

# **WRITING YOUR THESIS WITH LATEX**

**LIM LIAN TZE**

**UNIVERSITI SAINS MALAYSIA**

**2015**

# **WRITING YOUR THESIS WITH LATEX**

**by**

**LIM LIAN TZE**

**Thesis submitted in fulfilment of the requirements  
for the degree of  
Doctor of Philosophy**

**December 2015**

## ACKNOWLEDGEMENTS

Many thanks to Prof. Donald Knuth for giving us  $\text{\TeX}$ , and Leslie Lamport for  $\text{\LaTeX}$ .

I first learned  $\text{\LaTeX}$  as an undergraduate student in Computer Science at the University of Warwick. Back in Malaysia, I picked it up again while doing my M.Sc. at USM, as part of some productive procrastination (there I've admitted it!!). This coincided with Dr. Dhanesh's and Dr. Azman's efforts in raising awareness about  $\text{\LaTeX}$  at USM during NaCSPC'05 – somehow one thing led to another, and I now conduct trainings and consultations on  $\text{\LaTeX}$ . ☺

Since then, many friends and fellow  $\text{\LaTeX}$  users have given feedback and helped relayed important updates from IPS to me, to help improve the class and template. It has actually come to a point where you are too numerous to name! Thank you all, as well as everyone who has attended my talks and workshops, used my various templates, downloaded examples from my website (<http://liantze.penguinattack.org/latextypesetting.html>).

Hope everyone graduates quickly then!

# TABLE OF CONTENTS

	Page
Acknowledgements.....	ii
Table of Contents .....	iii
List of Tables .....	v
List of Figures .....	vi
List of Plates .....	vii
List of Abbreviations .....	viii
List of Symbols .....	ix
List of Publications .....	x
Abstrak .....	xi
Abstract .....	xii

## CHAPTER 1 – INTRODUCTION: SAMPLES OF BASIC L<sup>A</sup>T<sub>E</sub>X

1.1 Some Simple Command Usages. ....	1
1.2 Special Characters .....	3
1.3 Useful Resources .....	4

## CHAPTER 2 – CITATIONS AND BIBLIOGRAPHY

2.1 The *.bib File .....	5
2.2 Citations using the natbib package.....	6
2.2.1 Author-Year System .....	6
2.2.2 Numeric System.....	7

## CHAPTER 3 – FIGURES, TABLES, EQUATIONS, ALGORITHMS, ETC

3.1 Inserting Figures .....	9
3.2 How Do I Do Subfigures? .....	11

3.3	Inserting Plates .....	12
3.4	Inserting Tables .....	13
3.5	Full-paged, Sideways Figures and Tables .....	15
3.6	Mathematical Equations.....	16
3.7	Acronyms .....	18
3.8	Typesetting Algorithms .....	19
3.9	Program Listings .....	20
 <b>CHAPTER 4 – IMPLEMENTATION</b>		
4.1	Printing Your Thesis.....	23
 <b>CHAPTER 5 – DISCUSSION</b>		
 <b>CHAPTER 6 – CONCLUSION</b>		
<b>REFERENCES .....</b>		<b>26</b>
 <b>APPENDICES .....</b>		 <b>27</b>
<b>APPENDIX A – DATA USED .....</b>		<b>28</b>
<b>APPENDIX B – UML DIAGRAMS .....</b>		<b>29</b>

## LIST OF TABLES

		<b>Page</b>
Table 1.1	Special Characters in L <sup>A</sup> T <sub>E</sub> X	4
Table 3.1	Sample Table Only	14
Table 3.2	A table with decimal data	15
Table 3.3	A table with decimal data (mis-aligned)	15

## 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 2.1      A BibTeX Entry	5
Figure 3.1      Including a Graphics File	10
Figure 3.2      Pythagoras' Theroem	10
Figure 3.3      Creating subfigures within figures	12
Figure 3.4      This is the main caption of the figure.	12
Figure 3.4(a)   First caption	12
Figure 3.4(b)   Second caption	12
Figure 3.5      Inserting a Plate	13
Figure 3.6      Typesetting Tables	14
Figure 3.7      Aligning decimal data in tables	15
Figure 3.8      Including a sideways, full-page graphic	16
Figure 3.9      A full-page, sideways figure	17
Figure 3.10     Typesetting Mathematical Equations	18
Figure 3.11     The template <code>loa.tex</code> for acronyms	19
Figure 3.12     Typesetting Algorithms	19
Figure 3.13     Typesetting a Java program listing	20
Figure 3.14     A pretty-printed Java program listing with syntax highlighting	21
Figure 3.15     Typesetting a C program listing	21
Figure 3.16     A pretty-printed C program listing with syntax highlighting	21
Figure 3.17     A C program listing without syntax highlighting	22

## LIST OF PLATES

		<b>Page</b>
Plate 3.1	School of Computer Sciences, USM	13



## **LIST OF ABBREVIATIONS**

<b>IPS</b>	Institut Pengajian Siswazah
<b>PPSK</b>	Pusat Pengajian Sains Komputer
<b>USM</b>	Universiti Sains Malaysia
<b>UTMK</b>	Unit Terjemahan Melalui Komputer

## LIST OF SYMBOLS

$\lim$  limit

$\theta$  angle in radians

## LIST OF PUBLICATIONS

- Lim, L. T. (2007a).  $\text{\LaTeX}$ : Beautiful typesetting, [Online]. [Accessed September 18, 2015]. Available from World Wide Web: <http://liantze.penguinattack.org/latextypesetting.html>.
- Lim, L. T. (2007b). Writing your thesis with  $\text{\LaTeX}$ , Internal circulation, School of Computer Sciences, Universiti Sains Malaysia.

# **PENULISAN TESIS DENGAN LATEX**

## **ABSTRAK**

Ini merupakan abstrak Melayu untuk tesis USM. Ianya disediakan dengan sistem penyediaan dokumen  $\text{\LaTeX}$ .

# **WRITING YOUR THESIS WITH LATEX**

## **ABSTRACT**

This is the English abstract of a USM thesis. It was prepared with the  $\text{\LaTeX}$  document typesetting system.

# CHAPTER 1

## INTRODUCTION: SAMPLES OF BASIC L<sup>A</sup>T<sub>E</sub>X

Hello and welcome, fellow Universiti Sains Malaysia (USM) research postgrad! The `usmthesis` package and template files were written in the hope that they may help you prepare your research thesis using L<sup>A</sup>T<sub>E</sub>X, based on the Institut Pengajian Siswazah (IPS) requirements (IPS, 2007). **Please note that this version is based on the *new* guidelines, in force 17 Dec 2007 onwards.**

L<sup>A</sup>T<sub>E</sub>X 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, or have any suggestions or feedback, do e-mail me about it ([liantze@gmail.com](mailto:liantze@gmail.com)). The author cannot always guarantee prompt response, however. ☺

MiK<sub>T</sub>E<sub>X</sub>, my recommended L<sup>A</sup>T<sub>E</sub>X distribution for Windows, is available on the CSPC'07 CD. A step-by-step installation walkthrough is available at (Lim, 2007).

### 1.1 Some Simple Command Usages.

There are plenty of free L<sup>A</sup>T<sub>E</sub>X tutorials online, some of which are listed in the bibliographies or available at <http://e-office.cs.usm.my>. 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 footnotes\footnote{This is a footnote. However note that
    footnotes are not encouraged for the sciences.},
\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.cs.usm.my/~llt/}, \
    url{dummy.add@hotmail.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. footnotes<sup>1</sup>,
3. font effects such as
  - **bold**,
  - *italic*, and
  - typewriter-like
4. URLs and e-mail addresses: http://www.cs.usm.my/~llt/, dummy@hotmail.com;
5. citations: see Chapter 2

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

---

<sup>1</sup>This is a footnote. However note that footnotes are not encouraged for the sciences.

```

\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.

## 1.2 Special Characters

Bear in mind that certain characters are special  $\text{\LaTeX}$  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').





If you need to typeset special characters (such as , , , , etc), take a look



Table 1.1: Special Characters in L<sup>A</sup>T<sub>E</sub>X

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

at the Comprehensive L<sup>A</sup>T<sub>E</sub>X Symbol List. It should be under C:\ProgramFiles\MiKTeX2.9\doc\info\symbols\comprehensive\symbols-a4.pdf if you installed MiKTeX on a Windows machine.

### 1.3 Useful Resources

(Mittelbach et al., 2004) is a *very* useful book — but it’s quite an investment at RM180+-. A worthy one, nevertheless. Roberts (2005) has a website with very good L<sup>A</sup>T<sub>E</sub>X tutorials at <http://www.comp.leeds.ac.uk/andy/misc/latex/>, too. Don’t forget the famous lshort tutorial (Oetiker et al., 2006).

I’ve also compiled a list that I find useful at <http://liantze.penguinattack.org/latextypesetting> (Lim, 2007).

## CHAPTER 2

### CITATIONS AND BIBLIOGRAPHY

This chapter should have been a survey on the history of  $\text{T}_{\text{E}}\text{X}$  and  $\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$ , and a comparison to conventional word processors in preparing academic documents. Due to lack of time on the author's part, and also the abundance of such discussions on the web, we look at ways to prepare the bibliography and citations instead.

#### 2.1 The \*.bib File

First of all, bear in mind that your bibliography file (\*.bib files) is like a database. That means you can maintain a centralised list, and reuse it for all your publications.  $\text{L}_{\text{A}}\text{T}_{\text{E}}\text{X}$  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.

```
@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, the source

text of which is shown in Figure 2.1.

One thing to note about authors' names: BibT<sub>E</sub>X recognises “Mittelbach” as the last name for both Frank Mittelbach and Mittelbach, Frank. So for a name like “Lim Lian Tze”, you would have to specify it as either Lian Tze Lim or Lim, Lian Tze for BibT<sub>E</sub>X to recognise “Lim” as the last name correctly. In addition, if the surname or family name of an author consists of multiple words, enclose it with braces to avoid surprises, like so: Syed Muhammad Naquib {al-Attas}.

## 2.2 Citations using the natbib package

The usmthesis package imports the natbib package which provides flexible citation mechanisms, so see its documentation for more details. On a MiK<sub>T</sub>E<sub>X</sub> or ProT<sub>E</sub>Xt installation, use the command prompt to issue `mthelp --view natbib` to access the documentation. On t<sub>E</sub>X, 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.

### 2.2.1 Author-Year System

Author-year styles include those in the Harvard package, such as `agsm`, `dcu`, `kluwer` and others. If you're using an author-year system, like I did for this sample thesis, you get the following:

- `\citet{latex:companion}` → Mittelbach et al. (2004)
- `\citet[chap.~2]{latex:companion}` → Mittelbach et al. (2004, chap. 2)
- `\citep{latex:companion}` → (Mittelbach et al., 2004)
- `\citep[chap.~2]{latex:companion}` → (Mittelbach et al., 2004, chap. 2)
- `\citep[see also][]{latex:companion}` → (see also Mittelbach et al., 2004)
- `\citep[see also][chap.~2]{latex:companion}` → (see also Mittelbach et al., 2004, chap. 2)
- `\citet{latex:companion,roberts}` → Mittelbach et al. (2004); Roberts (2005)
- `\citep{latex:companion,roberts}` → (Mittelbach et al., 2004; Roberts, 2005)

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

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

### 2.2.2 Numeric System

If you prefer the plain, numerical system, do the following steps first:

1. In `usmthesis.cls`, search for the line `\RequirePackage{natbib}` and modify it to:  
  
`\RequirePackage[numbers]{natbib}`
2. In `usmthesis.tex`:
  - comment out the line starting with `\citestyle{...}`
  - modify the bibliography styles to:

`\bibliographystyle{plainnat}`

`\bibliographystyleown{plainnat}`

or any other number system style that you prefer.

You will then get the following citation outputs:

- `\citet{latex:companion}` → Mittelbach et al. [1]
- `\citet[chap.~2]{latex:companion}` → Mittelbach et al. [1, chap. 2]
- `\citep{latex:companion}` → [1]
- `\citep[chap.~2]{latex:companion}` → [1, chap. 2]
- `\citep[see also][]{latex:companion}` → [see also 1]
- `\citep[see also][chap.~2]{latex:companion}` → [see also 1, chap. 2]
- `\citet{latex:companion,roberts}` → Mittelbach et al. [1], Roberts [3]
- `\citep{latex:companion,roberts}` → [1, 3]
- `\citeauthor{latex:companion}` → Mittelbach et al.
- `\citeyear{latex:companion}` → 2004
- `\citeyearpar{latex:companion}` → [2004]

## CHAPTER 3

### 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.)

#### 3.1 Inserting Figures

You can draw diagrams with special  $\text{\LaTeX}$  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).

$\text{\LaTeX}$  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.

Do note that IPS **discourages** the use of colours in your thesis, including diagrams and figures. Photographs and colour plates are exceptions to this rule: see Section 3.3.

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}
\caption{Pythagoras’ Theorem}\label{fig:pythagoras}
\end{figure}
```

Figure 3.1: Including a Graphics File

The result would be:

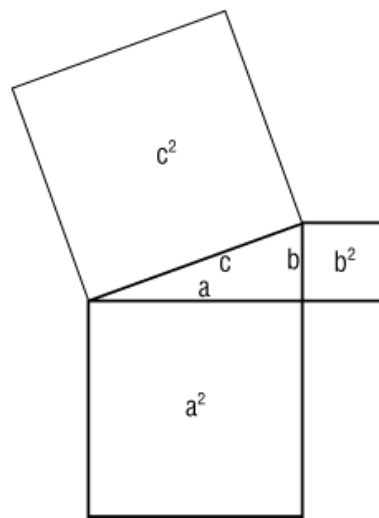


Figure 3.2: Pythagoras’ Theroem

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=.2\textwidth` would cause the graphics to occupy 20% of the text width.

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 3.1

Everytime the numbering of the heading changes, the reference will change automatically as well. **This is another advantage of using L<sup>A</sup>T<sub>E</sub>X**: 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.

You might also want to try out JpgfDraw: it is a vector graphics and drawing application (requiring Java), and can export to L<sup>A</sup>T<sub>E</sub>X code which you can paste into your L<sup>A</sup>T<sub>E</sub>X source. JpgfDraw is available from <http://theoval.cmp.uea.ac.uk/~nlct/jpgfdraw/index.html>.

## 3.2 How Do I Do Subfigures?

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



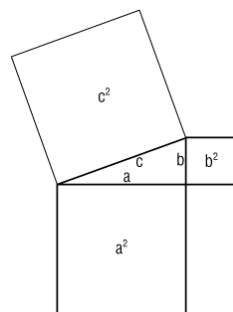
```

\begin{figure}[hbt!]
  \begin{minipage}{.49\textwidth}
    \centering
    \subfloat[First caption]{\includegraphics[width=3cm]{pythag}} \
      label{fig:sub1}
    \end{minipage}
    \hfill
    \begin{minipage}{.49\textwidth}
      \subfloat[Second caption]{\includegraphics[width=0.8\textwidth]{
        USMScience}}\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.

### 3.3 Inserting Plates

Colour photographs are now regarded as *plates*. They must be listed in the *List of Plates* instead of the List of Figures, and should be printed in colour on glossy photo paper (IPS, 2007).

The `usmthesis` document class defines a new plate environment, as well as a corresponding `\listofplates` command. (The `\listofplates` command is already placed in the sample template file `usmthesis.tex`.) In short, all you need to do to insert a photograph or plate (as a graphics file `USMScience.{eps,png,jpg}`) is shown

in Figure 3.5, and you will then get Plate 3.1 as the result.

```
\begin{plate}[hbt!]\centering
\includegraphics[width=.9\textwidth]{USMScience}
\caption{School of Computer Sciences, USM}\label{plate:ppsk:usm}
\end{plate}
```

Figure 3.5: Inserting a Plate



Plate 3.1: School of Computer Sciences, USM

### 3.4 Inserting Tables

Typesetting tables can be a little troublesome especially with complex layouts. Look up (Roberts, 2005) to learn about some tips, or you can use the LaTeX program (<http://www.g32.org/latable/>) to help you.

If using LaTeX, 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 com-

mands, 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, like this:

```
\begin{table}[hbt!]\centering
\begin{tabular}{|l|c||r|}
\hline
\textbf{Name} & \textbf{Category} & \textbf{Quantity} \\
\hline\hline
Apple & Fruit & 10 \\
\hline
Cucumber & Vegetable & 25 \\
\hline
Daisy & Flower & 5 \\
\hline
\end{tabular}
\caption{Sample Table Only} \label{table:sample}
\end{table}
```

Figure 3.6: Typesetting Tables

Table 3.1: Sample Table Only

<b>Name</b>	<b>Category</b>	<b>Quantity</b>
Apple	Fruit	10
Cucumber	Vegetable	25
Daisy	Flower	5

Note also that `usmthesis` 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 (as mentioned in the IPS guidelines) if not for this tip from (Mittelbach et al., 2004, pp. 274–276). This method uses the `dcolumn` package (already loaded by `usmthesis.cls`). Instead of using `l`, `c` or `r` as the column type in the `tabular` declaration, use

`D{input sep}{output sep}{decimal places}.`

```
\begin{table}[htb!]\centering
\begin{tabular}{| c | D{.}{.}{2} |}
\hline
Item & \multicolumn{1}{c|}{Reading}\\\hline
A & 1.11\\\hline
B & 3.99\\\hline
C & 2.27\\\hline
\end{tabular}
\caption{A table with decimal data}
\end{table}
```

Figure 3.7: Aligning decimal data in tables

The  $\text{\LaTeX}$  code in Figure 3.7 will give you Table 3.2.

Table 3.2: 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 3.3: A table with decimal data (mis-aligned)

Item	Reading
A	1.11
B	3.999
C	22.2

### 3.5 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=\textwidth]{latex-win-comp}
\caption{A full-page, sideways figure}\label{fig:sidewaysfig}
\end{sidewaysfigure}

```

Figure 3.8: Including a sideways, full-page graphic

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

For a sideways table, use the `sidewaystable` environment instead around your usual tabular material.

### 3.6 Mathematical Equations

Typesetting mathematical material is one of, if not *the*, strongest capabilities of  $\text{\LaTeX}$ . After all, that was the Knuth’s main motivation for creating  $\text{\TeX}$ . As it is impossible to enumerate all possible mathematically-related commands and macros here, we will just give some examples. The reader is directed to the many well-written online tutorials, such as (Roberts, 2005), for more elaborate examples.  $\text{\TeX}$ nicCenter also provides many shortcut buttons for inserting mathematical symbols.

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

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

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

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

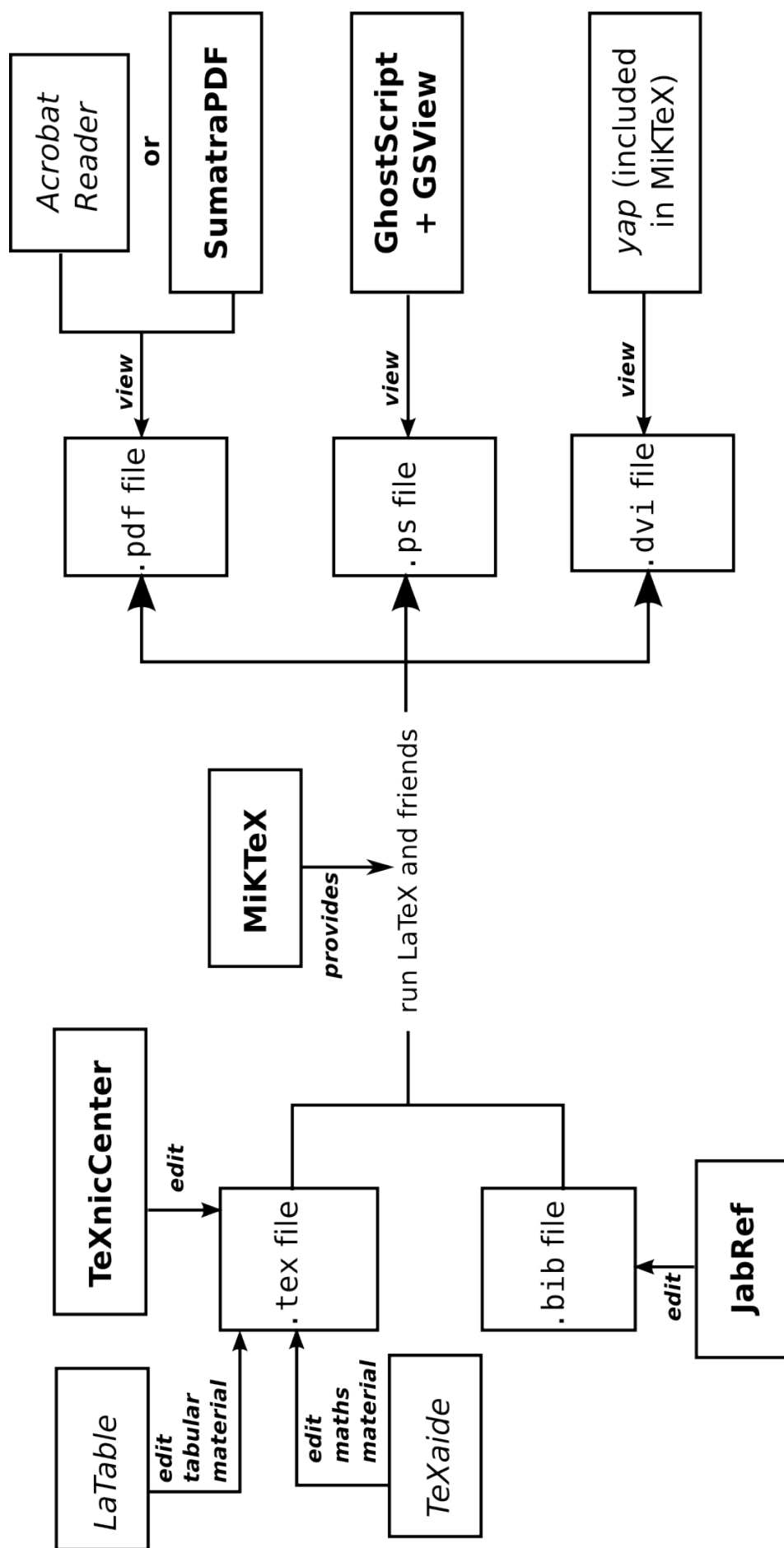


Figure 3.9: A full-page, sideways figure

```

\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_{n=1}^{\infty} \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

The  $\text{\LaTeX}$  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`.

A disclaimer: if you think the mathematic equations don't look as great as all those  $\text{\LaTeX}$  advocates make them out to be, that's because IPS requires Times to be used and the current offerings of free  $\text{\LaTeX}$  math fonts for Times don't look great. It would've been a different picture if we used Computer Modern.

### 3.7 Acronyms

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

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{USM}`, 'Universiti Sains Malaysia

```

\begin{acronym}[UTMK] %% replace 'UTMK' with the longest acronym in
    your list
\acro{IPS}{Institut Pengajian Siswazah}
\acro{PPSK}{Pusat Pengajian Sains Komputer}
\acro{USM}{Universiti Sains Malaysia}
\acro{UTMK}{Unit Terjemahan Melalui Komputer}
\end{acronym}

```

Figure 3.11: The template `loa.tex` for acronyms

(USM)’ will be the output (without the quotes). After that, all calls to `\ac{USM}` will give ‘USM’ (without the quotes). For more information, see the documentation for the acronym package.

### 3.8 Typesetting Algorithms

As computer scientists, it is quite common to include algorithms and/or pseudocode. There are a number of different packages available, but unfortunately they tend not to work well together! I’m using `algorithmicx` here.

```

\begin{algorithm}[hbt!]
\begin{algorithmic}
\Require $n \geq 0$
\Ensure $y = x^n$
\State $y \leftarrow 1$
\State $X \leftarrow x$
\State $N \leftarrow n$
\While{$N \neq 0$}
\If{$N$ is even}
\State $X \leftarrow X \times X$
\State $N \leftarrow \frac{N}{2}$ $ \Comment{This is a comment}
\ElseIf{$N$ is odd}
\State $y \leftarrow y \times X$
\State $N \leftarrow N - 1$
\EndIf
\EndWhile
\end{algorithmic}
\caption{Computing $x^n$, $n > 0$}
\end{algorithm}

```

Figure 3.12: Typesetting Algorithms



---

**Algorithm 1** Computing  $x^n, n > 0$ 

---

**Require:**  $n \geq 0$ **Ensure:**  $y = x^n$  $y \leftarrow 1$  $X \leftarrow x$  $N \leftarrow n$ **while**  $N \neq 0$  **do**    **if**  $N$  is even **then**         $X \leftarrow X \times X$          $N \leftarrow \frac{N}{2}$ 

▷ This is a comment

**else if**  $N$  is odd **then**         $y \leftarrow y \times X$          $N \leftarrow N - 1$     **end if****end while**

---

### 3.9 Program Listings

You may have noticed that I used the `lstlisting` environment to typeset some of the  $\text{\LaTeX}$  examples – with pretty-printing<sup>1</sup>, 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 3.13: Typesetting a Java program listing

---

<sup>1</sup>Whether you agree that it *is* pretty is another story altogether.

```

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

```

Figure 3.14: 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 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 3.15: Typesetting a C program listing

```

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

```

Figure 3.16: 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 3.17: A C program listing without syntax highlighting

## CHAPTER 4

### IMPLEMENTATION

Now is the time to “implement” your thesis with L<sup>A</sup>T<sub>E</sub>X. Go forth and typeset! Happy L<sup>A</sup>T<sub>E</sub>Xing! ☺

#### 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**

### **DISCUSSION**

Just a placeholder for the discussion chapter.

## **CHAPTER 6**

## **CONCLUSION**

T-that's all folks. Have fun with L<sup>A</sup>T<sub>E</sub>X!

## REFERENCES

- IPS (2007). *A Guide to the Preparation, Submission and Examination of Theses*, Institute of Graduate Studies, Universiti Sains Malaysia, Penang, Malaysia.
- Lim, L. T. (2007).  $\text{\LaTeX}$ : Beautiful typesetting, [Online]. [Accessed September 18, 2015]. Available from World Wide Web: <http://liantze.penguinattack.org/latex/typesetting.html>.
- Mittelbach, F., Goossens, M., Braams, J., Carlisle, D. and Rowley, C. (2004). *The  $\text{\LaTeX}$  Companion*, Addison-Wesley Series on Tools and Techniques for Computer Typesetting, 2nd edn, Addison-Wesley, Boston, MA, USA.
- Oetiker, T., Partl, H., Hyna, I. and Schlegl, E. (2006). *The Not So Short Introduction to  $\text{\LaTeX}$  2 $\epsilon$* , 4.2 edn.
- Roberts, A. (2005). Getting to grips with  $\text{\LaTeX}$ , [Online]. [Accessed September 18, 2015]. Available from World Wide Web: <http://www.andy-roberts.net/misc/latex/index.html>.

# **APPENDICES**



## **APPENDIX A**

### **DATA USED**

Put some test data here.

## **APPENDIX B**

### **UML DIAGRAMS**

Yet another dummy placeholder for appendix material.