word "Ach" or in Scottish "Loch".
  - It is definitely is *not* pronounced "ks"
  - In an ASCII environment TEX becomes TeX.

The Name of the Game (2)

- LATEX
- LaTeX is a macro package which enables authors to typeset their work at the highest typographical quality, using a predefined, professional layout.
- LaTeX was originally written by Leslie Lamport . It uses the TeX for typesetting.
- In 1995 the LaTeX package was updated by the LaTeX3 team. This version is called LaTeX2e.
- This document treats LaTeX2e.

Basics

- Author, Book Designer, and Typesetter
- Layout Design
- Advantages and Disadvantages

Author, Book Designer, and Typesetter (1)

- The traditional publishing process:
  - author gives manuscript to a publishing company.
  - a book designer from the publishing company decides the layout of the document (column width, fonts, etc.)
  - the book designer writes his instructions into the manuscript and gives it to a typesetter
  - the typesetter typesets the book according to these instructions.
- A human book designer tries to find out what the author had in mind while writing
  - He decides on chapter headings, citations, examples, formulae, etc. based on his *professional knowledge* and the contents of the manuscript.

Author, Book Designer, and Typesetter (2)

- LaTeX takes the role of the book designer and uses TeX as its typesetter.
- But LaTeX is "only" a program and therefore needs more guidance.
- The author has to provide additional information which describes the ***logical structure*** of his work.
- This information is written into the text as "LaTeX commands."
- This is quite different from the popular WYSIWYG approach (e.g. MS Word (without using styles properly – and even then it's hard)).
  - "Good" HTML is another example of a system that focuses on logical markup rather than formatting, e.g.
    <H1>Heading</H1>
    rather than
    <FONT SIZE="+3" FACE="ARIAL"><B>Heading</B></FONT>

Layout Design (1)

- Typographical design is a craft:
  - Unskilled authors often commit serious formatting errors by assuming that book design is a question of aesthetics

    "If a document looks good artistically it is well designed."
    - » This is *not* true!
  - A document has to be read, not hung up in a picture gallery
  - The readability and understandability of a document are much more important than its beauty, e.g.
    - » The font size and numbering of headings must be chosen to make the structure of chapters and sections clear to the reader.
    - » The line length must be short enough so as not to strain the reader's eyes, but long enough to fill the page beautifully.

Layout Design (2)

- With WYSIWYG systems, authors often generate aesthetically pleasing documents with very little, or inconsistent, structure
- LaTeX prevents such formatting errors by forcing the author to declare the *logical structure* of the document
  - LaTeX chooses the most suitable layout
- Logical mark-up also improves the portability of documents
  - Journals can use stylesheets to translate the logical mark-up into their in-house layout style

Advantages and Disadvantages (1)

- Advantages of LaTeX over WYSIWYG:
  - professionally crafted layouts are available
  - the typesetting of mathematical formulae is supported in a convenient way
  - users need only to learn a few simple commands, which specify the logical structure of a document. They almost never need to tinker with the actual layout of the document
  - complex structures such as footnotes, references, table of contents, and bibliographies can be generated easily
  - for many typographical tasks not directly supported by basic LaTeX, there exist free add-on packages
  - LaTeX encourages authors to write well structured texts
  - LaTeX is highly portable and free

Advantages and Disadvantages (2)

- LaTeX also has some disadvantages:
  - What you see is not what you get.
    - » Is this really a disadvantage? Why are you thinking about layout instead of content?
  - More resources (memory, disk-space, computing power) are required to run a LaTeX system than a *simple* word processor, But
    - » Word for Windows 6.0 needs even more disk space than a normal LaTeX system.
    - » When it comes to processor usage, LaTeX beats any WYSIWYG system, as it only needs a lot of CPU time when a document is actually processed
  - The design of a whole new layout is difficult and takes a lot of time.

LaTeX Input Files

- The input for LaTeX is a plain ASCII text file.
- You can create it with *any* text editor.
- It contains
  - the text of the document
  - commands which tell LaTeX how to typeset the text.
    - » Spaces
    - » Special Characters
    - » LaTeX Commands
    - » Comments

Spaces

- **Whitespace characters (e.g. blank, tab, *single* linebreak) are treated uniformly as "space" by LaTeX.**
  - **Several consecutive whitespace characters are treated as one ``space''.**
- **An empty line between two lines of text defines the end of a paragraph.**
  - **Several empty lines are treated in the same way as one empty line.**

It does not matter whether you enter
one of several spaces after a word.
An empty line starts a new paragraph.

```
It does not matter      whether you
enter one or    several spaces
after a word.

An empty line starts a new
paragraph.
```


Special Characters

- **The following symbols are reserved characters, that either**
  - **have a special meaning in LaTeX**
  - **are not available in all the fonts.**

**$ & % # _ { } ~ ^ **

- **Some of these characters can be used in your documents by adding a prefix backslash:**

```
$ & % # _ { }                    \$ \& \% \# \_ \{ \}
```

- **The other symbols (and many more!) can be printed with special commands in mathematical formulae or as accents.**

LaTeX Commands (1)

- **LaTeX commands are case sensitive and take one of two formats:**
  - **They start with a backslash \ and have a name consisting only of letters. Command names are terminated by a space, a number or any other "non-letter".**
  - **They consist of a backslash and exactly one special character.**
- **LaTeX ignores whitespace after commands.**
  - **If you want to get a space after a command, you have to put either {} and a blank or a special spacing command after the command name.**

I read that Knuth divides people working with TeX into TeXnicians and TeXperts Today is March 25th, 2004.

```
I read that Knuth divides people
working with \TeX{} into
\TeX{}nicians and \TeX perts. Today
is \today.
```


LaTeX Commands (2)

- **Some commands take a parameter which has to be given between curly braces { } after the command name.**
- **Some commands support optional parameters which are added after the command name in square brackets [ ].**
- **The next example uses some LaTeX commands. Don't worry about them, they will be explained later.**

This is *emphasized* text.

Please start a new line right here!
Thank you!

```
This is \emph{emphasized}
text.

Please start a new line right
here!\linebreak[3] Thank you!
```

Comments

- When LaTeX encounters a % character while processing an input file, it ignores the rest of the present line.
- This is useful for adding notes to the input file, which will not show up in the printed version.

This text is processed.

```
This text is processed. % A comment isn't
```


Input File Structure (1)

- When LaTeX2e processes an input file it expects it to follow a certain structure. Every input file starts with the command:

```
\documentclass{...}
```

  - This specifies what sort of document you intend to write (article, letter, book, cssethesis, etc.)
- After that, you can include global style commands or you can load packages which add new features to the LaTeX system. To load a package you use the command:

```
\usepackage{...}
```

Input File Structure (2)

- When all the setup work is done, you start the body of the text with the command:

```
\begin{document}
```

- Now you enter the text mixed with some useful LaTeX commands.
- At the end of the document you use the

```
\end{document}
```

- command, which tells LaTeX to finish. Anything which follows this command will be ignored by LaTeX

Input File Structure (3)

- A minimal LaTeX file:

```
\documentclass{article}
\begin{document}
Small is beautiful.
\end{document}
```

Input File Structure (4)

- **A more realistic LaTeX file:**

```
\documentclass[a4paper,11pt]{article}
\usepackage{latexsym}
\author{H.~Partl}
\title{minimalism}
\begin{document}
\maketitle
\tableofcontents
\section{Start}
Here begins my lovely article \ldots
\section{End}
\ldots{} and here it ends.
\end{document}
```


Page Styles

- **LaTeX supports three predefined header/footer combinations. These are known as page styles.**
- **The `style` parameter of the `\pagestyle{style}` command defines which one to use:**
  - `plain` **prints the page numbers on the bottom of the page in the middle of the footer (default page style)**
  - `headings` **prints the current chapter heading and the page number on each page. Footer is empty**
  - `empty` **- both header and footer empty**
- **More elaborate headers and footers can be created using the `fancyheadings` package**

Typesetting Mathematics - 1

- Type setting mathematics beautifully is perhaps the major strength of TeX and LaTeX - and perhaps the main reason for which researchers use them
- LaTeX can typeset just about any mathematical thing you can imagine …and if you can't do it with standard LaTeX then you almost certainly can with the `amstex` package (ams: American Mathematical Society)
- Here we will just scratch the surface. See reference books or the web for lists and tables of LaTeX maths commands

Typesetting Mathematics - 2

- LaTeX has a special mode for typesetting mathematics, called "math mode".
- Within a paragraph, math mode is entered between `$` characters, or by using the `\begin{math}` and `\end{math}` commands

To find the square of the hypotenuse, add a squared to b squared to find c squared, e.g. $a^2 + b^2 = c^2$. It's as easy as that!

```
To find the square of the
hypotenuse, add a squared
to b squared to find c
squared, e.g. $a^2 + b^2 =
c^2$. It's as easy as
that!
```

Typesetting Mathematics - 3

- **Here are some more examples:**

TEX is pronounced $\tau\epsilon\chi$.

```
\Tex is pronounced
$\tau\epsilon\chi$.
```

$100\mathrm{m}^3$ of water.

```
100m$^3$ of water.
```

- **Larger mathematical formulae are best displayed on a single line:**

To find the square of the hypotenuse, add a squared to b squared to find c squared,

$$a^2 + b^2 = c^2.$$

It's as easy as that!

```
To find the square of the
hypotenuse, add a squared to b
squared to find c squared,
\begin{displaymath}
a^2 + b^2 = c^2.
\end{displaymath}
It's as easy as that!
```


Typesetting Mathematics - 4

- **In a scholarly article or thesis, you will often want to number equations and refer to them in the text**
- **This is done using the `equation` environment, and the commands `\label` and `\ref`**

… it is clear that

$$\varepsilon > 0. \qquad (1)$$

From Equation 1 it follows that ...

```
\ldots it is clear that
\begin{equation}
\epsilon > 0.
\label{eq:eps}
\end{equation}
From Equation~\ref{eq:eps}
it follows that \ldots
```

- **(note that `\label` and `\ref` are used with figures and tables too)**

Including Graphics

- **LaTeX2e includes a standard package for including *PostScript* graphics in your document. Load it using**

```
\usepackage{graphics}
```

- **A figure can be included using, for example,**

```
\begin{figure}[ht]
\begin{center}
\includegraphics[width=140mm]{mypic.ps}
\end{center}
\caption{An example of a figure.}
\label{fig:example}
\end{figure}
```


Bibliographies (1)

- **Articles can be referred to in the text using the \cite command:**

By far the most commonly used feature is colour (e.g. [1,2,3]), usually computed in a colour space thought to be “perceptually accurate” (e.g. HSV [3] or CIE [4].

```
By far the most commonly used
feature is colour (e.g.\
\cite{NBE1993,JaV1996,SmC1996a}),
usually computed in a colour space
thought to be ``perceptually
accurate'' (e.g.\ HSV
\cite{SmC1996a} or CIE
\cite{STL1997}).
```

- **The details of the cited articles are stored in BibTeX format, in a “.bib” file.**
- **BibTeX resolves the citations in the LaTeX file and generates the required bibliography**

Bibliographies (2)

- **Example BibTeX entries from a .bib file:**

```
@book{AhR1975,
        author = {N. Ahmed and K. Rao},
        title =          {Orthogonal transforms for digital signal
                         processing},
        publisher =      {Springer-Verlag},
        year =           {1975},
        address =        {New York},
}

@inproceedings{Aus1989,
        author =         {James Austin and A. Phantom and Also Phantom},
        title =          {High Speed Invariant Recognition Using Adaptive
                         Neural Networks},
        booktitle =      {IEE 3rd International Conference on Image
                         Processing and its Applications},
        year =           {1989},
        pages =          {28--32},
        abstract =       {A method is described which...},
}
```


Setting up your UNIX account to use LaTeX (1)

- **One of the advantages of using LaTeX is that resources (eg. Document classes, packages, BibTeX bibliography files) can be used by multiple documents...**
- **…but to do this, LaTeX must be able to find them**
- **By default, LaTeX will look for files in the current directory, and then in some system directories defined when it was compiled and installed**
- **It is very useful to have default locations for your own files, e.g.,**
  - **a bibliography "database" myrefs .bib, which could be used in your literature review, thesis, conference and journal papers, etc.**
  - **a document class, such as cssethesis .cls**

Setting up your UNIX account to use LaTeX (2)

- The first thing to do is to create some directories to store any class (.cls), package (.sty), biblography (.bib), bibliography style (.bst) or even image (.pdf, .ps) files that you create or download
- I use the directories:

```
~/tex/
~/tex/sty/          # for .cls, .sty or image files
~/tex/bib/          # for .bib files
~/tex/bst/          # for .bst files
```

- You can of course choose different names – just change commands in the following slides accordingly

Setting up your UNIX account to use LaTeX (2)

- Once you have created the directories, you need to tell LaTeX how to find them
- This is done using environment variables, which are set when you log in. I use the shell tcsh, so I put the following commands in my ~/.cshrc file:

```
# the trailing // tells TeX to do a recursive search
setenv TEXINPUTS .:$HOME/tex//:
setenv BIBINPUTS .:$HOME/tex/bib/:
setenv BSTINPUTS .:$HOME/tex/bst/:
```

- If you are using a different shell (e.g. bash), you might need different commands to set and export environment variables

Setting up your UNIX account to use LaTeX (3)

- **Here are the commands you would need to add to your ~/.bashrc file to achieve the same effect, if you are using the bash shell:**

```
# the trailing // tells TeX to do a recursive search
TEXINPUTS=.:$HOME/tex//:
export TEXINPUTS
BIBINPUTS=.:$HOME/tex/bib/:
export BIBINPUTS
BSTINPUTS=.:$HOME/tex/bst/:
export BSTINPUTS
```

- **If you don't know which shell you are using, type**
  `echo $SHELL`
  at the command prompt

Running LaTeX (1)

- **The simplest way to run LaTeX on a source document is to do so at the UNIX command line:**

```
>latex test.tex
```

- **This will create several files. If `test.tex` is a simple document, these will be:**

`test.aux` # the auxiliary file that LaTeX will use in subsequent passes to resolve references to figures, tables, citations etc.
`test.log` # a log file that contains information about the LaTeX run
`test.dvi` # the DeVice Independent output file. This is the typeset document, ready for conversion to postscript or other printable formats

Running LaTeX (2)

- We can view the document we have created using a DVI viewer. The most common one under UNIX is `xdvi`. Type
  `>xdvi test`
  to see the typeset document
- It is important to realise that LaTeX sometimes needs to be run several times to resolve all references. This is because
  - LaTeX reads such information from the .aux file at the start of a run
  - If new information is written to the .aux file during the run, you will need to run LaTeX again. LaTeX will let you know about this, e.g.

```
LaTeX Warning: Label(s) may have changed. Rerun to get cross references right.
```


Running LaTeX (3)

- You also need to run LaTeX multiple times when you are using citations and `bibtex`
- There are other ways of running LaTeX
  - The most common under UNIX is probably from with `XEmacs`, using the `AUCTeX` package
  - There are also integrated environments like this under windows (e.g. WinEdt)
- All this stuff is much easier to learn by trying it on a computer, rather than hearing it in a lecture, so…
- … now we're going to do a demo
- To the honours lab!

Further reading

- This tutorial is largely based on parts of “The Not So Short Introduction to LaTeX2e” by Tobias Oetiker et al. You can find it on the web in many places, including:

  http://www.ctan.org/tex-archive/info/lshort/english/

- There are links to this and many more resources at the page:

  http://www.csse.monash.edu.au/software/latex/