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LaTex for Scientific Writing

Day One

Anthony Faustine

Outline

Tables

Creating Tables

Use the tabular environment

```
\begin{tabular}[position]{column alignments}
...
\end{tabular}
```

postion is optional (vertical position): [t] (top), [c] (center, this is default), [b] (bottom);

column alignments : l (left-justified), c (center justified), and r (right-justified);

Tables

Creating Tables

The column data is separated by `\\`,row end is marked as `\\` and `\hline` draw a horizontal line.

Consider the following simple table:

Parameter	**Value**
Path loss (n)	2.5
Model	Okumura-model
Cell-radius	1km

Tables

Creating Tables

Latex code for previous simple table

```
\centering
\begin{tabular}[t]{|l|l|}
\hline
\textbf{Parameter} & \textbf{Value}\\
\hline
Path loss (n) & 2.5\\
Model & Okumura-model\\
Cell-radius & $1km$\\
\hline
\end{tabular}
```

Tables

Creating Tables

The `booktabs` package improve the quality LaTeX tables.

- The horizontal rules are called with `\toprule`, `\midrule` and `\bottomrule` instead of `\hline` command.
- The `\cmidrule` is used for mid-rules that span specified columns.
- The content of the tables is filled in the same manner as before.
- To use this package first you need to add this code in preamble. `\usepackage{booktabs}`

Tables

Creating Tables

Example: consider the following code:

```
\centering
\begin{tabular}[t]{ll}
\toprule
\textbf{Parameter} & \textbf{Value}\\
\midrule
Path loss (n) & 2.5\\
Model & Okumura-model\\
Cell-radius & $1km$\\
\bottomrule
\end{tabular}
```

Tables

Creating Tables

Example: The previous code will result into the following table

Parameter	**Value**
Path loss (n)	2.5
Model	Okumura-model
Cell-radius	1km

Tables

Creating Tables

To draw multicolumn table like this one:

Name		
First name	Last Name	Grade
John	Doe	7.5
Richard	Miles	2

Use the following command:

```
\multicolumn{n}{alignment}{item}
```

Tables

Creating Tables

Use the following command:

```
\multicolumn{n}{alignment}{item}
```

n : is the number of columns to be spanned.

alignemnt : is one of the `l, r and c`.

item : is the content.

Example:

```
\multicolumn{2}{c}{Name}
```

Tables

Creating Tables

```
\begin{tabular}{llr}
\toprule
\multicolumn{2}{c}{Name} \\
\cmidrule(r){1-2}
First name & Last Name        & Grade \\
\midrule
John  & Doe         & $7.5$ \\
Richard   & Miles  & $2$ \\
\bottomrule
\end{tabular}
```

Tables

Floating Tables

Latex provides the `table` environments for typesetting floating tables.

- A table environment is set up as follows:

```
\begin{table}
\caption{title}
\label{tab:xxx}
%Place the table here
\end{table}
```

Tables

Floating Tables

`\caption` command is optional and used to set table tittle.

`\label` command is also optional and is used to reference the table's number.

Example: To produce the following table

Table: Simulation Parameters

Parameter	**Value**
Path loss (n)	2.5
Model	Okumura-model
Cell-radius	1km

Tables

Floating Tables

```
\begin{table}
\caption{Simulation Parameters}
\label{tab:model_parameter}
\begin{tabular}[t]{ll}
\toprule
\textbf{Parameter} & \textbf{Value}\\
\midrule
Path loss (n) & 2.5\\
Model & Okumura-model\\
Cell-radius & $1km$\\
\bottomrule
\end{tabular}
\end{table}
```

Graphics

Include Graphics

The easiest way to include images in your document is to use the `graphicx` package.
Load the package graphicx: `\usepackage{graphicx}`

- The image format available depend on what you're using to compile.
- If you're compiling using pdflatex (recommended), then you can use jpg, png, pdf, or eps files.
- Place the file in the same directory as your tex file, and use the `\includegraphics[key-values]{imagefile}` command.

Graphics

Include Graphics

Example: `\includegraphics[scale=0.2]{images/bulb}`

Graphics

Include Graphics

The image can be scaled to a specified height and/or width as follows:

```
\includegraphics[height=2in,width=1in]{images/bulb}
```

Graphics

Floating images

Use `figure` environment:

```
\begin{figure}
        \includegraphics{file}
        \caption{title }
        \label{fig:xxx}
\end{figure}
```

Graphics

Floating images

Figure: Green Bulb

To print the list of figures and tables use `\listoffigures` and `\listoftables` respectively.

Outline

Cross-reference text

Use `\label` and `\ref` for automatic numbering.

The amsmath package provides `\eqref` for referencing equations.

Example

```
\section{Introduction}\label{sec:intro}
In Section \ref{sec:method}, we \ldots
\section{Method}\label{sec:method}
```

Cross-reference text

Example: Cross-reference figure and table.

Figure 1 show a green bulb.

⇓

```
Figure \ref{fig:bulb} show a green bulb
```

The simulation data are shown in table 1

⇓

```
The simulation data are shown in table \ref{tab:parameter}
```

Cross-reference text

Example: Cross-reference equation

$$e^{i\pi} + 1 = 0 \tag{1}$$

By (1), we have ...

$$\Downarrow$$

```
\begin{equation} \label{eq:euler}
e^{i\pi} + 1 = 0
\end{equation}
By \eqref{eq:euler}, we have \ldots
\begin{center}
```

Notes with todonotes

The `\todo` command from the `todonotes` package is great for leaving notes to yourself and your collaborators.

Include this package in preamble:

```
\usepackage[colorinlistoftodos]{todonotes}
```

Example:

```
\todo{Plain todonotes.}

\todo[color=blue!40]{Todonote with a different color.}
```

Notes with todonotes

- Only inline notes are supported with beamer, but margin notes are supported for normal documents.
- There is also a handy `\listoftodos` command.
  - To use this load: `\usepackage[colorlinks]{hyperref}` before `\usepackage[colorinlistoftodos]{todonotes}`

Outline

Bibliography

To manage and include references in a LATEX document use BibTeX.

BibTex : a bibliographic tool that is used with LaTeX to help organize the user's references and create a bibliography.

- A BibTeX user creates a bibliography file with `.bib` extension.
- The `.bib` file is called a BibTEX database ⇒ a text file containing data in a structured format.
- Each entry in the `.bib` file is formatted with a certain structure and is given a "key" by which the author can refer to it in the source file.

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Bibliography

The BibTEX Format

The generic form of a BibTEX entry is

```
@type{key, field1 = “ ” or {} or none,
 field2 = “ ” or {} or none,
 ...
 fieldn = “ ” or {} or none
 }
```

Bibliography

The BibTEX Format

Example:

```
@article{Gettys90,
author = {Jim Gettys and Phil Karlton and Scott McGregor},
title = {The {X} Window System, Version 11},
journal = {Software Practice and Experience},
volume = {20},
number = {S2},
year = {1990},
abstract = {A technical overview of the X11 functionality.
of the X10 TOG paper by Scheifler \& Gettys.}
}
```

Bibliography

Export .bib file from Mendeley

- Open Mendeley, and within "My Library" found on the left, select references that you would like to texport to BibTeX.
- In the drop-down menu in the toolbar at the top of the screen, click "File → Export.
- In the dropdown list of filetypes chose "BibTeX (*.bib)" and save to the same location as the LaTeX file.

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Auto-syncing from Mendeley to BibTeX

Mendeley has the built-in capability to auto sync a BibTeX file when changes have been made to your Mendeley library.
To set up the Mendeley auto sync:

- Go to Mendeley Desktop preferences.
- Select the BibTeX tab.
- Select the box labeled “Enable BibTeX syncing” and select the BiBTeX file option you prefer.
- Select the location where you want the generated .bib file(s) to be stored (this should be the same location as your LaTeX file(s)).

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Bibliography

Using BibTEX in your LATEX Document

To use .bib file in latex document:

- We can use `natbib` packages with `\citet` and `\citep` commands ⇒ Reference sheet for natbib usage.
- Load with

  `\usepackage [options]{natbib}`

  See list of at the end of Reference sheet for natbib usage.
- Example: `\usepackage [round]{natbib}`
- Include .bib file at the end of document with `\bibliography {bib file}` and specify a bibliographic styles `\bibliographystyle {stylename}`.

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Bibliography

The BibTEX Format

Example:

```
\bibliographystyle{apa} %\bibliographystyle{apacite}
\newpage
\bibliography{bib/References_NILM}
```

Bibliography

The BibTEX Format

Example:

- According to Barker et al. (2015) ... ⇒

```
According to \cite{Alcala2015} \ldots
```

- ...energy is important (Barker et al., 2015) ⇒

```
\ldots energy is important \citep{Barker2015}
```

Outline

Thesis with Latex

Folder structure: create a new folder (your project directory).

- Add some additional folders within this folder:

  images ⇒ will contain all images.

  tex ⇒ will contain .tex file.

  bib ⇒ will contain bibliography files.

- This will help you keep the overview about your files.

Thesis with Latex

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Thesis with Latex

Creating the main LaTeX document: create a main tex file using document class report and save it into tex folder as Thesis.tex.

```
\documentclass[a4paper,12pt]{report}

\begin{document}

Hello World!

\end{document}
```

Thesis with Latex

Document structure: Let's create the main document structure for our thesis as shown below.

- Title page
- Abstract
- Table of contents
- List of Algorithms
- List of Figures
- List of Tables
- Introduction
- Literature Review
- Research Methodology
- Discussion
- Conclusion
- Acknowledgment
- Appendices
- Bibliography

Thesis with Latex

- First create the table of contents inside the begin and end document: `\tableofcontents` ⇒ a headline with Content will appear.
- To organize your files, create a new .tex file for each chapter of your thesis.
  - Lets create a new file and save it as Introduction.tex into the tex subfolder.

```
\chapter{Introduction}
\lipsum[2]
\section{Motivation}
\lipsum[4]
\section{Problem Statement}
\lipsum[3]
\section{Objectives}
\lipsum[2]
```

Thesis with Latex

- Import the file into you main document (Thesis.tex) after `\tableofcontents` as: `\input {tex/Introduction}`
- Great, we just started creating our document structure.
- Lets put all the other chapters in there as well.

```
\input {tex/Literature}
\input {tex/Methodology}
\input {tex/Results}
\input {tex/Conclusion}
```

- Don't forget to create the files, `\chapter {Some Name}` and save them.

Thesis with Latex

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Thesis with Latex

- Next add the additional lists just after `\tableofcontents`

  ```
  \listoffigures
  \listoftables
  \listofalgorithms
  ```

- The list of algorithms needs package:

  ```
  \usepackage {algorithm2e}
  ```

More details on how to typeset algorithms here.

Thesis with Latex

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More details on how to typeset algorithms here.

Thesis with Latex

Add Bibliography

- Auto-sync your Mendely bibliography library to bib subfolder.
- Add it to your main tex file and define a bibliography style just before `\end {document}`

```
\bibliographystyle {apa}
\bibliography {bib/References}
```

- Include the natbib package in preamble for citation

```
\usepackage [round]{natbib}
```

- For example to cite, write in any of you chapter files:

```
 We refer to \citet {Mvuma2016} for things you ...
```

Thesis with Latex

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We refer to \citet {Mvuma2016} for things you ...
```

Thesis with Latex

The title page

- Add a title page. Most universities require to use a predefined title page.
- Create a title.tex file and save it in tex subfolder. Define the title page as title page by inserting;
  `\begin {titlepage} tittle page contents \end {titlepage}`
- Input the file just after `\begin {document}` as follows:

Thesis with Latex

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  `\begin {titlepage} tittle page contents \end {titlepage}`
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Thesis with Latex

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- Create a title.tex file and save it in tex subfolder. Define the title page as title page by inserting;
  `\begin {titlepage} tittle page contents \end {titlepage}`
- Input the file just after `\begin {document}` as follows:

Thesis with Latex

Sample Tittle Page

```
\begin{titlepage}
\centering
{\Large \textbf{ MAXIMIZING LTE PERFORMACE WITH MIMO SYSTEMS}} \\
\vspace{0.5in}
\includegraphics[width=0.4\textwidth]{images/logo} \\
\vspace{1in}
{\large \textbf {\textbf{BY}}} \\
\vspace{.5in}
{\large \textbf {\textbf{JAMES KALUMUNA}}} \\
\vspace{1in}
{\large A dissertation in (partial) fulfillment of the requirements for
Master of Science in Telecommunications Engineering of the University of
\vspace{0.5in}
{\large University of Dodoma } \\
\vspace{0.1in}
{\large Jun 2015}
\end{titlepage}
```

Thesis with Latex

Add certification Page: Create a Certification.tex file and save it in tex subfolder, define it by inserting:

```
\begin{center}
{\large \textbf{CERTIFICATION}} \\
\vspace{2in}
\end{center}
The undersigned certify that they have read and hereby recommend
for acceptance by the University of Dodoma dissertation entitled
\textbf{Maximizing LTE performance with MIMO Systems} in fulfillment
of the requirements for the degree of \textbf{Master of Science in
Telecommunications Engineering} of the University of Dodoma.
```

Input the file just after `\input{tex/tittle}`.

Thesis with Latex

Add certification Page

Includes supervisors approval as follows

```
        \vspace{1in}
        \centering
        Approved by:
        \bigbreak

\noindent\begin{tabular}{ll}
\makebox[2.5in]{\hrulefill} & \makebox[2.5in]{\hrulefill}\\
Prof A.N Mvuma (First Supervisor) & Date\\[8ex]% adds space between the
\makebox[2.5in]{\hrulefill} & \makebox[2.5in]{\hrulefill}\\
Dr. Hector Mongi (Second Supervisor) & Date\\
\end{tabular}
```

Thesis with Latex

Add empty pages between the title, abstract and table of contents and change the numbering to be roman. The real Arabic page numbering of the thesis should start with the first page of the introduction.

- First include the following commands into the preamble:

```
\setcounter{secnumdepth}{3}
 % determines up to what level the sectioning titles are numbered
\setcounter{tocdepth}{3}
\pagenumbering{roman}
```

- Then add `\newcounter{rom}` just after the `\begin{document}`.

Thesis with Latex

- Also add the following commands just before `\tableofcontents`.

```
\addtocounter{rom}{1}\setcounter{page}{2}~
\newpage\thispagestyle{plain}\setcounter{page}{3}
```

- Finally add the following command just before `\input{tex/introduction}`.

```
\newpage\thispagestyle{plain}~
\clearpage
\pagenumbering{arabic}
```

Thesis with Latex

```
documentclass[a4paper,12pt]{report}

\usepackage{lipsum}  %Generate dummy text (lorem ipsum) in your
\usepackage{algorithm2e}  %
\usepackage[round]{natbib} %for citation
\usepackage{graphicx} % for images and figures

\setcounter{secnumdepth}{3}
\setcounter{tocdepth}{3}
\pagenumbering{roman}

\begin{document}
\newcounter{rom}
\input{tex/tittle} % The tittle page
\input{tex/Certification}

\addtocounter{rom}{1}\setcounter{page}{2}~
\newpage\thispagestyle{plain}\setcounter{page}{3}

\tableofcontents % Create table of comments
```

Thesis with Latex

```
\listoffigures % list of figures
\listoftables  % list of tables
\listofalgorithms % list of algorithms

\newpage\thispagestyle{plain}~
\clearpage
\pagenumbering{arabic}

\input{tex/introduction}
\input{tex/Literature}
\input{tex/Methodology}
\input{tex/Results}
\input{tex/Conclusion}

\bibliographystyle{apa}
\bibliography{bib/References}

\end{document}
```

Outline

THANK YOU

References I

References II

Barker, S., Musthag, M., Irwin, D., and Shenoy, P. (2015). Non-intrusive load identification for smart outlets. In *Proceeding of the 2014 IEEE International Conference on Smart Grid Communications, SmartGridComm 2014*, pages 548–553.