

CSC 491: Professional Experience

Using LaTex

Instructor: Haidar M. Harmanani

Notes from Gordon J. Pace

What are TeX and LaTeX?

- LaTeX is a typesetting systems suitable for producing scientific and mathematical documents
 - LaTeX enables authors to typeset and print their work at the highest typographical quality.
 - LaTeX is pronounced “Lay-tech”.
 - LaTeX uses TeX formatter as its typesetting engine.
- TeX is a program written by Donald Kunth for typesetting text and mathematical formulas

Why Use LaTeX?

- High quality

$$J[x(\cdot), u(\cdot)] = \int_{t_0}^{\infty} F(x(t), u(t), t) dt \quad \text{Word}$$

$$J[x(\cdot), u(\cdot)] = \int_{t_0}^{\infty} F(x(t), u(t), t) dt \quad \text{LaTeX}$$

- Easy to use, especially for typing mathematical formulas
- Portability (Windows, Unix, Mac)
- Stability and interchangeability (Office 97 \rightleftarrows Office 2017)
- Most journals have their LaTeX styles (just download and use them).
- Final reason: most likely, you will be forced to use it, since everyone else around you is using it.

How to Setup LaTeX for Windows

- Download and install MikTeX
 - <http://www.miktex.org/> ← *LaTeX package*
 - Install Ghostscript and Gsview <http://pages.cs.wisc.edu/~ghost/> ← *PS device driver ...*
 - Install Acrobat Reader
 - Install Editor
 - WinEdt
 - <http://www.winedt.com/>
 - TexnicCenter
 - <http://www.texniccenter.org/>
 - Emacs, vi, etc.
- The diagram consists of two rounded rectangular boxes. The top box is labeled 'For MAC Users' and contains the text: TeXShop, iTeXMac, Texmaker, ...'. The bottom box is labeled 'For Linux Users' and contains the text: Just install the package!

Document Organisation

LOGICAL

Sectioning
Emphasis
Document style
References

VISUAL

Font
Local spacing
Text size

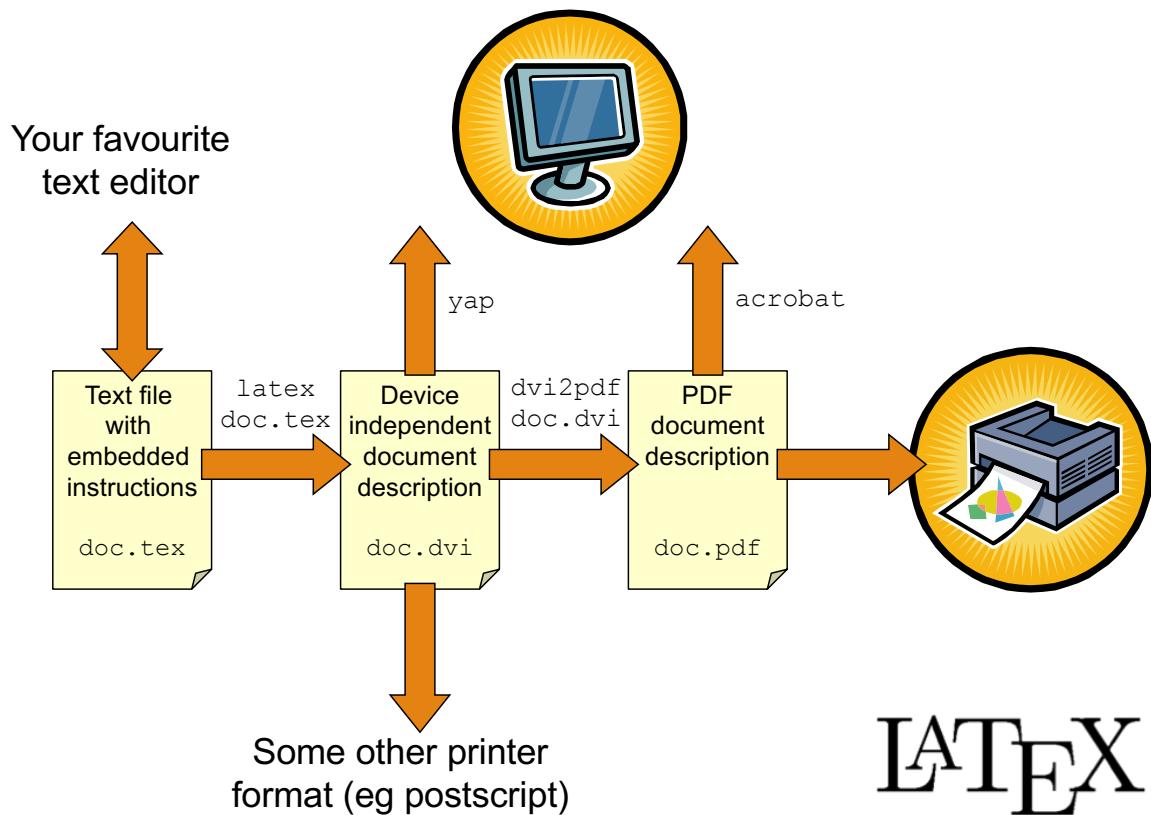
Pronunciation Guide

- Latex: pronounced Lay TeX' or perhaps 'Lah TeX'

LATEX: pronounced *lay-tech* (*tech* as in technical)

```
\documentclass{article}  
\begin{document}  
  
\emph{Long Live \LaTeX}  
  
Note the emphasis!  
\end{document}
```

Long Live LATEX
Note the emphasis!



LaTeX

Spring 2018

CSC 491: Professional Experience



Your favourite text editor

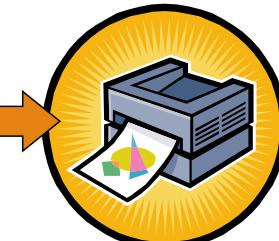
Text file with embedded instructions
doc.tex

pdftex doc.tex



PDF document description
doc.pdf

Acrobat



pdfTeX

Spring 2018

CSC 491: Professional Experience



Some advantages of

- concentrate on content before appearance;
- mathematical formulae easily described:

$$\int_{\sum_{i=0}^{10} \sin^{-1}(i)}^{\int_0^{\infty} \frac{1}{x^2} dx} \sqrt{\frac{e^x}{x^{\sqrt{e}}}} dx$$

- freely available for all popular platforms;
- output comparable (equivalent) to that of published books;
- various tools available eg **L^AT_EX2HTML**

‘Coding’ Basics

- L^AT_EX commands start with a backslash \
- Parameters are given in curly brackets { }
- Environments (blocks with a certain type of content) are of the form:

```
\begin{environment_type}  
    environment content  
\end{environment_type}
```

The Simplest Document

```
\documentclass{report}
```

```
\begin{document}
```

```
\end{document}
```

The Simplest Document

```
\documentclass{report}
```

```
\begin{document}
```

The way the document
is formatted is
deduced through its
class

```
\end{document}
```

The Simplest Document

```
\documentclass{report}
```

```
\begin{document}
```

This specifies the type of the document: report, book, article, letter, etc.

```
\end{document}
```

The Simplest Document

```
\documentclass{report}
```

```
\begin{document}
```

Anything within the document environment is typeset as output

```
\end{document}
```

Hello World!

```
\documentclass{report}
\begin{document}
Hello
World!

Bye!
\end{document}
```

Hello World!

```
\documentclass{report}
\begin{document}
Hello
World!

Bye!
\end{document}
```

Hello World!
Bye!

Hello World!

```
\documentclass{report}  
\begin{document}  
Hello  
World!  
  
Bye!  
\end{document}
```

- Newlines in the source are ignored.
- Skipping a line in the source starts a new paragraph

Hello World!
Bye!

Commonly Used Symbols

| | | |
|----------------------|---|---|
| The name | L <small>A</small> T <small>E</small> X | \LaTeX |
| ellipsis | ... | \ldots |
| single quotes | 'text' | 'text' |
| double quotes | "text" | "text" |
| dash (between words) | — | --- |
| number range | 1–2 | 1--2 |
| endashed words | pre-order | pre-order |
| accents | Íçàöñû | \'{I}\c{c} \'{a}"{o} \^{n}\^{{u}} |

Excuse my French

```
\documentclass{report}
```

```
\begin{document}
He said ``She said
`H\{e}ll\^{o},
j'adore \LaTeX!' ''
```

```
She was French, you
see \ldots
\end{document}
```

Excuse my French

```
\documentclass{report}
```

```
\begin{document}
He said ``She said
`H\{e}ll\^{o},
j'adore \LaTeX!' ''
```

```
She was French, you
see \ldots
\end{document}
```

He said “She said ‘Héllô, j’adore
L^AT_EX!’ ”

She was French, you see ...

Useful Document Classes

- **Article:** Ideal for a short paper (divided into sections, subsections, etc). Typeset to be printed double-sided.
- **Book:** Class to be used to typeset a book (chapters, sections, etc). Typeset to be printed double-sided.
- **Report:** (Almost) identical to the book class but for single-sided printing.
- Other classes include **letter**, **slides**, etc.

Organising a Document

- A document is split into logical parts:
 - A title
 - An abstract
 - A number of parts
 - A number of chapters in each part
 - A number of sections in each chapter
 - A number of subsections in each section
 - A number of subsubsections in each subsection
- Availability of a logical part depends on the document class (eg no chapters in a paper).
- Typesetting of the sections may vary depending on document class.

The Title

```
\documentclass{article}
\begin{document}

\titulo{\LaTeX: Fun with Text}
\author{Cikku Flieles}
\date{31st February 2000}

\maketitle

\end{document}
```

The Title

```
\documentclass{article}
\begin{document}

\titulo{\LaTeX: Fun with Text}
\author{Cikku Flieles}
\date{31st February 2000}

\maketitle

\end{document}
```

\LaTeX: Fun with Text

Cikku Flieles

31st February 2000

The Abstract

- Available in article and report class.
- Used to give an overview of the content of the document.
- Is usually typeset with wider margins than the main text.
- Specified using the abstract environment:

```
\begin{abstract}
```

...

```
\end{abstract}
```

Logical Sections

- To start a named part, chapter, section, subsection or subsubsection use the command:

```
\section_type{section name}
```

where `section_type` is one of `part`, `chapter`, `section`, `subsection` and `subsubsection`.

- This will automatically create the title and numbering of the section.
- Any text after the command will appear inside the section named.
- Parts and chapters are only available in the report and book class.

Logical Sections

```
\documentclass{report}
\begin{document}
\chapter{Basics}
\section{First of all \ldots}
Initially, we think.

\subsection{Sit Down}
Find a chair and sit down.

\subsection{Think}
Think about the chair.
\end{document}
```

Logical Sections

```
\documentclass{report}
\begin{document}
\chapter{Basics}
\section{First of all \ldots}
Initially, we think.

\subsection{Sit Down}
Find a chair and sit down.

\subsection{Think}
Think about the chair.
\end{document}
```

Chapter 1

Basics

1.1 First of all ...

Initially, we think.

1.1.1 Sit Down

Find a chair and sit down.

1.1.2 Think

Think about the chair.

Figures and Tables

- The `figure` environment is used to include a *floating* figure in the text.
- Similarly the `table` environment can be used to insert a *floating* table.
- A caption can be added to both using the `\caption{ }` command.
- The two environments are identical except for the caption title, and whether they appear in a list of figures, or the list of tables.

Figures and Tables

- The `figure` environment is used to include a *floating* figure in the text.
- Similarly the `table` environment can be used to insert a *floating* table.
- A caption can be added to both using the `\caption{ }` command.
- The two environments are identical except for the caption title, and whether they appear in a list of figures, or the list of tables.

Floating objects do not have a fixed position in the body of the text, but may be moved around by L^AT_EX to improve the layout

Figures and Tables

```
\begin{figure}  
Here include whatever you  
want in the figure.
```

```
\caption{A demo figure}  
\end{figure}
```

Any other text \ldots

```
\begin{table}  
Here include whatever you  
want in the table.
```

```
\caption{A demo table}  
\table}
```

Note that the figures and
tables may move \ldots

Figures and Tables

```
\begin{figure}  
Here include whatever you  
want in the figure.
```

```
\caption{A demo figure}  
\end{figure}
```

Any other text \ldots

```
\begin{table}  
Here include whatever you  
want in the table.
```

```
\caption{A demo table}  
\table}
```

Note that the figures and
tables may move \ldots

Here include whatever you want in the figure.

Figure 1: A demo figure

Here include whatever you want in the table.

Table 1: A demo table

Any other text ...

Note that the figures and tables may move ...

Figures and Tables

```
\begin{figure}  
Here include whatever you want in the figure.  
A figure  
LATEX  
keeps count of the figure and  
table numbering  
automatically.
```

```
\begin{table}  
Here include whatever you want in the table.  
\caption{A demo table}  
\table
```

Note that the figures and
tables may move \ldots

Here include whatever you want in the figure.

Here include whatever you want in the table.

Figure 1: A demo figure

Table 1: A demo table

Any other text ...

Note that the figures and tables may move ...

Figures and Tables

```
\begin{figure}  
Here include whatever you want in the figure.
```

```
\caption{A demo figure}  
\end{figure}
```

Any other text \ldots

```
\begin{table}  
Here include whatever you want in the table.
```

```
\caption{A demo table}  
\table
```

Note that the tables may move \ldots

Here include whatever you want in the figure.

Figure 1: A demo figure

in the table.

Table 1: A demo table

may move ...

If LATEX puts the figures and
tables in strange positions there
are ways of giving it
suggestions. Check a book
on LATEX for more details.

Tables of Contents

- To add a table of contents, with parts, chapters, sections, etc use the command `\tableofcontents`.
- You may also include a list of figures and a list of tables using `\listoffigures` and `\listoftables`.

Tables of Contents

```
\title{A Quick \LaTeX\ Primer}
\author{Gordon J. Pace}
\date{}
\maketitle

\tableofcontents
```

Tables of Contents

```
\title{A Quick \LaTeX\ Primer}
\author{Gordon J. Pace}
\date{}
\maketitle

\tableofcontents
```

A Quick L^AT_EX Primer

Gordon J. Pace

Contents

| | | |
|----------|--|----------|
| 1 | Introduction | 3 |
| 1.1 | Motivation | 3 |
| 1.2 | What is L ^A T _E X? | 3 |
| 1.3 | Trivia | 3 |
| 2 | Producing Output | 3 |
| 3 | The first few steps | 4 |
| 3.1 | Starting a document | 4 |
| 3.2 | Paragraphs and line breaks | 4 |
| 3.3 | Titles | 5 |
| 4 | Frills | 5 |
| 4.1 | Typefaces | 5 |
| 4.2 | Type Size | 6 |
| 4.3 | Verbatim Environment | 6 |

Tables of Contents

```
\title{A Quick \LaTeX\ Pr
\author{Gordon J. Pace}
\date{}
\maketitle

\tableofcontents
```

CAUTION

L^AT_EX creates an auxiliary file with all page numbers when run through a file. Run L^AT_EX twice to ensure that they match

Contents

| | | |
|----------|--|----------|
| 1 | Introduction | 3 |
| 1.1 | Motivation | 3 |
| 1.2 | What is L ^A T _E X? | 3 |
| 1.3 | Trivia | 3 |
| 2 | Producing Output | 3 |
| 3 | The first few steps | 4 |
| 3.1 | Starting a document | 4 |
| 3.2 | Paragraphs and line breaks | 4 |
| 3.3 | Titles | 5 |
| 4 | Frills | 5 |
| 4.1 | Typefaces | 5 |
| 4.2 | Type Size | 6 |
| 4.3 | Verbatim Environment | 6 |

Cross References

- Quite regularly, you will want to refer to section 4.2.1.4 from section 7.6.4.2.
- But when you add a section before section 4.2, you will have to revise the numbering...
- **L^AT_EX** provides a way of naming sections, chapters, figures and tables to allow references updated automatically.

Cross References

- Use `\label{label_name}` to name a numbered object (figure, section, chapter, etc). It may appear within the `\caption`, `\section`, etc parameter or just after it.
- Use `\ref{label_name}` to insert the number of the object named using `\label` command.
- Use `\pageref{label_name}` to insert the page number where the named object appears.
- References may be forward or backward ones.

Cross References

```
\section{Introduction}  
... more details can be found in section \ref{s:proof}  
(in particular look at figure\ref{f:proof} on page  
\pageref{f:proof})...  
  
\section{Proofs and Roofs}  
...  
  
\subsection{Proof \label{s:proof}}  
  
\begin{figure}  
...  
\caption{Proof outline  
 \label{f:proof}}  
\end{figure}  
...
```

Cross References

```
\section{Introduction}  
... more details can be found in section \ref{s:proof}  
(in particular look at figure\ref{f:proof} on page  
\pageref{f:proof})...  
  
\section{Proofs and Roofs}  
...  
  
\subsection{Proof \label{s:proof}}  
  
\begin{figure}  
...  
\caption{Proof outline  
 \label{f:proof}}  
\end{figure}  
...
```

1 Introduction

... more details can be found in section 3.2 (in particular look at figure 8 on page 32).
...

3 Proofs and Roofs

...

3.2 Proof

...

Figure 3: Proof outline

Cross R

Using labels starting with f:
(for figures), s: (for
sections), c: (for chapters)
is not obligatory but will
help you remember.

```
\section{Introduction}
...
\begin{figure}
...
\caption{Proof outline
    \label{f:proof}}
\end{figure}
...
\section{Proofs and Roofs}
...
\subsection{Proof \label{s:proof}}
...
\begin{figure}
...
\caption{Proof outline
    \label{f:proof}}
\end{figure}
...
\pageref{f:proof}...  

... more details can be found in section \ref{s:proof}
```

1 Introduction

... more details can be found in section 3.2 (in particular look at figure 8 on page 32).

3 Proofs and Roofs

3.2 Proof

Figure 3: Proof outline

Cross R

Using labels starting with f:
(for figures), s: (for
sections), c: (for chapters)
is not obligatory but will
help you remember.

```
\section{Introduction}
...
\begin{figure}
...
\caption{Proof outline
    \label{f:proof}}
\end{figure}
...
\section{Proofs and Roofs}
...
\subsection{Proof \label{s:proof}}
...
\begin{figure}
...
\caption{Proof outline
    \label{f:proof}}
\end{figure}
...
\pageref{f:proof}...  

... more details can be found in section \ref{s:proof}
```

1 Introduction

... more details can be found in section 3.2 (in particular look at figure 8 on page 32).

3 Proofs and Roofs

3.2 Proof

Figure 3: Proof outline

Cross References

```
\section{Introduction}

... more details can be found in section \ref{s:proof}
(in particular look at figure\ref{f:proof})

\pageref{f} Using labels starting with f:
\section{F          (for figures), s: (for
...           sections), c: (for chapters)
\subsection{Proof
\begin{figure}    is not obligatory but will
...           help you remember.

\caption{Proof outline
\label{f:proof}}
\end{figure}
...
```

Introduction

more details can be found in section 3.2 (in particular look at page 8 on page 32).

Proofs and Roofs

3.2 Proof

Figure 3: Proof outline

Cross References

```
\section{Introduction}

... more details can be found in section \ref{s:proof}
(in particular look at figure\ref{f:proof})
\pageref{f}...

\section{Proofs and Roofs}
...

\subsection{Proof \label{s:proof}}
\begin{figure}
\caption{Proof outline
\label{f:proof}}
\end{figure}
...
```

CAUTION
As with tables of contents, L^AT_EX uses an auxiliary file with all references. Run L^AT_EX twice to ensure that references match

Figure 3: Proof outline

Organising a Large Document

- Writing a large document can make access to different parts unwieldy.
- **L^AT_EX** has two commands to import files from one another:
`\input{file}`, `\include{file}`.
- Both include the text in the file given as parameter as-is into the main document.
- They are identical except that `\include` starts a new page automatically.

Organising a Large Document

- Writing a large document can make access to different parts unwieldy.
- **L^AT_EX** has two commands to import files from one another:
`\input{file}`, `\include{file}`.
- Both include the text in the file given as parameter as-is into the main document.
- They are identical except that `\include` starts a new page automatically.

Note that the although the files are assumed to be L^AT_EX files, the .tex extension is left out.

Typical Document Organisation

```
% Document: FYP Chicken-Sort
% Date:      1/9/2005
% Author:    Cikku Flieles

\documentstyle{report}
\begin{document}
\input{frontpage}

% short introduction
\input{introduction}

% The algorithm
\input{algorithm}

% Correctness proof
\input{proof}

% Conclusions
\input{conclusions}
\end{document}
```

Spring 2018

CSC 491: Professional Experience



Typical Document Organisation

```
\chapter{The Proof of  
Correctness}  
  
\section{Proof Outline}  
  
We prove the correctness of  
chicken sort using a technique  
based on the Socratic method  
of discourse.  
  
Let us start by assuming that  
Plato knew about this  
proof
```

Spring 2018

CSC 491: Professional Experience



Images

- Images can be added anywhere in a document (not just as a figure)
- To include an image, use the command
`\includegraphics{filename}`
- Various formats are allowed, including gif, jpg, pdf (when using pdftex), etc.

Resizing Images

- Images can be resized using the

```
\resizebox{width}{height}  
{object to resize}
```

- Width and height can be set in various units: cm, mm, in, textwidth (the size of the page less the margins).
- Use ! as the width or height to scale it according to the other given size.

Il-Ahwa x'Figure!

```
\begin{figure}
\resizebox{0.8textwidth}{!}
{\includegraphics{girlinlatex.gif}}
\caption{Il-Ahwa x'Figure}
\end{figure}
```

Il-Ahwa x'Figure!

```
\begin{figure}
\resizebox{0.8textwidth}{!}
{\includegraphics{girlinlatex.gif}}
\caption{Il-Ahwa x'Figure}
\end{figure}
```

LaTeX

Figure 1: Il-Ahwa x'Figure

Tables

- To draw up tabular data, use the `tabular` environment.
- An extra parameter gives the information about the column layout.
- Separate lines using `\backslash` and columns using the ampersand (`&`) symbol.
- `\hline` draws a horizontal line.

Tables

- To draw up tabular data, use the `tabular` environment.
- An extra parameter gives the information about the column layout.
- Separate lines using `\backslash` and columns using the ampersand (`&`) symbol.
- `\hline` draws a horizontal line.

eg { ||| l | c | r | } results in two vertical lines, a left aligned column, another vertical line, a centred column, and a right aligned column, and a vertical line.

Eurovision Singers

```
\begin{tabular}{||l|cr|}\hline Name & Pos & Pnts \\ \hline Cikku & 3rd & 5 \\ Pippo & 2nd & 10 \\ Salvu & 1st & 15 \\ \hline\end{tabular}
```

Eurovision Singers

```
\begin{tabular}{||l|cr|}\hline Name & Pos & Pnts \\ \hline Cikku & 3rd & 5 \\ Pippo & 2nd & 10 \\ Salvu & 1st & 15 \\ \hline\end{tabular}
```

| Name | Pos | Pnts |
|-------|-----|------|
| Cikku | 3rd | 5 |
| Pippo | 2nd | 10 |
| Salvu | 1st | 15 |

Eurovision Singers

```
\begin{tabular}{|l|l|l|} \hline Name & Pos & Pnts \\ \hline Cikku & 3rd & 5 \\ Pippo & 2nd & 10 \\ Salvu & 1st & 15 \\ \end{tabular}
```

| Name | Pos | Pnts |
|-------|-----|------|
| Cikku | 3rd | 5 |
| Pippo | 2nd | 10 |
| Salvu | 1st | 15 |

left

centre

right

Footnotes

- To add a footnote, use the:

```
\footnote{footnote text}
```

- A footnote mark (such as ¹ or ²) appears where the command is given, and the footnote at the bottom of the page.
- LATEX takes care of the rest.

Unordered Lists

- The `itemize` environment creates an unordered list (like this one).
- Items are started using the `\item` command.
- You can have nested lists.

Ordered Lists

1. The `enumerate` environment creates an ordered list (like this one).
2. Items are also started using the `\item` command.
3. Nested ordered lists can be used.

Description Lists

The environment: The `description` environment creates a description list (like this one).

Items: Items are started using the `\item` command, with the title given as an optional parameter (in square brackets) just after the command.

Pre-Formatted Text

- Anything given within the `verbatim` environment is typeset exactly as given in a monospaced font, with no command interpretation.
- To include a non-interpreted string within your text, use `\verb+the text+` command. You may use `!``, `|` or a number of other characters to start and end the text (the same symbol must be used to start and end the text).

Centre Alignment

- Anything appearing within a `center` environment is centred on the page.
- If you have just one line, such as an image, you can use:

```
\centerline{centred line}
```

Typesetting Haskell

```
\begin{enumerate}
\item The first\footnote{not second} item
    \centerline{\lambda.pdf}

\item The second\footnote{not first} item
    \begin{verbatim}
let f n = n `mod` 17
in map (\x -> x * f x) [ 1..10 ]
    \end{verbatim}
\end{enumerate}
```

Typesetting Haskell

```
\begin{enum}
\item The
\caption{lambda.pdf}
\item The
\begin{code}
let f n = n `mod` 17
in map (\x -> x * f x) [ 1..10 ]
\end{code}
\end{enum}
```

1. The first¹ item

lambda.pdf

2. The second² item

```
let f n = n `mod` 17
in map (\x -> x * f x) [ 1..10 ]
```

¹not second

²not first

Elephants and Giraffes

```
\begin{description}
\item[Elephants:] Elephants can be
    typeset using the \verb+\elephant+
    command.
\item[Giraffes:] Two points should be
    kept in mind:
    \begin{itemize}
        \item \LaTeX\ offers no support
            for giraffes.
        \item Neither does Word.
    \end{itemize}
\end{description}
```

Elephants and Giraffes

```
\begin{de
\item[Ele
ty
co
\item[Gir
ke
\b
\end{desc
```

Elephants: Elephants can be typeset using the `\elephant` command.

Giraffes: Two points should be kept in mind:

- L^AT_EX offers no support for giraffes.
- Neither does Word.

Emphasis and Boldface

- *Emphasised* text is produced using the `\emph{ text }` command.
- **Boldface** is obtained through the use of `\textbf{ text }`.
- Rarely used are sans-serif `\textsf{ text }`, small caps `\textsc{ text }` and typewritten `\texttt{ text }`.

Bold Elephants in Occam

```
\textbf{Definition:} An \emph{elephant}  
can be defined to be a giraffe who should  
go on a diet.
```

```
\textbf{Definition:} A \emph{giraffe}  
is nothing but an anorexic elephant.
```

```
\textsf{Occam} implements elephants very  
efficiently. Note that \textsf{Occam} is  
not written \textsc{Occam} or  
\texttt{Occam}!
```

Bold Elephants in Occam

```
\textbf{Definition:  
can be defined to  
go on a diet.}
```

```
\textbf{Definition:  
is nothing but an}
```

```
\textsf{Occam} im-  
efficiently. Note  
not written \textsc{  
}\texttt{Occam}!
```

Definition: An *elephant* can be defined to be a giraffe who should go on a diet.

Definition: A *giraffe* is nothing but an anorexic elephant.

Occam implements elephants very efficiently. Note that Occam is not written OCCAM or Occam!

Some Symbols

- To illustrate the rest of this part, we will introduce some mathematical symbols. More can be found on the last few slides.
- All mathematics must appear in maths mode – but more about this in a moment...
- The following symbols \leq \times π ∞ can be produced using the commands: `\leq`, `\times`, `\pi`, `\infty`.

More Symbols

Some symbols are used to combine other mathematical expressions:

- Powers:

$$e^{i\pi} = -1 \quad e^{i\pi} = -1$$

- Subscripts:

$$a_{n+1} = 2 \times a_n \quad a_{n+1} = 2 \times a_n$$

- Fractions:

$$\frac{x^\pi}{a_{25}}$$

- Summation:

$$\sum_{i=0}^{\infty} a^i \quad \sum_{i=0}^{\infty} a^i$$

Inline Mathematics

- If a mathematical expression appears in a line of normal text, use a dollar symbol \$ to start and to end the mathematics.
- This ensures that the lines are kept as narrow as possible to avoid **LATEX** having to change line spacing drastically.

Inline Mathematics

- If a mathematical expression appears in a line of normal text, use a dollar symbol \$ to start and to end the mathematics.
- This ensures that the lines are kept as narrow as possible to avoid **LATEX** having to change line spacing drastically.

It has already been shown
that $a_{n+1} = 2 \times a_n$. We can thus conclude
that $\frac{a_n}{a_0} = 2^n$.

Inline Mathematics

- If a mathematical expression appears in a line of normal text, use a dollar symbol \$ to start and to end the mathematics.
- This ensures that the lines are kept as narrow as possible to avoid L^AT_EX having to change line spacing drastically.

It has already been shown that $a_{n+1} = 2 \times a_n$. We can thus conclude that $\frac{a_n}{a_0} = 2^n$.

It has already been shown that $a_{n+1} = 2 \times a_n$. We can thus conclude that $\frac{a_n}{a_0} = 2^n$.

Large Formulae

- If the mathematical formulae are to appear on a separate line, start the mathematics using \ [, and end it with \].

It has already been shown that $a_{n+1} = 2 \times a_n$. We can thus conclude that:

$\left[\frac{a_n}{a_0} = 2^n \right]$

Note the difference from inline mode: $\frac{a_n}{a_0} = 2^n$.

Large Formulae

- If the mathematical formulae are to appear on a separate line, start the mathematics using `\[`, and end it with `\]`.

It has already been shown that $a_{n+1} = 2 \times a_n$. We can thus conclude that:

$$[\frac{a_n}{a_0} = 2^n]$$

Note the difference from inline mode: $\frac{a_n}{a_0} = 2^n$.

It has already been shown that $a_{n+1} = 2 \times a_n$. We can thus conclude that:

$$\frac{a_n}{a_0} = 2^n$$

Note the difference from inline mode: $\frac{a_n}{a_0} = 2^n$.

Equations

- Quite regularly, one needs equations with aligned equality signs. The environment `eqnarray` is used for this.
- Separate lines using `\backslash\backslash`, and the left hand side, equality, and right hand side of the equations using `&`.

Equations

- Quite regularly, one needs equations with aligned equality signs. The environment `eqnarray` is used for this.
- Separate lines using `\backslash`, and the left hand side, equality, and right hand side of the equations using `&`.

```
\begin{eqnarray}
a_0 &=& 1 \\
a_{n+1} &=& 2\times a_n
\end{eqnarray}
```

Equations

- Quite regularly, one needs equations with aligned equality signs. The environment `eqnarray` is used for this.
- Separate lines using `\backslash`, and the left hand side, equality, and right hand side of the equations using `&`.

```
\begin{eqnarray}
a_0 &=& 1 \\
a_{n+1} &=& 2\times a_n
\end{eqnarray}
```

$$a_0 = 1 \quad (1)$$
$$a_{n+1} = 2 \times a_n \quad (2)$$

Equations

- Quite regularly, one needs equations with aligned equality signs. The environment `eqnarray` is used for this.
- Separate lines using `\backslash`, and the left hand side of the equations using `&`.

```
\begin{eqnarray}
a_0 &=& 1 \\
a_{n+1} &=& 2 \times a_n
\end{eqnarray}
```

Note that the equations are numbered. If you don't want this feature, use the `eqnarray*` environment instead

$$a_0 = 1 \quad (1)$$

$$a_{n+1} = 2 \times a_n \quad (2)$$

Some Notes ...

- Spacing is ignored in math mode – `$x y$` gives the same result as `xy`.
- If you need to escape from math mode to include normal text (eg for the name of a function) use the command `\mbox{text}` (eg `$e^n + \mbox{fibonacci} (n+1)$`)
- Never use math mode to emphasise text – because `$different$` gives *different*, not *different!*

Some Mathematical Symbols

| | | | | | |
|------------|-----------------------|--------------|-------------------------|----------------|---------------------------|
| \aleph | <code>\aleph</code> | \prime | <code>\prime</code> | \forall | <code>\forall</code> |
| \hbar | <code>\hbar</code> | \emptyset | <code>\emptyset</code> | \exists | <code>\exists</code> |
| \imath | <code>\imath</code> | ∇ | <code>\nabla</code> | \neg | <code>\neg</code> |
| \jmath | <code>\jmath</code> | \surd | <code>\surd</code> | \flat | <code>\flat</code> |
| ℓ | <code>\ell</code> | \top | <code>\top</code> | \natural | <code>\natural</code> |
| \wp | <code>\wp</code> | \bot | <code>\bot</code> | \sharp | <code>\sharp</code> |
| \Re | <code>\Re</code> | \mid | <code>\mid</code> | \clubsuit | <code>\clubsuit</code> |
| \Im | <code>\Im</code> | \angle | <code>\angle</code> | \diamondsuit | <code>\diamondsuit</code> |
| ∂ | <code>\partial</code> | \triangle | <code>\triangle</code> | \heartsuit | <code>\heartsuit</code> |
| ∞ | <code>\infty</code> | \backslash | <code>\backslash</code> | \spadesuit | <code>\spadesuit</code> |

Binary Operators

| | | | | | |
|-------------|------------------------|--------------------|-------------------------------|------------|-----------------------|
| \pm | <code>\pm</code> | \cap | <code>\cap</code> | \vee | <code>\vee</code> |
| \mp | <code>\mp</code> | \cup | <code>\cup</code> | \wedge | <code>\wedge</code> |
| \setminus | <code>\setminus</code> | \uplus | <code>\uplus</code> | \oplus | <code>\oplus</code> |
| \cdot | <code>\cdot</code> | \sqcap | <code>\sqcap</code> | \ominus | <code>\ominus</code> |
| \times | <code>\times</code> | \sqcup | <code>\sqcup</code> | \otimes | <code>\otimes</code> |
| $*$ | <code>*</code> | \triangleleft | <code>\triangleleft</code> | \oslash | <code>\oslash</code> |
| \star | <code>\star</code> | \triangleright | <code>\triangleright</code> | \odot | <code>\odot</code> |
| \diamond | <code>\diamond</code> | \wr | <code>\wr</code> | \dagger | <code>\dagger</code> |
| \circ | <code>\circ</code> | \bigcirc | <code>\bigcirc</code> | \ddagger | <code>\ddagger</code> |
| \bullet | <code>\bullet</code> | \bigtriangleup | <code>\bigtriangleup</code> | \amalg | <code>\amalg</code> |
| \div | <code>\div</code> | \bigtriangledown | <code>\bigtriangledown</code> | | |

Relational Operators

| | | | | | |
|---------------|--------------------------|---------------|--------------------------|-----------|----------------------|
| \leq | <code>\leq</code> | \geq | <code>\geq</code> | \equiv | <code>\equiv</code> |
| \prec | <code>\prec</code> | \succ | <code>\succ</code> | \sim | <code>\sim</code> |
| \preceq | <code>\preceq</code> | \succeq | <code>\succeq</code> | \simeq | <code>\simeq</code> |
| \ll | <code>\ll</code> | \gg | <code>\gg</code> | \asymp | <code>\asymp</code> |
| \subset | <code>\subset</code> | \supset | <code>\supset</code> | \approx | <code>\approx</code> |
| \subseteq | <code>\subseteq</code> | \supseteq | <code>\supseteq</code> | \cong | <code>\cong</code> |
| \sqsubset | <code>\sqsubset</code> | \sqsupset | <code>\sqsupset</code> | \bowtie | <code>\bowtie</code> |
| \sqsubseteq | <code>\sqsubseteq</code> | \sqsupseteq | <code>\sqsupseteq</code> | \propto | <code>\propto</code> |
| \in | <code>\in</code> | \ni | <code>\ni</code> | \models | <code>\models</code> |
| \vdash | <code>\vdash</code> | \dashv | <code>\dashv</code> | \models | <code>\models</code> |
| \smile | <code>\smile</code> | \mid | <code>\mid</code> | \doteq | <code>\doteq</code> |
| \frown | <code>\frown</code> | \parallel | <code>\parallel</code> | \perp | <code>\perp</code> |

Some Arrows

| | | | |
|-----------------------|----------------------------------|-----------------------|----------------------------------|
| \leftarrow | <code>\leftarrow</code> | \rightarrow | <code>\rightarrow</code> |
| \longleftarrow | <code>\longleftarrow</code> | \longrightarrow | <code>\longrightarrow</code> |
| \Leftarrow | <code>\Leftarrow</code> | \Rightarrow | <code>\Rightarrow</code> |
| \Longleftarrow | <code>\Longleftarrow</code> | \Longrightarrow | <code>\Longrightarrow</code> |
| \leftrightarrow | <code>\leftrightarrow</code> | \Leftrightarrow | <code>\Leftrightarrow</code> |
| \longleftrightarrow | <code>\longleftrightarrow</code> | \Longleftrightarrow | <code>\Longleftrightarrow</code> |
| \hookleftarrow | <code>\hookleftarrow</code> | \hookrightarrow | <code>\hookrightarrow</code> |
| \leftharpoonup | <code>\leftharpoonup</code> | \rightharpoonup | <code>\rightharpoonup</code> |
| \leftharpoondown | <code>\leftharpoondown</code> | \rightharpoondown | <code>\rightharpoondown</code> |
| \uparrow | <code>\uparrow</code> | \downarrow | <code>\downarrow</code> |
| \Uparrow | <code>\Uparrow</code> | \Downarrow | <code>\Downarrow</code> |
| \updownarrow | <code>\updownarrow</code> | \Updownarrow | <code>\Updownarrow</code> |
| \nearrow | <code>\nearrow</code> | \nwarrow | <code>\nwarrow</code> |
| \searrow | <code>\searrow</code> | \swarrow | <code>\swarrow</code> |
| \mapsto | <code>\mapsto</code> | \longmapsto | <code>\longmapsto</code> |
| \rightleftharpoons | <code>\rightleftharpoons</code> | | |

Big Symbols

| | | | | | |
|-----------|----------------------|-------------|------------------------|--------------|-------------------------|
| \sum | <code>\sum</code> | \bigcap | <code>\bigcap</code> | \bigodot | <code>\bigodot</code> |
| \prod | <code>\prod</code> | \bigcup | <code>\bigcup</code> | \bigotimes | <code>\bigotimes</code> |
| \coprod | <code>\coprod</code> | \bigsqcup | <code>\bigsqcup</code> | \bigoplus | <code>\bigoplus</code> |
| \int | <code>\int</code> | \bigvee | <code>\bigvee</code> | \biguplus | <code>\biguplus</code> |
| \oint | <code>\oint</code> | \bigwedge | <code>\bigwedge</code> | | |

Greek Letters

| | | | | | |
|------------|-----------------------|---------------|--------------------------|------------|-----------------------|
| α | <code>\alpha</code> | ι | <code>\iota</code> | ρ | <code>\rho</code> |
| β | <code>\beta</code> | κ | <code>\kappa</code> | σ | <code>\sigma</code> |
| γ | <code>\gamma</code> | λ | <code>\lambda</code> | τ | <code>\tau</code> |
| δ | <code>\delta</code> | μ | <code>\mu</code> | υ | <code>\upsilon</code> |
| ϵ | <code>\epsilon</code> | ν | <code>\nu</code> | ϕ | <code>\phi</code> |
| ζ | <code>\zeta</code> | ξ | <code>\xi</code> | χ | <code>\chi</code> |
| η | <code>\eta</code> | \circ | <code>\circ</code> | ψ | <code>\psi</code> |
| θ | <code>\theta</code> | π | <code>\pi</code> | ω | <code>\omega</code> |
| | | | | | |
| ϵ | <code>\epsilon</code> | ε | <code>\varepsilon</code> | | |
| θ | <code>\theta</code> | ϑ | <code>\vartheta</code> | | |
| π | <code>\pi</code> | ϖ | <code>\varpi</code> | | |
| ρ | <code>\rho</code> | ϱ | <code>\varrho</code> | | |
| σ | <code>\sigma</code> | ς | <code>\varsigma</code> | | |
| ϕ | <code>\phi</code> | φ | <code>\varphi</code> | | |

Standard Functions

| | | | |
|---------|--------|------|-----|
| \cos | cos | \exp | exp |
| \arccos | arccos | \ln | ln |
| \sin | sin | \log | log |
| \arcsin | arcsin | \gcd | gcd |
| \tan | tan | \min | min |
| \arctan | arctan | \max | max |

Simple Bibliographies

- To create the bibliography, use the `thebibliography` environment.
- Items in the bibliography are added using the `\bibitem{label}` command. The label is used to refer to the entry.
- Citing a bibliography item in the main text can be done using the `\cite{label}` or `\cite{label1, label2, ...}` command to obtain citations such as [2] or [7,4].

Citing Papers the Easy Way

```
\cite{alur:94,asarin:01} talk about timed-automata, even if  
\cite{asarin:01} treats a particular case of the general case  
appearing in \cite{alur:94}.

\begin{thebibliography}{99}
\bibitem{alur:94} R. Alur and D.L. Dill,  
    \emph{A theory of timed automata,\/}  
    Theoretical Computer Science 126:1(183--235), 1994.

\bibitem{asarin:01} E. Asarin, G. Schneider and S. Yovine,  
    \emph{On the Decidability of the Reachability Problem for  
    Planar Differential Inclusions,\/} in Lecture Notes in  
    Computer Science 2034, 2001.
\end{thebibliography}
```

Citing Papers the Easy Way

```
\cite{alur:94,asarin:01} talk about timed-automata, even if  
\cite{asarin:01} appearing in  
[1, 2] talk about timed-automata, even if [2] treats a particular  
case of the general case Appearing in [1].
```

References

- [1] R. Alur and D.L. Dill, *A theory of timed automata*, Theoretical Computer Science 126:1(183–235), 1994.
- [2] E. Asarin, G. Schneider and S. Yovine, *On the Decidability of the Reachability Problem for Planar Differential Inclusions*, in Lecture Notes in Computer Science 2034, 2001.

Citing Papers the Easy Way

```
\cite{alur:94,asarin:01} talk about timed-automata, even if  
\cite{asarin:01} treats a particular case of the general case  
appearing in \cite{alur:94}.
```

```
\begin{thebibliography}{99}  
\bibitem{alur:94} R. Alur and D. L. Dill.  
  \emph{A theory of timed automata},  
  Theoretical Computer Science 126:1–2,  
  1994.  
  
\bibitem{asarin:01} E. Asarin, G. Schmitz,  
  \emph{On the Decidability of the Real-time  
  Planar Differential Inclusions},  
  Journal of Computer Science 2034, 2001.  
\end{thebibliography}
```

The number here is used to tell \LaTeX that no more than 99 entries will appear in the bibliography

Citing Papers the Easy Way

```
\cite{alur:94,asarin:01} talk about timed-automata, even if  
\cite{asarin:01} treats a particular case  
appearing in \cite{alur:94}.
```

```
\begin{thebibliography}{99}  
\bibitem{alur:94} R. Alur and D. L. Dill.  
  \emph{A theory of timed automata},  
  Theoretical Computer Science 126:1–2,  
  1994.  
  
\bibitem{asarin:01} E. Asarin, G. Schmitz,  
  \emph{On the Decidability of the Real-time  
  Planar Differential Inclusions},  
  Journal of Computer Science 2034, 2001.  
\end{thebibliography}
```

CAUTION
creates an bibliography file with all reference information when run through a file. Run \LaTeX twice to ensure that references and citations match

The Problems with This...

- It is your responsibility to ensure that the references appear in a standard way (eg all journal papers start with the author name, have an emphasised title, etc).
- Reuse of bibliographies can be cumbersome.

Using BibTeX .

- **BibTeX** is an additional tool, which takes a list of references (generated by **LATEX**), a (.bib) file with all the bibliographic entries, and generates a file with all the reference entries to be used by **LATEX**

Using BibTeX.

1. Run **LATEX** to generate the list of citations.
2. Run **BibTeX** to obtain the reference details.
3. Run **LATEX** to use the reference details.
4. Run **LATEX** again to get references right.

Using BibTeX.

1. Run **LATEX** to generate the list of citations.
2. Run **BibTeX** to obtain the reference details.
3. Run **LATEX** to use the reference details.
4. Run **LATEX** again to get references right.

Luckily, WinEdt does this at the click of one button!

Using BibTeX.

- Citations in the **LATEX** file appear as before using the \cite command.
- At the point where you want the references to appear, use the \bibliography{file} command, where filename.bib is the name of the file with the **BibTEX** entries.

Your BibTEX Will Look Like This ...

```
@article{alur:94,
    author="R. Alur and D.L. Dill",
    title="A theory of timed automata",
    journal="Theoretical Computer Science",
    year=1994,
    volume=126,
    pages="183--235"
}

@Book{bird:88,
    author = "R. Bird and P. Wadler",
    title = "Introduction to Functional Programming",
    publisher = "Prentice Hall International, New York",
    year = 1988
}
```

Your BibTEX Will Look Like This ...

```
@article{alur:94,
    author="R. Alur and D. Lichtenstein",
    title="A theory of the parallel computation of recursive functions",
    journal="Theoretical Computer Science",
    year=1994,
    volume=126,
    pages="183--235"
}

@Book{bird:88,
    author = "R. Bird and P. Wadler",
    title = "Introduction to Functional Programming",
    publisher = "Prentice Hall International, New York",
    year = 1988
}
```

You can either download these entries, type them in yourself, or use a bibliography database tool (eg *bibdesk* or *Mendeley*) to manage them

Using BibTEX.

- Using **BibTEX** will only show the items in the bibliography referred to in the text. Use the \nocite{*} command in the **LATEX** file to show all the items in the bibliography.
- If you prefer citations of the form [Alu94] instead of [1], add the command \bibliographystyle{alpha} before the bibliography in the **LATEX** file.

Quick and Dirty Bibliographies, or BibTEX?

- If you're writing a quick document, with references you will use only once, don't bother with **BibTEX**
- However, in that case, make sure that your bibliographic entries appear in a standard way, and contain all the necessary information.
- For a bigger project, even an FYP, I would start building a **BibTEX** database early on to reduce work later on.