Writing Your Thesis with LaTeX and It's A Very Long Title That It Span to Three Lines Where the Longer the Title Makes Your Thesis Looks Awesome

by

BUDIN BIN BUYUNG
(161150042)

A thesis submitted in fulfilment of the requirements for the degree
of
Bachelor of Engineering (Biomedical Electronic Engineering)

School of Mechatronic Engineering
UNIVERSITI MALAYSIA PERLIS

2020

UNIVERSITI MALAYSIA PERLIS

DECLARATION OF REPORT

Author's Full Name	:	WAN ZUKI AZMAN WAN MUHAMAD
Title	:	NEW DIMENSION IN MULTIVARIATE PATTERN RECOGNITION FOR THE APPLICATION OF INDUSTRIAL PROCESS TECHNOLOGY INDUSTRIAL PROCESS TECHNOLOGY INDUSTRIAL PROCESS TECHNOLOGY
Date of Birth	:	20 OCTOBER 1994
Academic Session	:	2016/2017

I hereby declare that this report becomes the property of Universiti Malaysia Perlis (UniMAP) and to be placed at the library of UniMAP. This report is classified as:

☐	**CONFIDENTIAL**	(Contains confidential information under the Official Secret Act 1997)*
☐	**RESTRICTED**	(Contains restricted information as specified by the organization where research was done)*
☑	**OPEN ACCESS**	I agree that my report to be published as online open access (Full Text)

I, the author, give permission to reproduce this report in whole or in part for the purpose of research or academic exchange only.

Checked and approved by:

SIGNATURE OF STUDENT	**SIGNATURE OF SUPERVISOR**
950923-01-1001	PROF. DR. MOHD YUSOF MASHOR
(NEW IC NO. /PASSPORT NO.)	**NAME OF SUPERVISOR**
Date: 20 October 2016	Date: 25 December 2016
	Supervisor official stamp

NOTES : * If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization with the period and reasons for confidentiality or restriction.

UNIVERSITI MALAYSIA PERLIS

PANEL APPROVAL AND DECLARATION SHEET

Author's Full Name	:	WAN ZUKI AZMAN WAN MUHAMAD
Title	:	NEW DIMENSION IN MULTIVARIATE PATTERN RECOGNITION FOR THE APPLICATION OF INDUSTRIAL PROCESS TECHNOLOGY INDUSTRIAL PROCESS TECHNOLOGY INDUSTRIAL PROCESS TECHNOLOGY
Date of Birth	:	20 OCTOBER 1994
Academic Session	:	2016/2017

This project report has been found satisfactory in terms of scope, quality and presentation as partial fulfilment of the requirement for the Bachelor of Engineering (Biomedical Electronic Engineering) in Universiti Malaysia Perlis (UniMAP).

Checked by:	Checked by:
SIGNATURE OF PANEL 1	**SIGNATURE OF PANEL 2**
DR MUHAMMAD JUHAIRI AZIZ BIN SAFAR	PROF. DR. MOHD YUSOF MASHOR
NAME OF PANEL 1	**NAME OF PANEL 2**
Date: 20 October 2016	Date: 25 December 2016
Panel official stamp	Panel official stamp

ACKNOWLEDGEMENT

Many thanks to Prof. Donald Knuth for giving us TEX, and Leslie Lamport for LATEX.

I first heard about LATEX as a postgraduate student in Australia. But back then, I have no idea how the LATEX works. Then, I started to learn how to **use** LATEX for conference/journal paper. I planned to write my Doctor of Engineering (DE) thesis (University of Fukui, Japan) in LATEX but somehow my supervisor is more comfortable with standard word processor. So, good bye LATEX!!.

Back in Malaysia, I picked it up again because I want to make a LATEX template for postgraduate thesis in UniMAP. But, I started with FYP level first. Thanks to the `usmthesis.cls` template provided by Lim Lian Tze.

One thing led to another, and I now conduct trainings and consultations on LATEX in UniMAP (for the time being).

Hope everyone can GOT!

Mohd Hanafi Mat Som, DE

TABLE OF CONTENTS

PAGE

DECLARATION OF REPORT **i**

PANEL APPROVAL AND DECLARATION SHEET **ii**

ACKNOWLEDGEMENT **iii**

TABLE OF CONTENTS **iv**

LIST OF TABLES **vi**

LIST OF FIGURES **vii**

LIST OF ABBREVIATIONS **ix**

LIST OF SYMBOLS **x**

ABSTRAK **xi**

ABSTRACT **xii**

CHAPTER 1 INTRODUCTION **1**

1.1 Background History 1

1.2 Samples of Basic LaTeX 2

1.3 Dimensions in LaTeX 5

1.4 Special Characters 5

1.5 Useful Resources 6

1.6 Useful Tips 7

CHAPTER 2 LITERATURE REVIEW **8**

2.1 Citations and Bibliography 8

2.2 The `*.bib` File 8

2.3 Citations using the `natbib` package 10

2.3.1 IEEE Citation Style 10

2.3.1.1 Change citation format 11

2.3.2 Entry Types 11

CHAPTER 3 METHODOLOGY 12

3.1 Figures, Tables, Equations, Algorithms, etc 12

3.2 Inserting Figures 12

3.3 How Do I Do Subfigures? 15

3.4 Inserting Tables 16

3.5 Long Table Spanning More Than a Page 20

3.6 Full-paged, Sideways Figures and Tables 22

3.7 Mathematical Equations 27

3.7.1 Puting equations in the text 29

3.7.2 Equation aligned at = 29

3.7.3 Normal text in math mode 30

3.7.4 Bold Math and Vector 31

3.8 Acronyms 31

3.9 Program Listings 32

CHAPTER 4 RESULT & DISCUSSION 35

4.1 Printing Your Thesis 35

CHAPTER 5 CONCLUSION 36

REFERENCES 37

APPENDIX A DATA USED 39

APPENDIX B UML DIAGRAMS 40

APPENDIX C DUMMY APPENDIX 41

LIST OF TABLES

		PAGE
Table 1.1	Special Characters in LaTeX	6
Table 3.1	A table with decimal data	18
Table 3.2	A table with decimal data (mis-aligned)	18
Table 3.3	This is an example to for a table. This is straightforward version. The caption of this table is long that takes up to two lines.	18
Table 3.4	This is another example for a table. Advance version of a table.	19
Table 3.5	This is an example to for a table	20
Table 3.6	This is an example of a long table	21
Table 3.7	This is an example of a sidewaystable.	24
Table 3.8	This is an example of a long table in landscape page using `pdflscape` package	25

LIST OF FIGURES

		PAGE
Figure 1.1	Common Layout and Formatting Tasks. Note how this long title wraps around I hope it works anyway. Look it needs more, so here's some more longer text. Is that enough? I hope it is.	2
Figure 1.2	Compact Lists	3
Figure 1.3	Compact Lists and single spacing	4
Figure 1.4	Compact Lists, single spacing, and change the numbered format	5
Figure 1.5	Dimension in LaTeX	5
Figure 2.1	A BibTeX Entry	8
Figure 2.2	Setting Google Scholar to show Import to BibTeX menu	9
Figure 3.1	Including a Graphics File	13
Figure 3.2	Pythagoras' Theroem	13
Figure 3.3	Creating subfigures within figures	15
Figure 3.4	This is the main caption of the figure. The caption of this figure is long enough to take up two lines.	15
Figure 3.4(a)	First caption	15
Figure 3.4(b)	Second caption	15
Figure 3.5	This is how you do subfigures	16
Figure 3.5(a)	This is a plot of *Absolute Salinity* across a section of the ocean, x-axis is latitude, y-axis is depth	16
Figure 3.5(b)	This is a plot of *Absolute Salinity* across the surface of the ocean around Tasmania in summer 2007, x-axis is longitude, y-axis is latitude	16
Figure 3.5(c)	This is a plot of *dissolved aluminium* across the same section of the ocean as 3.5a, x-axis is latitude, y-axis is depth	16
Figure 3.6	Aligning decimal data in tables	17

Figure 3.7 Note the differences between this table and previous tables. 19
Figure 3.8 Including a sideway, full-page graphic 22
Figure 3.9 A full-page, sideways figure 23
Figure 3.10 Typesetting Mathematical Equations 28
Figure 3.11 The template `loa.tex` for acronyms 31
Figure 3.12 Typesetting a Java program listing 32
Figure 3.13 A pretty-printed Java program listing with syntax highlighting 32
Figure 3.14 Typesetting a C program listing 33
Figure 3.15 A pretty-printed C program listing with syntax highlighting 33
Figure 3.16 A C program listing without syntax highlighting 34

LIST OF ABBREVIATIONS

CGS	Centre for Graduate Studies
PPKMt	Pusat Pengajian Kejuruteraan Mekatronik
USM	Universiti Sains Malaysia
UniMAP	Universiti Malaysia Perlis

LIST OF SYMBOLS

lim	limit
θ	angle in radians

ABSTRAK

Ini merupakan abstrak Melayu untuk tesis UniMAP. Ianya disediakan dengan sistem penyediaan dokumen LaTeX.

Writing Your Thesis with LaTeX and It's A Very Long Title That It Span to Three Lines Where the Longer the Title Makes Your Thesis Looks Awesome

ABSTRACT

This is the English abstract of a UniMAP thesis. It was prepared with the LaTeX document typesetting system.

CHAPTER 1: INTRODUCTION

1.1 Background History

Hello and welcome, Universiti Malaysia Perlis (UniMAP) FYP students! The `unimapcgsfyp` class and template files were written in the hope that they may help you prepare your research thesis using LaTeX, based on the Centre for Graduate Studies (CGS) requirements [1]. **Please note that this version is based on the guidelines, in force 2017 onwards.** Also, I would like to give credit to Lim Lian Tze, where this document class is created based on her *usmthesis.cls* [2]. The explanation beyond this paragraph also heavily edited based on her *usmthesis.cls* document class.

If you prefer the acronym to be written in full like it was mentioned first time, use `\acf{youracronym}`. Subsequently, you use the usual `\ac{youracronym}`. Remember the acronym for Universiti Malaysia Perlis (UniMAP)?.

LaTeX is powerful and produces beautiful documents. However, there is definitely a learning curve to it – one that is worth the effort. If you find any errors in these templates or documents [3], or have any suggestions or feedback, do e-mail me about it (`msmhanafi@gmail.com`). The author cannot always guarantee prompt response, however.

MiKTeX, my recommended LaTeX distribution for Windows, is available on the `https://miktex.org/howto/install-miktex`. Macbook users can opt to install

MacTeX `http://www.tug.org/mactex/`. The complete version of MacTeX (over 2 gigabytes of material) installs TeXShop, a GUI front end to TeX, TeX Live 2019, a GUI front end to manage LaTeX core and packages, and other important materials. The basic version of MacTeX is lightweight (around 110 megabytes) but require user to install TeX Live 2019 separately.

1.2 Samples of Basic LaTeX

There are plenty of free LaTeX tutorials online. This sample thesis includes some examples to do some common tasks. We start with some examples for lists (both bulleted and numbered), highlighting texts in bold and italic, and URLs:

```
\begin{enumerate}
\item bulleted and numbered lists,
\item font effects such as

\begin{itemize}
\item \textbf{bold},
\item \emph{italic}, and
\item \texttt{typewriter-like}
\end{itemize}

\item URLs and e-mail addresses: \url{http://www.mohdhanafi.unimap.edu.
   my/template}, \url{dummy.add@outlook.com};
\item citations: see Chapter \ref{chap:review}.
\end{enumerate}
```

Figure 1.1 Common Layout and Formatting Tasks. Note how this long title wraps around I hope it works anyway. Look it needs more, so here's some more longer text. Is that enough? I hope it is.

1. bulleted and numbered lists,
2. font effects such as
    - **bold**,

    - *italic*, and
    - `typewriter-like`

3. URLs and e-mail addresses:

   `http://www.mohdhanafi.unimap.edu.my/template`, `dummy@outlook.com`;

4. citations: see Chapter 2

Incidentally, if you feel that the lists above are too far apart vertically, you can customize them using the `enumitem` package. The effect is then like the following:

```
\begin{enumerate}[nosep]
\item item one,
\item item two,
\item item three.
\end{enumerate}

\begin{itemize}[nosep]
\item item one,
\item item two,
\item item three.
\end{itemize}
```

Figure 1.2 Compact Lists

1. item one,
2. item two,
3. item three.

- item one,
- item two,
- item three.

Granted, the lists are still wide, but this is because we need to honour the

requirement for double line-spacing. If allowable, then you can do the list in single line-spacing.

```
\begin{enumerate}[nosep]\singlespacing
       \item item one,
       \item item two,
       \item item three.
\end{enumerate}

\begin{itemize}[nosep]\singlespacing
       \item item one,
       \item item two,
       \item item three.
\end{itemize}
```

Figure 1.3 Compact Lists and single spacing

1. item one,
2. item two,
3. item three.

- item one,
- item two,
- item three.

If, for some reasons, you want to change the look of your numbered list or bullet shape, you can refer to this post `https://texblog.org/lists-enumerate-itemize/` and `http://www.texnia.com/archive/enumitem.pdf`. For examples, you can change to number with parenthesis (`\arabic*`), alphabet `\alph*` or `Alph*`, roman style `\roman*` or `\Roman*`

(1) item one,
(2) item two.

(a) item one,
(b) item two.

I) item one,
II) item two.

```
\begin{enumerate}[nosep,label=(\arabic*)]\singlespacing
        \item item one,
        \item item two.
\end{enumerate}

\begin{enumerate}[nosep,label=(\alph*)]\singlespacing
        \item item one,
        \item item two.
\end{enumerate}

\begin{enumerate}[nosep,label=\Roman*)]\singlespacing
        \item item one,
        \item item two.
\end{enumerate}
```

Figure 1.4 Compact Lists, single spacing, and change the numbered format

1.3 Dimensions in LaTeX

Examples of dimension in LaTeX are given in Figure 1.5.

1pt	1mm	1cm	1ex	1em	1bp	1dd	1pc	1in	
1	2.84526	28.45274	4.30554	10.00002	1.00374	1.07	12	72.26999	**pt**
0.35146	1	10.00005	1.51323	3.51462	0.35277	0.37607	4.21754	25.40013	**mm**
0.03514	0.1	1	0.15132	0.35146	0.03528	0.03761	0.42175	2.54	**cm**
0.23225	0.66084	6.6084	1	2.32259	0.23312	0.24852	2.78711	16.78534	**ex**
0.1	0.28453	2.84528	0.43056	1	0.10037	0.107	1.2	7.22699	**em**
0.99628	2.83467	28.34677	4.2895	9.96277	1	1.06602	11.9553	72.00082	**bp**
0.93457	2.6591	26.59117	4.02385	9.34575	0.93806	1	11.21487	67.54158	**dd**
0.08333	0.2371	2.37106	0.3588	0.83333	0.08365	0.08917	1	6.0225	**pc**
0.01384	0.03937	0.3937	0.05957	0.13837	0.01389	0.0148	0.16605	1	**in**

Figure 1.5 Dimension in LaTeX

1.4 Special Characters

Bear in mind that certain characters are special LaTeX symbols and need to be escaped, as shown in Table 1.1.

Note that for quotation marks, you might prefer ``this'' and `that' (“this” and ‘that’) instead of "this" and 'that' ("this" and 'that'). The symbol ` can be found

Table 1.1 Special Characters in LaTeX

Symbol	Name	Escape code
#	hash, pound	\#
$	dollar	\$
%	percent	\%
^	"hat"	\^{}
&	ampersand	\&
_	underscore	_
{	left brace	\{
}	right brace	\}
~	tilde	\~{}
$\sim$	wide tilde	$\sim$
"	open double quotes	``
"	close double quotes	''

below esc keyboard, together with tilde ~ symbol.

If you need to typeset special characters (such as $\curvearrowright$, etc), take a look at the left side on the navigation panel of the TeXstudio. If you installed MiKTeX on a Windows machine, Comprehensive LaTeX Symbol List could be found under C:\ProgramFiles\MiKTeX2.9\doc\info\symbols\comprehensive\symbols-a4.pdf.

1.5 Useful Resources

Mittelbach et al. [4] is a *very* useful book — but it's quite an investment at RM180++. A worthy one, nevertheless. Roberts [5] has a website with very good LaTeX tutorials at http://www.comp.leeds.ac.uk/andyr/misc/latex/, too. Don't forget the famous lshort https://tobi.oetiker.ch/lshort/lshort.pdf tutorial [6].

You can also find the list compiled by Lim Lian Tze (the template owner of usmthesis.cls, which this thesis is based on) at http://liantze.penguinattack.org/latextypesetting [7]. Also, on my website

http://mohdhanafi.unimap.edu.my/[3].

1.6 Useful Tips

You might encounter where the section heading in the table of contents appear at the bottom of the page. You can force a page break before a table of content entry. Place an insertion point above the heading in the document, then type `\addtocontents{toc}{\protect\pagebreak}`. Recompile the document and you can see the change on the table of contents.

For example, the Chapter 3 header appear at the bottom of the page.

```
\addtocontents{toc}{\protect\pagebreak}
\chapter{Figures, Tables, Equations, Algorithms, etc}\label{chap:
    design}
```

If you encounter problems, please make use of google. Start by searching `latex yourproblem`. For example, `latex figure size`.

CHAPTER 2: LITERATURE REVIEW

2.1 Citations and Bibliography

This is supposed to be your literature review chapter. Instead, we look at ways to prepare the bibliography and citations instead.

2.2 The `*.bib` File

First of all, bear in mind that your bibliography file (`*.bib` files) is like a database like Mendeley. That means you can maintain a centralised list, and reuse it for all your publications. LaTeX will only list sources that you actually cite in the text for each document, according to the bibliography and citation style you select in each document. But you can still hack it so that your own publications are listed, even if you did not cite it. The order of the entry is not important.

```
@BOOK{latex:companion,
  title = {The {\LaTeX} Companion},
  publisher = {Addison-Wesley},
  year = {2004},
  author = {Frank Mittelbach and Michel Goosens and Johannes Braams and
      David Carlisle and Chris Rowley},
  series = {Addison-Wesley Series on Tools and Techniques for Computer
      Typesetting},
  address = {Boston, MA, USA},
  edition = {2nd}
}
```

Figure 2.1 A BibTeX Entry

As an example, in `mybib.bib` I created a BibTEX entry with JabRef and google scholar, the source text of which is shown in Figure 2.1. Go to `https://scholar.google.com/`, click setting (on the left side of the page with three lines), click `Show links to import citations into BibTeX` under the `Bibliography manager` menu, and click `Save`.

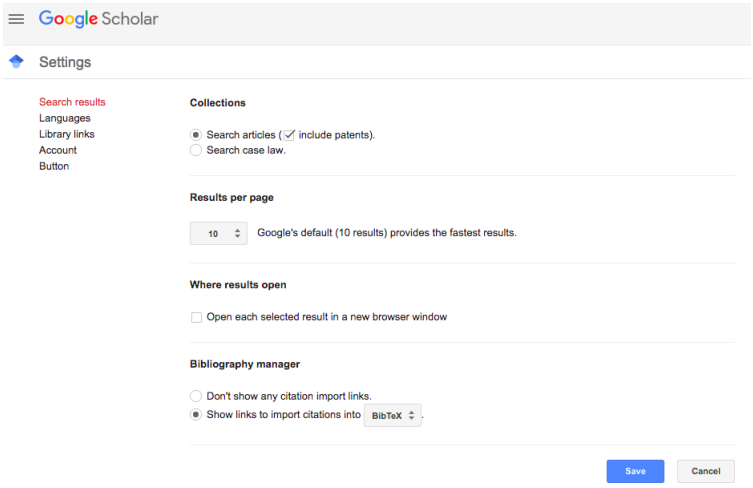


Figure 2.2 Setting Google Scholar to show Import to BibTeX menu

One thing to note about authors' names: BibTEX recognises "Mittelbach" as the last name for both `Frank Mittelbach` and `Mittelbach, Frank`. So for a name like "Mohd Hanafi Mat Som" and "Lim Lian Tze", you would have to specify it as `Mat Som, Mohd Hanafi` and either `Lian Tze Lim` or `Lim, Lian Tze` for BibTEX to recognise "Mat Som" and "Lim" as the last name correctly. In addition, note that my surname (or family name) consists of multiple words, thus enclose it with braces to avoid surprises, like so: `Mohd Hanafi {Mat Som}`.

2.3 Citations using the `natbib` package

The `unimapcgsfyp` class imports the `natbib` package which provides citation mechanism as per required by the CGS (and School), so see its documentation for more details. On a MiKTEX installation, use the command prompt to issue `mthelp --view natbib` to access the documentation. On TeXLive, simply type `texdoc natbib` and the documentation will be displayed automatically, if it's found on your machine.

The basic citation commands are `\citet` and `\citep`, which stands for *textual* and *parenthetical* citation respectively. They take extra arguments, too, for adding notes in the citations. Please refer to the `natbib` manual `http://texdoc.net/texmf-dist/doc/latex/natbib/natbib.pdf` [1, 2, 4, 7].

2.3.1 IEEE Citation Style

The default for FYP bibliography style is IEEE:

- `\citet{latex:companion}` → Mittelbach et al. [4]
- `\citep{latex:companion}` → [4]
- `\citet{latex:companion,roberts}` → Mittelbach et al. [4], Roberts [5]
- `\citep{latex:companion,roberts}` → [4, 5]
- `\citet[chap.~2]{latex:companion}` → Mittelbach et al. [4, chap. 2]
- `\citep[chap.~2]{latex:companion}` → [4, chap. 2]

You may also want to write only the author's name or year occassionally:

- `\citeauthor{latex:companion}` → Mittelbach et al.
- `\citeyear{latex:companion}` → 2004

2.3.1.1 Change citation format

You may want to change the citation format for example in literature review table. See Table 3.6 in Chapter 3. This can be achieved using `\setcitestyle{authoryear,round}`. For more information please see the `natbib` documentation.

- `\citet{latex:companion}`
  → Mittelbach et al. [4]
- `\citet{latex:companion} {\setcitestyle{authoryear,round} }`
  → Mittelbach et al. (2004)
- `\citet{latex:companion}`
  → Mittelbach et al. [4]

2.3.2 Entry Types

This section give some examples of entry of references. There references are formatted according to IEEE style [8].

- Journal (`@article`): Othman et al. [9]
- Proceeding/Conference (`@inproceedings`): Wanna et al. [10] found that...
- Book (`@book`): As mentioned earlier [4]
- Internet Sources (`@misc`): As mentioned earlier [7]

CHAPTER 3: METHODOLOGY

3.1 Figures, Tables, Equations, Algorithms, etc

This is supposed to be the design or methodology chapter. Instead, we include examples on inserting figures, tables, mathematical equations. . . i.e. things that you might want to include in your thesis.

3.2 Inserting Figures

You can draw diagrams with special LaTeX commands, but this may take some extra time to learn. I've had some forays into the `pgf` and `tikz` packages and must say I quite like the results; but as I said, they take time to learn. If you want a faster solution, you can draw your diagrams using other applications, and saving them as graphic files (EPS, PNG, JPG, PDF).

LaTeX requires EPS (encapsulated postscript) graphic files when generating DVI output, and **PNG, JPG or PDF** when generating **PDF output**.

For exporting to EPS, try `http://www.cloudconvert.com`. It's like a Swiss knife for converting from almost any format, to almost any format.

Here's how to insert a picture with the filename `pythag.eps` or `pythag.png`. I'm going to display it here with 5cm width, and the caption "Pythagoras' Theorem".

```
\begin{figure}[hbt!]\centering
\includegraphics[width=50mm]{pythag}
%\includegraphics[width=.4\textwidth]{pythag}
%\includegraphics[keepaspectratio=true, width=.4\textwidth, height=10cm
    ]{pythag}
%\includegraphics[scale=0.7]{pythag}
\caption{Pythagoras' Theorem}
\label{fig:pythagoras}
\end{figure}
```

Figure 3.1 Including a Graphics File

The result would be:

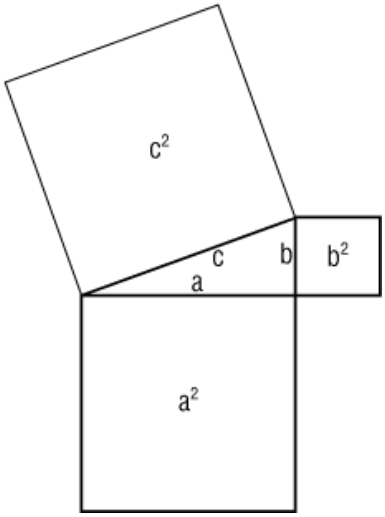


Figure 3.2 Pythagoras' Theroem

Don't specify the extension of the graphic file. The template will automatically look for the EPS or the PNG (or otherwise) versions, depending on whether `latex` or `pdflatex` was used. The `figure` environment will also ensure that that an entry is inserted into the *List of Figures* automatically – including the figure numbering, caption and page number.

In addition, the width of the included graphics can also be specified as a percentage of the text width, e.g. `width=.4\textwidth` would cause the graphics to occupy 40% of the text width. You can also use `scale=0.7` to scale the figure to 70% of the original

size. If you specify the width and height, you might want to keep the aspect ratio of the image by using `keepaspectratio=true`.

Notice that I inserted a `\label` just after the `\caption`. This can be used for referencing the figure number, like this:

`Figure \ref{fig:pythagoras}` → Figure 3.2

This works the same for chapters, sections, tables, equations too. In `chap-intro.tex`, I labelled the Introduction chapter with `\label{chap:intro}`. I also labelled the section on inserting figures, `\label{sec:figure}`. So now I can do

`Chapter \ref{chap:intro}` → Chapter 1

`section \ref{sec:figure}` → section 3.2

Everytime the numbering of the heading changes, the reference will change automatically as well. **This is another advantage of using LaTeX**: you do not need to manually update the reference counters (nor the Table of Contents, List of Figures and Tables) whenever you add or remove figures, tables, sections or chapters.

Please read more about how to handle figure here `https://en.wikibooks.org/wiki/LaTeX/Floats,_Figures_and_Captions`.

You might also want to try out `Inkscape` or `FlowframTk`. Both program are a vector graphics and drawing application, and can export to LaTeX code which you can paste into your LaTeX source. `Inkscape` and `FlowframTk` are available from `https://inkscape.org/` and `https://www.dickimaw-books.com/software/flowframtk/`.

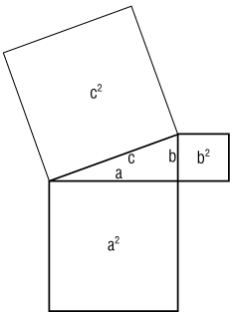
3.3 How Do I Do Subfigures?

Here's an example on how to do subfigures (and similarly subtables):

```
\begin{figure}[hbt!]
  \begin{minipage}{.39\textwidth}
  \centering
  \subfloat[First caption]{\includegraphics[width=3cm]{pythag}} \label{
     fig:sub1}
  \end{minipage}
  \hfill
  \begin{minipage}{.59\textwidth}
  \vspace{6.5ex}
  \subfloat[Second caption]{\includegraphics[scale=0.35]{mechatronic}}\
     label{fig:sub2}
  \end{minipage}

  \caption{This is the main caption of the figure.}
  \label{fig:main}
\end{figure}
```

Figure 3.3 Creating subfigures within figures



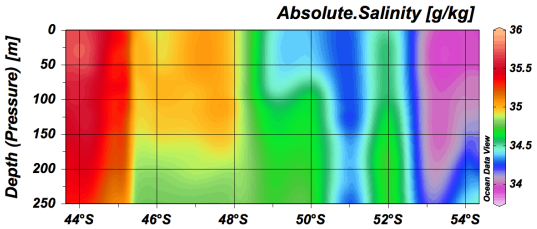
(a) First caption

(b) Second caption

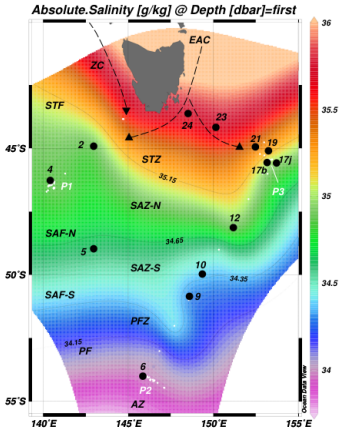
Figure 3.4 This is the main caption of the figure. The caption of this figure is long enough to take up two lines.

Note that I added vertical space on the second figure using `\vspace` to force the caption on the same level with the first figure.

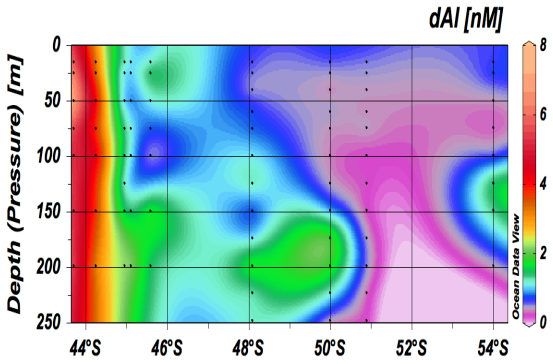
Another examples of subfigure is given in Figure 3.5.



(a) This is a plot of *Absolute Salinity* across a section of the ocean, x-axis is latitude, y-axis is depth



(b) This is a plot of *Absolute Salinity* across the surface of the ocean around Tasmania in summer 2007, x-axis is longitude, y-axis is latitude



(c) This is a plot of *dissolved aluminium* across the same section of the ocean as 3.5a, x-axis is latitude, y-axis is depth

Figure 3.5 This is how you do subfigures

3.4 Inserting Tables

Typesetting tables can be a little troublesome especially with complex layouts. Look up Roberts [5] to learn about some tips, or the wikibook for table `https://en.wikibooks.org/wiki/LaTeX/Tables`, or you can use the online LaTeX table generator (`https://www.tablesgenerator.com/`) to help you.

When you're done designing the table, copy the whole table as LaTeX code, and paste it in your source file. (You may add additional formatting commands, like bold, italics, etc.) If this is going to be a numbered table, remember to surround it with `\begin{table}` and `\end{table}`, and give it a caption.

Note also that `fypcgsthesis.cls` is configured such that captions for figures are placed *below* the figures, and captions for tables are placed *above* them, in accordance with the formatting guidelines.

Many of us would have had massive headaches about lining up decimal places in table columns if not for this tip from Mittelbach et al. [4, pp. 274–276]. This method uses the `dcolumn` package (already loaded by `unimapcgsfyp.cls`). Instead of using `L`,`C` or `R` as the column type in the `tabulary` declaration, use `D{`*`input sep`*`}{`*`output sep`*`}{`*`decimal places`*`}`. Note that in Table 3.1, I use `tabulary` instead of `tabular`. The `tabulary` package is awesome. The column width is set automatically so that it will wrap long sentences into a few lines as demonstrated in Table 3.3.

```
\begin{table}[htb!]\centering
\begin{tabulary}{\textwidth}{ C D{.}{.}{3} }
\toprule[1.2pt]
Item & \multicolumn{1}{c}{Reading}\\ \midrule[1.2pt]
A & 1.11\\
B & 3.999\\
C & 22.2\\
\bottomrule[1.2pt]
\end{tabulary}
\caption{A table with decimal data}\label{tab:align:decimal}
\end{table}
```

Figure 3.6 Aligning decimal data in tables

The LaTeX code in Figure 3.6 will give you Table 3.1.

Table 3.1 A table with decimal data

Item	Reading
A	1.11
B	3.999
C	22.2

Without using `dcolumn`, you'd get something like this:

Table 3.2 A table with decimal data (mis-aligned)

Item	Reading
A	1.11
B	3.999
C	22.2

Table 3.3 This is an example to for a table. This is straightforward version. The caption of this table is long that takes up to two lines.

Short sentences	short one	Long sentences
This is short.	173	This is much looooooooonger, because there are many more words.
This is not shorter.	put some word here	This is still looooooooonger, because there are many more words. This table make use of `tabulary` package.

In Table 3.3 and 3.4, I specify the position of the table as `H` instead of `tbh!` so that the table will appear **HERE** instead of giving the decision to LaTeX for placing the table either *top*, *bottom*, or *here*.

```
\begin{table}[H]\centering \singlespacing
\caption{This is another example for a table. Advance
   version of a table.} \label{tab:tablemulticolumnrow}
\begin{tabulary}{0.8\textwidth}{|C|R|C|}
\hline
\multicolumn{2}{|c|}{\textbf{Merge 2 columns}} & \textbf{
   Long sentences} \\ \hline
\multirow{2}{=}[-4.5mm]{This is short text LoL.} & \
   multicolumn{1}{c|}{\multirow{2}{*}{173}} & This is
   much looooooooonger, because there are many more words.
    \\ \cline{2-3}
& put some word here & This is still looooooooonger,
   because there are many more words. \\ \hline
\end{tabulary}
\end{table}
```

Figure 3.7 Note the differences between this table and previous tables.

Table 3.4 This is another example for a table. Advance version of a table.

Merge 2 columns		**Long sentences**
This is short text LoL.	173	This is much looooooooonger, because there are many more words.
	put some word here	This is still looooooooonger, because there are many more words.

Table 3.4 set the table width so that it will occupy 80% of the paper width. Then, I use `multirow` package to span through 2 columns. This package also can be made to adjust the vertical alignment in a table whenever a row occupy more than a single line of sentence. Try to use either * or = with `\multirow` width. `multicolumn` not only use to merge two or more column, but can also be used to change a properties of a single row and column such as the text alignment and table border.

Table 3.5 This is an example to for a table

Merge 2 columns		**Long sentences**
This is short.	173	This is much looooooooonger, because there are many more words.
	put some word here	This is still looooooooonger, because there are many more words.

If you want to specify the exact size of each column, then make use of `p{size}`, `m{size}`, or `b{size}`. `p` means normal cells, they are like parbox with alignment at the top line. `b` means alignment at the bottom, so the baseline is at the bottom line. `m` means alignment in the vertical center, i.e. the baseline is in the center. However, they not work very well with `multitrow`. Example of specific size table is given in the next example, Table 3.6. The table uses ratio of the textwidth, e.g. A4 paper width.

3.5 Long Table Spanning More Than a Page

Samples of typesetting for longtable also can be found here at `https://textblog.org/...longtable`. For further information, you can refer to `longtable` documentation.

Table 3.6 give you the example of using longtable that spans through more than a page.

Table 3.6 This is an example of a long table

Author (Year)	**Methodology**	**Important Findings**
Mittelbach et al. (2004)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Othman et al. (2019)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Wanna et al. (2018)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Mat Som (2019)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Othman et al. (2019)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Wanna et al. (2018)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Mittelbach et al. (2004)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Othman et al. (2019)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Wanna et al. (2018)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Mat Som (2019)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Othman et al. (2019)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Wanna et al. (2018)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Mittelbach et al. (2004)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Othman et al. (2019)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Wanna et al. (2018)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Mat Som (2019)	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Othman et al. (2019)	Explain the methodology used in the paper.	Explain important findings you found in the paper.

Continue to next page ...

Author (Year)	Methodology	Important Findings
Wanna et al. (2018)	Explain the methodology used in the paper.	Explain important findings you found in the paper.

3.6 Full-paged, Sideways Figures and Tables

To make a figure appear on a landscape, full-page layout, put your `\includegraphics` command in a `sidewaysfigure` environment (Figure 3.8).

```
\begin{sidewaysfigure}\centering
\includegraphics[width=\textheight]{latex-win-comp}
\caption{A full-page, sideways figure}\label{fig:sidewaysfig}
\end{sidewaysfigure}
```

Figure 3.8 Including a sideway, full-page graphic

The resultant figure (Figure 3.9) should appear on the next page.

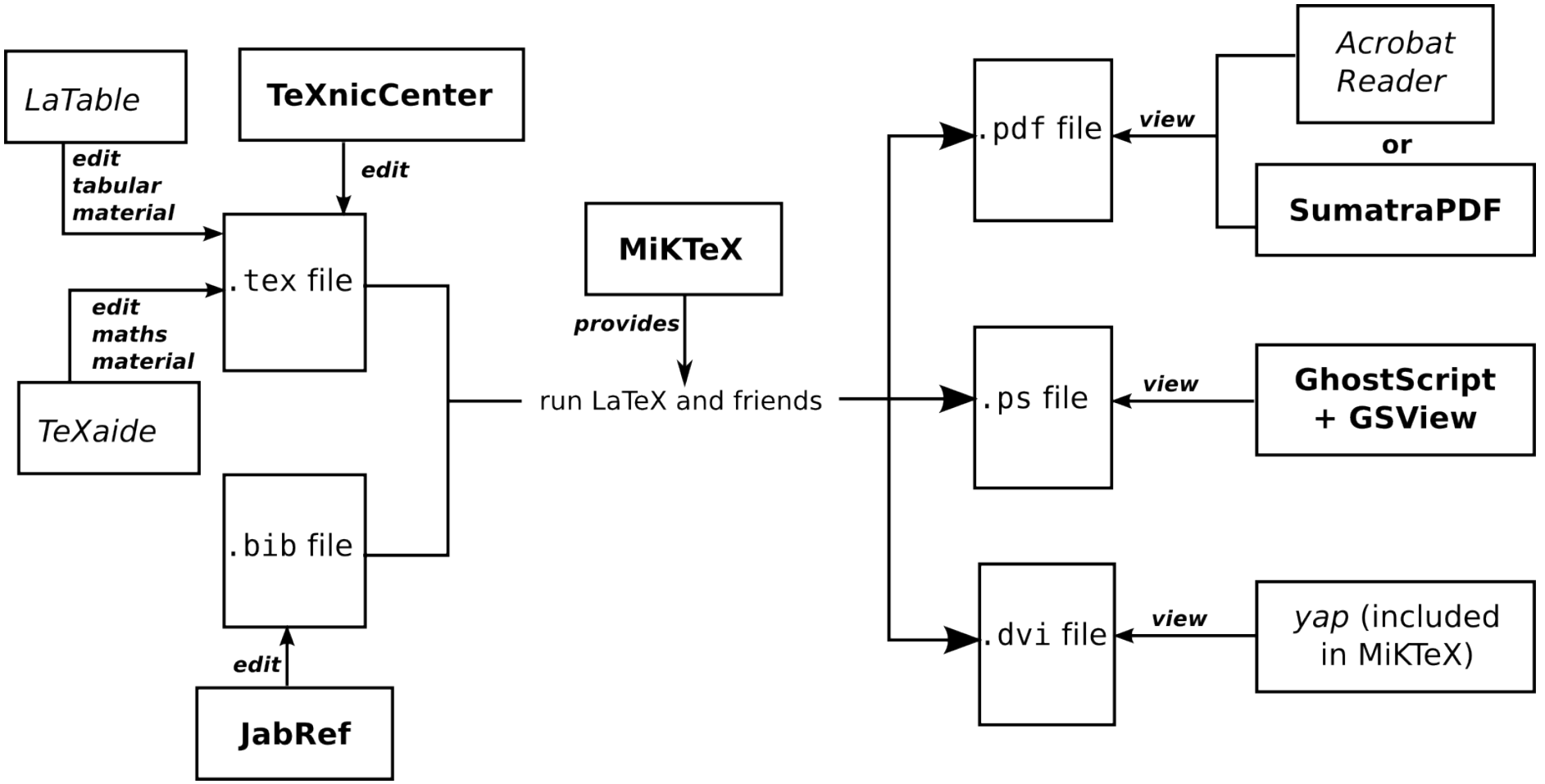


Figure 3.9 A full-page, sideways figure

Table 3.7 This is an example of a sidewaystable.

Short sentences	short one	Long sentences
This is short.	173	This is much looooooooonger, because there are many more words.
This is not shorter.	put some word here	This is still looooooooonger, because there are many more words. This table make use of `tabulary` package.

Table 3.8 This is an example of a long table in landscape page using `pdflscape` package

Author (Year)	**Title**	**Methodology**	**Important Findings**
Mittelbach et al. (2004)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Othman et al. (2019)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Wanna et al. (2018)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Mat Som (2019)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Othman et al. (2019)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Wanna et al. (2018)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Mittelbach et al. (2004)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Othman et al. (2019)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Wanna et al. (2018)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Mat Som (2019)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Othman et al. (2019)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.

Continue to next page ...

Author (Year)	Title	Methodology	Important Findings
Othman et al. (2019)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.
Wanna et al. (2018)	The title of the paper	Explain the methodology used in the paper.	Explain important findings you found in the paper.

For a sideways table, use the `sidewaystable` environment instead around your usual `tabular` material. The default positioning of the figure/table is in the middle of a page. You can use `\setlength{\rotFPtop}{3pc}` before the `sidewaystable` environment to change the figure/table positioning. Please enclose the `sidewaystable` environment inside `begingroup` and `endgroup` so that it won't affect the positioning of the figure/table of the whole document. Play around with the size, 1pc, 0pt etc.

However, for a table that spans to multiple pages (using `longtable`), you **must** use `lscape` or `pdflscape` package. `sidewaystable` didn't work with `longtable`. Please refer to the `.tex` file to see how it is written. `pdflscape` package will rotate the landscape page for better readability.

3.7 Mathematical Equations

Typesetting mathematical material is one of, if not *the*, strongest capabilities of LaTeX. After all, that was the Knuth's main motivation for creating TeX. As it is impossible to enumerate all possible mathematically-related commands and macros here, I will just give some examples. The reader is directed to the many well-written online tutorials, such as `https://en.wikibooks.org/..Mathematics`, Roberts [5], for more elaborate examples. You can also refer to documentation of `amsmath` package.

$$z^2 = x^2 + y^2 \tag{3.1}$$

$$\phi = \frac{1}{2}(1+\sqrt{5}) \tag{3.2}$$

$$\phi = 1 + \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{F_n F_{n+1}} \tag{3.3}$$

Equation 3.1 is the Pythagoras Theorem. (3.2) gives the golden ratio ϕ, and (3.3) relates it to the Fibonacci series.

The LaTeX code to generate the above mathematics materials are shown in Figure 3.10. As you can see, references to equations can be achieved with either `\ref` or `\eqref`. Note the difference of using `\ref` and `\eqref`.

You might want to try the online equation editor such as `https://hostmath.com/`, `http://www.sciweavers.org/..equation-editor`, `https://www.mathcha.io/`, and `https://www.latex4technics.com/` to familiarize with the LaTeX equation.

```
\begin{equation}\label{eq:pythagoras}
z^2 = x^2 + y^2
\end{equation}

\begin{equation}\label{eq:golden:ratio}
\phi = \frac{1}{2} (1 + \sqrt{5})
\end{equation}

\begin{equation}\label{eq:golden:ratio}
\phi = \frac{1}{2} (1 + \sqrt{5})
\end{equation}
\begin{equation}\label{eq:golden:ratio:fibonacci}
\phi = 1 + \sum ^ {\infty} _ {n=1}
              \frac{ (-1) ^ {n+1} }{ F_n F_{n+1} }
\end{equation}

Equation~\ref{eq:pythagoras} is the Pythagoras Theorem.
\eqref{eq:golden:ratio} gives the golden ratio $\phi$, and
\eqref{eq:golden:ratio:fibonacci} relates it to the Fibonacci
series.
```

Figure 3.10 Typesetting Mathematical Equations

3.7.1 Puting equations in the text

This is how you do equations in a sentence using the Math environment: $a = b + 7c^2 - d_{testing} \times 15e^{2_i^h} \rightarrow 2f_{2\Delta}$.

However, this equation is cut by the end of the line on the page. So to force and 'end of line', I will put in a 'newline' command "\\".

This is how you do equations in a sentence using the Math environment:
$a = b + 7c^2 - d_{testing} \times 15e^{2_i^h} \rightarrow 2f_{2\Delta}$

3.7.2 Equation aligned at =

This is how you do it. Note the symbol **&** just before **=** in the codes ie **&=** using `align` environment. The star version `align*` suppresses numbering of the equation. You can also suppress the numbering while using the standard `align` with `\nonumber` as shown in Equation (3.4).

For more explanation, refer to `https://www.sharelatex.com/..amsmath`

$$A_d = \frac{1}{2}\left[\frac{R_2}{R_1}\left(\frac{1+\frac{R_4}{R_3}}{1+\frac{R_2}{R_1}}\right)+\frac{R_4}{R_3}\right]$$
$$A_{cm} = \left[\frac{R_2}{R_1}\left(\frac{1+\frac{R_4}{R_3}}{1+\frac{R_2}{R_1}}\right)-\frac{R_4}{R_3}\right] \tag{3.4}$$

$$f(x) = \begin{cases} x^2 & : x < 0 \\ x^3 & : x \geq 0 \end{cases} \tag{3.5}$$

3.7.3 Normal text in math mode

Simply use (see codes in .tex file) normal text *in math mode*

or

Simply use (see codes in .tex file) normal text in *math mode*.

$$\rho + \delta - \frac{345^{x^2} + \theta \times \Omega_{x-1}}{\text{rarely you may want (some written text} \times \pi + \chi)} \tag{3.6}$$

3.7.4 Bold Math and Vector

This is how you bold math $y = mx + c$. This is another example of using bold math and vector.

$$\Phi_E = \int_S \mathbf{E}.d\vec{A}$$

This is another example of using vector $\overrightarrow{AB} = 0_E$

3.8 Acronyms

If you have a list of acronyms or symbols, edit the file `loa.tex` as in Figure 3.11.

```
\begin{acronym}[MMMMMM] %% replace 'MMMMMM' with the longest acronym in
    your list
\acro{CGS}{Centre for Graduate Studies}
\acro{PPKMt}{Pusat Pengajian Kejuruteraan Mekatronik}
\acro{USM}{Universiti Sains Malaysia}
\acro{UniMAP}{Universiti Malaysia Perlis}
\end{acronym}
```

Figure 3.11 The template `loa.tex` for acronyms

You can also use this acronym list to help expand it the first time you mention it in your text. For example, the first time you use `\ac{UniMAP}`, 'Universiti Malaysia Perlis (UniMAP)' will be the output (without the quotes). After that, all calls to `\ac{UniMAP}` will give 'UniMAP' (without the quotes). For more information, see the documentation for the `acronym` package.

3.9 Program Listings

You may have noticed that I used the `lstlisting` environment to typeset some of the LaTeX examples – with pretty-printing[1], too, including automatic line-breaking. For more information, see the documentation for the `listings` package: it's available online at `http://www.texdoc.net/pkg/listings`.

Just to give some simple example here. For example, to typeset a "Hello World" Java program with syntax highlighting, you can use the following code:

```
\lstset{basicstyle=\small\ttfamily, language=Java, breaklines=true,
   columns=fullflexible, tabsize=2}
\begin{lstlisting}
public class HelloWorld {
       public static void main( String arg[] ) {
       for (int i = 0; i < 10; i++) {
                      System.out.println( "Hello World!" + i);
              }
       }
}
\end{lstlisting}
```

Figure 3.12 Typesetting a Java program listing

```
public class HelloWorld {
  public static void main( String arg[] ) {
       for (int i = 0; i < 10; i++) {
     System.out.println( "Hello␣World!" + i);
    }
  }
}
```

Figure 3.13 A pretty-printed Java program listing with syntax highlighting

If you want to turn off the syntax highlighting, set `language={}`. (See the `listings` documentation for a list of programming languages for which syntax

[1] Whether you agree that it *is* pretty is another story altogether.

highlighting is supported.) You can also change the `basicstyle` value to get different effects: e.g. a different font family, size or text formatting.

Here's another example for a C program:

```
\lstset{basicstyle=\sffamily, language=C, breaklines=true, columns=
   fullflexible, tabsize=2}
\begin{lstlisting}
int main() {
       int c = 0;
       c = c + 1;
       printf( "%d", c );
       return 0;
}
\end{lstlisting}
```

Figure 3.14 Typesetting a C program listing

```
int main() {
    int c = 0;
    c = c + 1;
    printf( "%d", c );
    return 0;
}
```

Figure 3.15 A pretty-printed C program listing with syntax highlighting

And here is the same C program listing *without* syntax highlighting (by setting `language={}`):

```
int main() {
    int c = 0;
    c = c + 1;
    printf( "%d", c );
    return 0;
}
```

Figure 3.16 A C program listing without syntax highlighting

CHAPTER 4: RESULT & DISCUSSION

Now is the time to "implement" your thesis with LaTeX. Go forth and typeset! Happy LaTeXing!

4.1 Printing Your Thesis

This is *very* important. Assuming you're printing your thesis from Acrobat Reader, make sure the following settings are chosen correctly in the Print window:

- A4 paper size is selected.
- Make sure your Printer settings is using A4 too.
- No page scaling.

Otherwise, the margins of your printed outputs may go horribly wrong. Print one or two pages first to make sure everything looks fine before printing your entire thesis.

CHAPTER 5: CONCLUSION

T-that's all folks. Have fun with LaTeX!.

REFERENCES

[1] Centre for Graduate Studies, Universiti Malaysia Perlis, *UniMAP Thesis Guidelines 2017*, Perlis, Malaysia, 2017.

[2] L. T. Lim, "Writing your thesis with LaTeX," Internal circulation, School of Computer Sciences, Universiti Sains Malaysia., 2007.

[3] M. H. Mat Som, "LaTeX template for CGS and FYP thesis," Sept 2019. [Online]. Available: http://mohdhanafi.unimap.edu.my/template

[4] F. Mittelbach, M. Goossens, J. Braams, D. Carlisle, and C. Rowley, *The LaTeX Companion*, 2nd ed., ser. Addison-Wesley Series on Tools and Techniques for Computer Typesetting. Boston, MA, USA: Addison-Wesley, 2004.

[5] A. Roberts, "Getting to grips with LaTeX," 2005. [Online]. Available: http://www.andy-roberts.net/misc/latex/index.html

[6] T. Oetiker, H. Partl, I. Hyna, and E. Schlegl, *The Not So Short Introduction to LaTeX 2ε*, 4th ed., 2006.

[7] L. T. Lim, "LaTeX: Beautiful typesetting," Dec 2007. [Online]. Available: http://liantze.penguinattack.org/latextypesetting.html

[8] M. Shell, "How to use the IEEEtran BIBTeX style," 2002. [Online]. Available: ftp://tug.ctan.org/pub/tex-archive/macros/latex/contrib/IEEEtran/bibtex/IEEEtran_bst_HOWTO.pdf

[9] N. F. Othman, K. S. Basaruddin, M. H. Mat Som, M. S. Abdul Majid, and A. R. Sulaiman, "The effect of leg length inequality on joint contact forces of lower limbs during walking." *Acta of Bioengineering & Biomechanics*, vol. 21, no. 1, 2019.

[10] S. B. C. Wanna, K. S. Basaruddin, M. H. Mat Som, A. R. Sulaiman, M. S. Awang, S. F. K. Mohammad Khan, M. S. Abdul Majid, and M. R. Mohd Jamir, "Fracture risk prediction on children with osteogenesis imperfecta subjected to loads under activity of daily living," in *IOP Conference Series: Materials Science and Engineering*, vol. 429, no. 1, 2018, p. 012004.

APPENDICES

APPENDIX A
DATA USED

Put some test data here.

APPENDIX B
UML DIAGRAMS

Yet another dummy placeholder for appendix material.

APPENDIX C
DUMMY APPENDIX