Preparing Documents with LATEX
CS 2ME3/SE 2AA4

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Outline

LATEX

LATEX is a document preparation system used for preparing professional quality documents. Assuming you have primarily used MS Word or equivalent in the past, LATEX will be a very new experience:

- LATEX uses markup language source files, which can be compiled into .pdf documents.
- LATEX produces documents in a What You See Is What You Mean (WYSIWYM) fashion, whereas Word-type programs are What You See Is What You Get (WYSIWYG).
- In other words, LATEX gives you complete control over every aspect of your document (surely everyone has suffered the restrictiveness of Word at some point!)

Motivations to Learn LaTeX

Compared to Word-like editors, LaTeX has a much steeper learning curve (we will just be using basic LaTeX in this course, however, so it shouldn't be so bad!). There are of course significant benefits:

- Professional quality typesetting.
- A large library of packages that allow you to create documents however you envision: many of these packages are very useful for sfwr eng/comp sci students (presenting code, drawing graphs, etc.)
- You will be required to use LaTeX in upper year courses – better to get familiar with the basics now!

Installing TeX Distribution

You hopefully have already done this last week to get Doxygen working, but...

- You will need a TeX distribution.
    - TeX Live is recommended.
    - For Ubuntu-based Linux distributions you can install via `apt-get install texlive-full`.
    - For other operating systems see https://www.tug.org/texlive/ for installation details.

Structure of a LATEX Source

LATEX document sources use the following structure:

```
\documentclass[options]{<document type>}
  ...preamble...
\begin{document}
  ...document body...
\end{document}
```

For this course, you can just use the article class with 12 pt font for your document class:

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

The Preamble

The LATEX preamble follows the \documentclass command. Here we declare which packages we want to use, perform setups for certain packages, define (or redefine) commands, and set certain fields (like title, author, date).

For this course, the following preamble should suffice:

```latex
\usepackage{fullpage}   % extends margins to full page
\usepackage{booktabs}   % for pretty tables
\usepackage{graphicx}   % for including images in figures
\usepackage{hyperref}   % for internal links

\title{Title goes here}
\author{Author goes here}
```

The Document Body

The body of your LATEX document is contained in the `document` environment. Recall:

```
\begin{document}
  ...document body...
\end{document}
```

You will generally begin your document with a title page (and possibly a table of contents if you want):

```
\maketitle
\tableofcontents

% note that page breaks do not follow these by default
% to include page breaks use the following:
\maketitle
\newpage
\tableofcontents
\newpage
```

Sectioning

The following commands are used to create sections in
LATEX documents:

```
% creates a top level section with automatic numbering
\section{section title}

% creates a subsection of the current section
\subsection{subsection title}

% creates a subsubsection of the current subsection
\subsubsection{subsubsection title}
```

Sections are automatically numbered.

Paragraph Text

Paragraph text is simply typed directly into the source. A double
line break indicates a new paragraph should be started. For
example:

```
This is an example paragraph.   To start a new paragraph
use a double line break.

This is a new paragraph.
```

Whitespace besides a double line break and single spaces is ignored.
This will produce exactly the same output as before:

```
This is an example paragraph.
To start a new paragraph
use a double line break.

This    is    a    new      paragraph.
```

Environments

Several pieces of the document (lists, tables, figures) require special
environments in LATEX. Environments are used in the following way:

```
\begin{environment name}   % this starts an environment
   ...environment body...   % do things
\end{environment name}      % end the environment
```

We have seen this already with the `document` environment, in
which the body of the document is written.

Lists

To make a list in LATEX , we must use an environment:

```
% use the itemize environment for bullet lists
\begin{itemize}
  % use \item to start each bullet
  \item text for first bullet
  \item text for second bullet
  \item etc.
\end{itemize}

% use the enumerate environment for numbered lists
\begin{enumerate}
  % use \item to start each numbered point
  \item text for 1.
  \item text for 2.
  \item etc.
\end{enumerate}
```

Tables

To make a table in LATEX , we use the `table` environment:

```
% use the table environment for tables
\begin{table}[<positions>]
  % <positions> tell LaTeX where our table is allowed
  % to be placed

  % you should use a combination of h, t, and b
  % h = here   (in line)
  % t = top of page
  % b = bottom of page

  % Ex:  \begin{table}[ht] means our table can either be
  % placed in line or at the top of a page (but not
  % at the bottom of a page) -- LaTeX will decide what
  % fits using a placement algorithm
\end{table}
```

Tables

We define the table using a `tabular` environment inside the `table` environment:

```
% use the table environment for tables
\begin{table}[h]    % h = in line
  \centering  % \centering centers the table
  % use the tabular environment to define your table
  \begin{tabular}{<columns>}
    % <columns> defines how many columns we will have
    % in our table, and their justification

    % use a combination of l, r, and c
    % l = left    r = right    c = center

    % Ex:  \begin{tabular}{lcr} will create a table
    % with 3 columns, with the first left justified,
    % the second centered, and the last right justified
  \end{tabular}
\end{table}
```

Tables

Now we can construct the rows of the table:

```
\begin{table}[h]
  \centering
  \begin{tabular}{lr}   % 2 columns
    \toprule  % this creates a horizontal top line
    x-coord & y-coord\\ % these are our column headings
    \midrule  % this creates a horizontal mid line
    1.2354  & 4.5543\\  % table entries
    3.4328  & 9.0033\\
    \bottomrule  % this creates a horizontal bottom line
  \end{tabular}
\end{table}
```

Tables

Finally, we add a caption (table title), and a label (used to reference our table in text):

```
\begin{table}[h]
  \centering
  \begin{tabular}{lr}
    \toprule
    x-coord & y-coord\\
    \midrule
    1.2354  & 4.5543\\
    3.4328  & 9.0033\\
    \bottomrule
  \end{tabular}
  \caption{Example table}    % table title
  \label{Table:example}      % table reference name
  % NOTE:  \label MUST come after \caption
\end{table}
```

Tables

The following table is produced by the code in the previous slide:

x-coord	y-coord
1.2354	4.5543
3.4328	9.0033

Table 1: Example table

Figures

Figures in LaTeX are defined using the `figure` environment. It is similar to using the `table` environment:

```
% we use the figure environment for figures
% as with table, we must include permissible figure
% positions (combination of h, t, b)
\begin{figure}[h]
  \centering  % to center figure
  \includegraphics{relative path to image file}
  \caption{Example figure}  % figure title
  \label{Figure:example}    % figure reference name
  % NOTE: \label MUST come after \caption
\end{figure}
```

Figures

Often, we want to scale our image to a certain fraction of the width of the document text (left margin to right margin). We can do this by adding a `width` option to the `\includegraphics` command:

```latex
\begin{figure}[h]
  \centering

  % assuming we have an image file called img.png the
  % same directory as our .tex source, this will create
  % a figure with the image img.png, and scale it to
  % 0.3 times the width of the document text
  \includegraphics[width=0.3\textwidth]{img.png}
  \caption{Example figure}
  \label{Figure:example}
\end{figure}
```

Figures

The code on the previous slide produces the following figure:

Figure 1: Example figure

Internal Referencing

Certain parts of the LaTeX document can be given labels using the
\label{...} command. We saw this in tables and figures
(sections can be labelled as well).

We can use the \ref{...} command in text to make internal
references to these labels as follows:

```
% recall that we labelled our table "Table:example"
% and our figure "Figure:example"

% we can now reference their table/figure numbers:
Refer to table \ref{Table:example}.

See figure \ref{Figure:example}.
```

Internal Referencing

Here is the previous slide's referencing code in action:

Refer to table 1.

See figure 1.

Compiling a LATEX Source to PDF

To compile a .tex source into a .pdf file, simply run the following
command (on the command prompt/terminal):

```
pdflatex source.tex
```

Of course replacing source.tex with the actual name of your .tex
file. If you installed TeX Live properly, `pdflatex` should be
installed and found in your PATH.

Note: you may need to run `pdflatex` a second (sometimes even
third) time to get all internal references working properly.

Putting it All Together

A small LATEX source example can be found in Tutorials/T2/src on the GitLab repo – `example.tex`. This file contains an example of everything covered in the previous section.

Try to compile it using `pdflatex example.tex`.

LaTeX Editors

You will probably want to use an editor with syntax highlighting
(and maybe some additional features) when writing your
LaTeX source. Some recommendations:

- TeXworks (multiplatform)
- WinEdt (Windows)
- NotePad++ with LaTeX syntax highlighting (Windows)
- gedit with LaTeX syntax highlighting (Linux)

Additional References

- If you want to do something in particular and don't know how, your best resource is Google: any question you have will likely have already been asked and answered on Stack Exchange or similar.

- A complete listing of all LATEX packages, along with documentation for each package, can be found at https://www.ctan.org/?lang=en (Comprehensive TEX Archive Network)

Fun Fact

This presentation was written as a LaTeX document. The source is available along with the pdf if you are interested – although do be advised it is much more advanced than the example tex file so don't worry if some parts look confusing!