

Vladimir Milenković

**The Travelling Salesman problem  
- Comparison of different  
approaches**

Diploma in Computer Science

Trinity College

March 18, 2020



# Proforma

|                     |   |
|---------------------|---|
| Name:               | Vladimir Milenković   |
| College:            | Trinity College   |
| Project Title:      | <b>The Travelling Salesman problem -<br/>Comparison of different approaches</b> |
| Examination:        | <b>Diploma in Computer Science, May 2020</b>                                    |
| Word Count:         | <b>TODO<sup>1</sup></b>   |
| Project Originator: | <b>Dr T. Sauerwald and V. Milenkovic</b>  |
| Supervisor:         | <b>Dr T. Sauerwald</b>  |

## Original Aims of the Project

To code, compare and contrast different algorithms and approaches in solving one of the most famous problems ever to exist - the Travelling Salesman Problem. All the code done for this project is easy to use for anybody wishing to tackle this problem, and the overview of all the algorithms with the suggested usecase for each one is included as well.

## Work Completed

All work that was done during this project will be mentioned in the dissertation, the code will be submitted as well.

## Special Difficulties

Getting Lin-Kernighan algorithm to work significantly better than the other algorithms, reproducing the results mentioned on the original paper. TODO

---

<sup>1</sup>This word count was computed by `detex diss.tex | tr -cd '0-9A-Za-z \n' | wc -w`

## Declaration

I, Vladimir Milenkovic of Trinity College, being a candidate for Part II of the Computer Science Tripos , hereby declare that this dissertation and the work described in it are my own work, unaided except as may be specified below, and that the dissertation does not contain material that has already been used to any substantial extent for a comparable purpose.

Signed Vladimir Milenkovic

Date TODO

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## Acknowledgements

This document owes much to an earlier version written by Simon Moore [2]. His help, encouragement and advice was greatly appreciated.



# Chapter 1

## Introduction

### 1.1 Overview of the files

This document consists of the following files:

- `Makefile` — The Makefile for the dissertation and Project Proposal
- `diss.tex` — The dissertation
- `probody.tex` — Appendix C – the project proposal
- `proposal.tex` — A  $\text{\LaTeX}$  main file for the proposal
- `figs` – A directory containing diagrams and pictures
- `refs.bib` — The bibliography database

### 1.2 Building the document

This document was produced using  $\text{\LaTeX} 2_{\epsilon}$  which is based upon  $\text{\LaTeX}$ [1]. To build the document you first need to generate `diss.aux` which, amongst other things, contains the references used. This is done by executing the command:

```
latex diss
```

Then the bibliography can be generated from `refs.bib` using:

```
bibtex diss
```

Finally, to ensure all the page numbering is correct run `latex` on `diss.tex` until the `.aux` files do not change. This usually takes 2 more runs.

### 1.2.1 The makefile

To simplify the calls to `latex` and `bibtex`, a makefile has been provided, see Appendix B.1. It provides the following facilities:

- `make`  
Display help information.
- `make prop`  
Run `latex proposal`; `xdvi proposal.dvi`.
- `make diss.ps`  
Make the file `diss.ps`.
- `make gv`  
View the dissertation using ghostview after performing `make diss.ps`, if necessary.
- `make gs`  
View the dissertation using ghostscript after performing `make diss.ps`, if necessary.
- `make count`  
Display an estimate of the word count.
- `make all`  
Construct `proposal.dvi` and `diss.ps`.
- `make pub`  
Make a `.tar` version of the `demodiss` directory and place it in my `public_html` directory.
- `make clean`  
Delete all files except the source files of the dissertation. All these deleted files can be reconstructed by typing `make all`.
- `make pr`  
Print the dissertation on your default printer.

## 1.3 Counting words

An approximate word count of the body of the dissertation may be obtained using:

```
wc diss.tex
```

Alternatively, try something like:

```
detex diss.tex | tr -cd '0-9A-Z a-z\n' | wc -w
```



## Chapter 2

# Preparation

This chapter is empty!



# Chapter 3

## Implementation

### 3.1 Verbatim text

Verbatim text can be included using `\begin{verbatim}` and `\end{verbatim}`. I normally use a slightly smaller font and often squeeze the lines a little closer together, as in:

```
GET "libhdr"

GLOBAL { count:200; all  }

LET try(ld, row, rd) BE TEST row=all
                        THEN count := count + 1
                        ELSE { LET poss = all & ~(ld | row | rd)
                              UNTIL poss=0 DO
                                { LET p = poss & -poss
                                  poss := poss - p
                                  try(ld+p << 1, row+p, rd+p >> 1)
                                }
                              }

LET start() = VALOF
{ all := 1
  FOR i = 1 TO 12 DO
  { count := 0
    try(0, 0, 0)
    writef("Number of solutions to %i2-queens is %i5*n", i, count)
    all := 2*all + 1
  }
  RESULTIS 0
}
```

## 3.2 Tables

Here is a simple example<sup>1</sup> of a table.

| Left<br>Justified | Centred | Right<br>Justified |
|-------------------|---------|--------------------|
| First             | A       | XXX                |
| Second            | AA      | XX                 |
| Last              | AAA     | X                  |

There is another example table in the proforma.

## 3.3 Simple diagrams

Simple diagrams can be written directly in  $\text{\LaTeX}$ . For example, see figure 3.1 on page 9 and see figure 3.2 on page 9.

## 3.4 Adding more complicated graphics

The use of  $\text{\LaTeX}$  format can be tedious and it is often better to use encapsulated postscript to represent complicated graphics. Figure 3.3 and 3.5 on page 11 are examples. The second figure was drawn using `xfig` and exported in `.eps` format. This is my recommended way of drawing all diagrams.

---

<sup>1</sup>A footnote



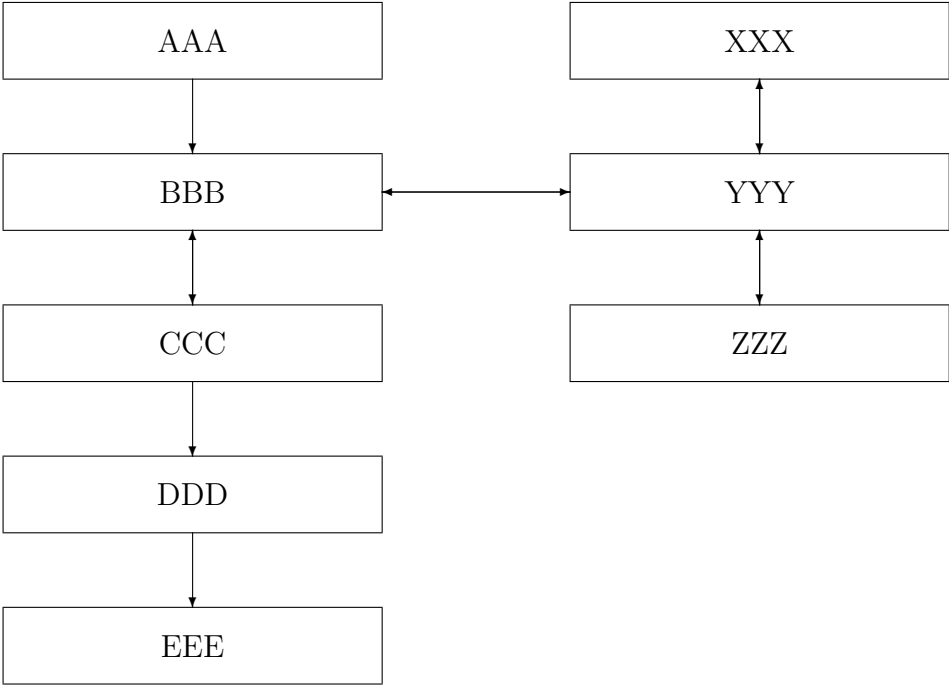


Figure 3.1: A picture composed of boxes and vectors.

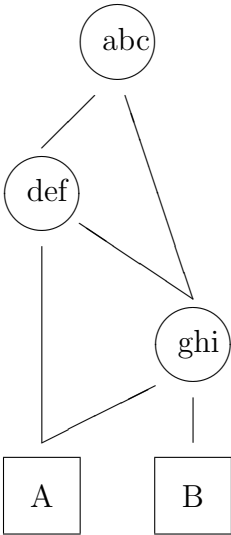


Figure 3.2: A diagram composed of circles, lines and boxes.

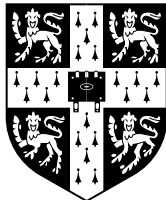


Figure 3.3: Example figure using encapsulated postscript

Figure 3.4: Example figure where a picture can be pasted in

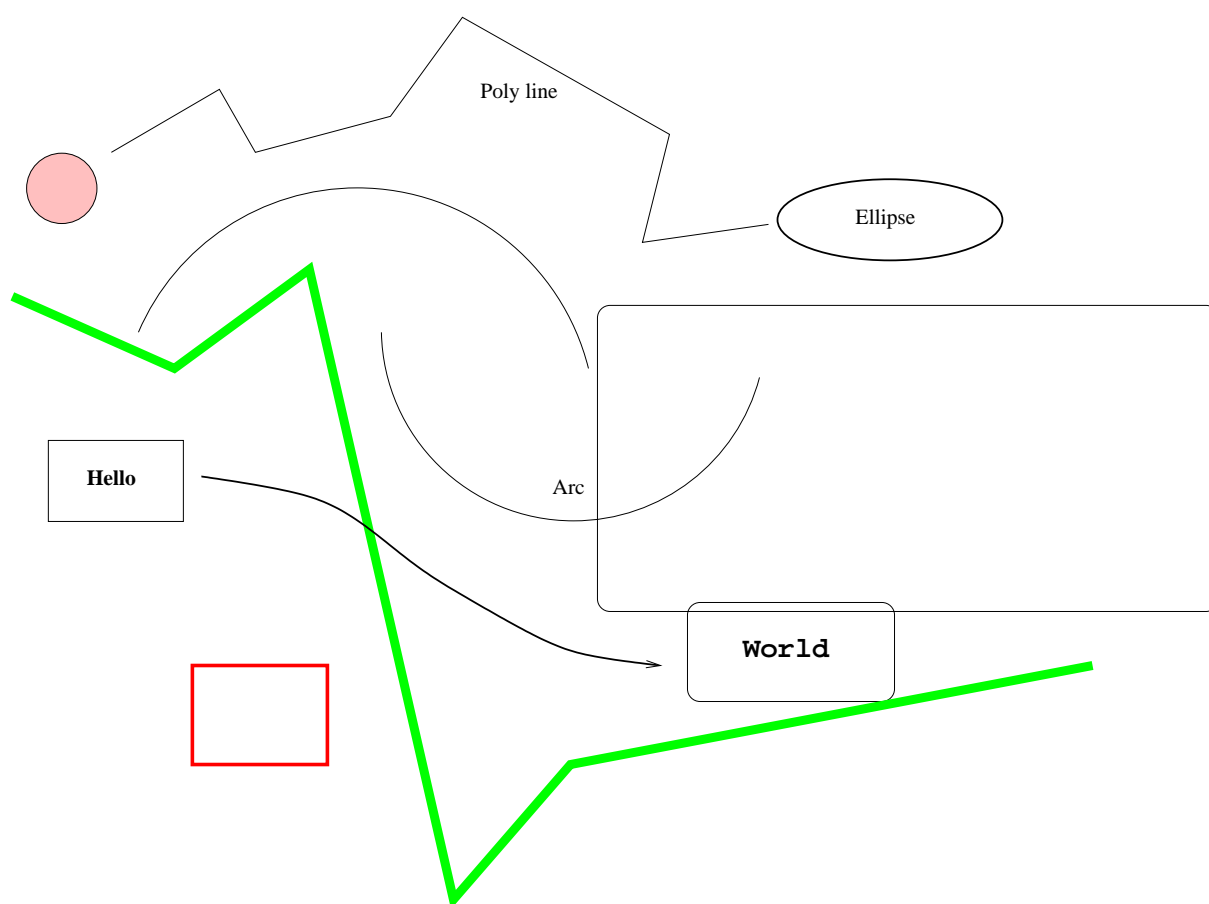


Figure 3.5: Example diagram drawn using xfig



# Chapter 4

## Evaluation

### 4.1 Printing and binding

If you have access to a laser printer that can print on two sides, you can use it to print two copies of your dissertation and then get them bound by the Computer Laboratory Bookshop. Otherwise, print your dissertation single sided and get the Bookshop to copy and bind it double sided.

Better printing quality can sometimes be obtained by giving the Bookshop an MSDOS 1.44 Mbyte 3.5" floppy disc containing the Postscript form of your dissertation. If the file is too large a compressed version with **zip** but not **gnuzip** nor **compress** is acceptable. However they prefer the uncompressed form if possible. From my experience I do not recommend this method.

#### 4.1.1 Things to note

- Ensure that there are the correct number of blank pages inserted so that each double sided page has a front and a back. So, for example, the title page must be followed by an absolutely blank page (not even a page number).
- Submitted postscript introduces more potential problems. Therefore you must either allow two iterations of the binding process (once in a digital form, falling back to a second, paper, submission if necessary) or submit both paper and electronic versions.
- There may be unexpected problems with fonts.

## 4.2 Further information

See the Computer Lab's world wide web pages at URL:

<http://www.cl.cam.ac.uk/TeXdoc/TeXdocs.html>

# Chapter 5

## Conclusion

I hope that this rough guide to writing a dissertation is  $\text{\LaTeX}$  has been helpful and saved you time.





# Bibliography

- [1] L. Lamport. *LaTeX — a document preparation system — user's guide and reference manual*. Addison-Wesley, 1986.
- [2] S.W. Moore. How to prepare a dissertation in latex, 1995.



# Appendix A

## Latex source

### A.1 diss.tex

```
\documentclass[12pt,twoside,notitlepage]{report}

\usepackage{a4}
\usepackage{verbatim}

\input{epsf} % to allow postscript inclusions
% On thor and CUS read top of file:
% /opt/TeX/lib/texmf/tex/dvips/epsf.sty
% On CL machines read:
% /usr/lib/tex/macros/dvips/epsf.tex

\raggedbottom % try to avoid widows and orphans
\sloppy
\clubpenalty1000%
\widowpenalty1000%

\addtolength{\oddsidemargin}{6mm} % adjust margins
\addtolength{\evensidemargin}{-8mm}

\renewcommand{\baselinestretch}{1.1} % adjust line spacing to make
% more readable

\begin{document}

\bibliographystyle{plain}

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Title

\pagestyle{empty}

\hfill{\LARGE \bf Vladimir Milenkovi\'}c}
```

```

\vspace*{60mm}
\begin{center}
\Huge
{\bf The Travelling Salesman problem - Comparison of different approaches } \\
\vspace*{5mm}
Diploma in Computer Science \\
\vspace*{5mm}
Trinity College \\
\vspace*{5mm}
\today % today's date
\end{center}

```

```

\cleardoublepage

```

```

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Proforma, table of contents and list of figures

```

```

\setcounter{page}{1}
\pagenumbering{roman}
\pagestyle{plain}

```

```

\chapter*{Proforma}

```

```

{\large
\begin{tabular}{ll}
Name:           & \bf Vladimir Milenkovi\'c           \\
College:        & \bf Trinity College           \\
Project Title:   & \bf The Travelling Salesman problem - \\
& \bf Comparison of different approaches \\
Examination:    & \bf Diploma in Computer Science, May 2020 \\
Word Count:     & \bf TODO\footnotemark[1] \\
Project Originator: & \bf Dr T. Sauerwald and V. Milenkovic \\
Supervisor:     & \bf Dr T. Sauerwald           \\
\end{tabular}
}
\footnotetext[1]{This word count was computed
by {\tt detex diss.tex | tr -cd '0-9A-Za-z $\t\tbackslash$n' | wc -w}
}
\stepcounter{footnote}

```

```

\section*{Original Aims of the Project}

```

To code, compare and contrast different algorithms and approaches in solving one of the most famous problems ever to exist

```

\section*{Work Completed}

```

All work that was done during this project will be mentioned in the dissertation, the code will be submitted as well.

```

\section*{Special Difficulties}

```

Getting Lin-Kernighan algorithm to work significantly better than the other algorithms, reproducing the results mentioned

```

\newpage
\section*{Declaration}

```

I, Vladimir Milenkovic of Trinity College, being a candidate for Part II of the Computer Science Tripos , hereby declare

that this dissertation and the work described in it are my own work, unaided except as may be specified below, and that the dissertation does not contain material that has already been used to any substantial extent for a comparable purpose.

```
\bigskip
\leftline{Signed Vladimir Milenkovic}
```

```
\medskip
\leftline{Date TODO}
```

```
\cleardoublepage
```

```
\tableofcontents
```

```
\listoffigures
```

```
\newpage
\section*{Acknowledgements}
```

This document owes much to an earlier version written by Simon Moore \cite{moore95}. His help, encouragement and advice was greatly appreciated.

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% now for the chapters
```

```
\cleardoublepage          % just to make sure before the page numbering
                           % is changed
```

```
\setcounter{page}{1}
\pagenumbering{arabic}
\pagestyle{headings}
```

```
\chapter{Introduction}
```

```
\section{Overview of the files}
```

This document consists of the following files:

```
\begin{itemize}
\item {\tt Makefile} --- The Makefile for the dissertation and Project Proposal
\item {\tt diss.tex} --- The dissertation
\item {\tt propbody.tex} --- Appendix~C -- the project proposal
\item {\tt proposal.tex} --- A \LaTeX\ main file for the proposal
\item {\tt figs} -- A directory containing diagrams and pictures
\item {\tt refs.bib} --- The bibliography database
\end{itemize}
```

```
\section{Building the document}
```

This document was produced using \LaTeXe which is based upon \LaTeX\cite{Lamport86}. To build the document you first need to generate {\tt diss.aux} which, amongst other things, contains the references used. This is done by executing the command:

```
{\tt latex diss}
```

```
\noindent
```

Then the bibliography can be generated from `{\tt refs.bib}` using:

```
{\tt bibtex diss}
```

```
\noindent
```

Finally, to ensure all the page numbering is correct run `{\tt latex}` on `{\tt diss.tex}` until the `{\tt .aux}` files do not change. This usually takes 2 more runs.

```
\subsection{The makefile}
```

To simplify the calls to `{\tt latex}` and `{\tt bibtex}`, a makefile has been provided, see Appendix~\ref{makefile}. It provides the following facilities:

```
\begin{itemize}
```

```
\item{\tt make} \\  
Display help information.
```

```
\item{\tt make prop} \\  
Run {\tt latex proposal; xdvi proposal.dvi}.
```

```
\item{\tt make diss.ps} \\  
Make the file {\tt diss.ps}.
```

```
\item{\tt make gv} \\  
View the dissertation using ghostview after performing  
{\tt make diss.ps}, if necessary.
```

```
\item{\tt make gs} \\  
View the dissertation using ghostscript after performing  
{\tt make diss.ps}, if necessary.
```

```
\item{\tt make count} \\  
Display an estimate of the word count.
```

```
\item{\tt make all} \\  
Construct {\tt proposal.dvi} and {\tt diss.ps}.
```

```
\item{\tt make pub} \\  
Make a {\tt .tar} version of the {\tt demodiss}  
directory and place it in my {\tt public\_html} directory.
```

```
\item{\tt make clean} \\  
Delete all files except the source files of  
the dissertation. All these deleted files can be reconstructed by  
typing {\tt make all}.
```

```
\item{\tt make pr} \\  
Print the dissertation on your default printer.
```

```
\end{itemize}
```

```
\section{Counting words}
```

An approximate word count of the body of the dissertation may be obtained using:

```
{\tt wc diss.tex}
```

```
\noindent
```

Alternatively, try something like:

```
\verb/detex diss.tex | tr -cd '0-9A-Z a-z\n' | wc -w/
```

```
\cleardoublepage
```

```
\chapter{Preparation}
```

This chapter is empty!

```
\cleardoublepage
```

```
\chapter{Implementation}
```

```
\section{Verbatim text}
```

Verbatim text can be included using `\verb|\begin{verbatim}|` and `\verb|\end{verbatim}|`. I normally use a slightly smaller font and often squeeze the lines a little closer together, as in:

```
{\renewcommand{\baselinestretch}{0.8}\small\begin{verbatim}
GET "libhdr"
```

```
GLOBAL { count:200; all }
```

```
LET try(ld, row, rd) BE TEST row=all
    THEN count := count + 1
    ELSE { LET poss = all & ~(ld | row | rd)
        UNTIL poss=0 DO
            { LET p = poss & -poss
              poss := poss - p
              try(ld+p << 1, row+p, rd+p >> 1)
            }
        }
    }
```

```
LET start() = VALOF
{ all := 1
  FOR i = 1 TO 12 DO
    { count := 0
      try(0, 0, 0)
      writef("Number of solutions to %i2-queens is %i5*n", i, count)
      all := 2*all + 1
    }
  RESULTIS 0
}
```

```
\end{verbatim}
```

```
}
```

```
\section{Tables}
```

```
\begin{samepage}
```

Here is a simple example\footnote{A footnote} of a table.

```

\begin{center}
\begin{tabular}{l|c|r}
Left      & Centred & Right \\
Justified &         & Justified \\
\hline
First     & A       & XXX \\
Second    & AA      & XX \\
Last      & AAA     & X
\end{tabular}
\end{center}

\noindent
There is another example table in the proforma.
\end{samepage}

\section{Simple diagrams}

Simple diagrams can be written directly in \LaTeX. For example, see
figure~\ref{latexpic1} on page~\pageref{latexpic1} and see
figure~\ref{latexpic2} on page~\pageref{latexpic2}.

\begin{figure}
\setlength{\unitlength}{1mm}
\begin{center}
\begin{picture}(125,100)
\put(0,80){\framebox(50,10){AAA}}
\put(0,60){\framebox(50,10){BBB}}
\put(0,40){\framebox(50,10){CCC}}
\put(0,20){\framebox(50,10){DDD}}
\put(0,0){\framebox(50,10){EEE}}

\put(75,80){\framebox(50,10){XXX}}
\put(75,60){\framebox(50,10){YYY}}
\put(75,40){\framebox(50,10){ZZZ}}

\put(25,80){\vector(0,-1){10}}
\put(25,60){\vector(0,-1){10}}
\put(25,50){\vector(0,1){10}}
\put(25,40){\vector(0,-1){10}}
\put(25,20){\vector(0,-1){10}}

\put(100,80){\vector(0,-1){10}}
\put(100,70){\vector(0,1){10}}
\put(100,60){\vector(0,-1){10}}
\put(100,50){\vector(0,1){10}}

\put(50,65){\vector(1,0){25}}
\put(75,65){\vector(-1,0){25}}
\end{picture}
\end{center}
\caption{\label{latexpic1}A picture composed of boxes and vectors.}
\end{figure}

\begin{figure}
\setlength{\unitlength}{1mm}
\begin{center}

\begin{picture}(100,70)
\put(47,65){\circle{10}}

```



```

\put(45,64){abc}

\put(37,45){\circle{10}}
\put(37,51){\line(1,1){7}}
\put(35,44){def}

\put(57,25){\circle{10}}
\put(57,31){\line(-1,3){9}}
\put(57,31){\line(-3,2){15}}
\put(55,24){ghi}

\put(32,0){\framebox(10,10){A}}
\put(52,0){\framebox(10,10){B}}
\put(37,12){\line(0,1){26}}
\put(37,12){\line(2,1){15}}
\put(57,12){\line(0,2){6}}
\end{picture}

\end{center}
\caption{\label{latexpic2}A diagram composed of circles, lines and boxes.}
\end{figure}

```

```
\section{Adding more complicated graphics}
```

The use of `\LaTeX` format can be tedious and it is often better to use encapsulated postscript to represent complicated graphics. Figure `\ref{epsfig}` and `\ref{xfig}` on page `\pageref{xfig}` are examples. The second figure was drawn using `{\tt xfig}` and exported in `{\tt eps}` format. This is my recommended way of drawing all diagrams.

```

\begin{figure}[tbh]
\centerline{\epsfbox{figs/cuarms.eps}}
\caption{\label{epsfig}Example figure using encapsulated postscript}
\end{figure}

\begin{figure}[tbh]
\vspace{4in}
\caption{\label{pastedfig}Example figure where a picture can be pasted in}
\end{figure}

\begin{figure}[tbh]
\centerline{\epsfbox{figs/diagram.eps}}
\caption{\label{xfig}Example diagram drawn using {\tt xfig}}
\end{figure}

```

```

\cleardoublepage
\chapter{Evaluation}

```

```
\section{Printing and binding}
```

If you have access to a laser printer that can print on two sides, you can use it to print two copies of your dissertation and then get them

bound by the Computer Laboratory Bookshop. Otherwise, print your dissertation single sided and get the Bookshop to copy and bind it double sided.

Better printing quality can sometimes be obtained by giving the Bookshop an MSDOS 1.44~Mbyte 3.5" floppy disc containing the Postscript form of your dissertation. If the file is too large a compressed version with {\tt zip} but not {\tt gunzip} nor {\tt compress} is acceptable. However they prefer the uncompressed form if possible. From my experience I do not recommend this method.

\subsection{Things to note}

\begin{itemize}

\item Ensure that there are the correct number of blank pages inserted so that each double sided page has a front and a back. So, for example, the title page must be followed by an absolutely blank page (not even a page number).

\item Submitted postscript introduces more potential problems. Therefore you must either allow two iterations of the binding process (once in a digital form, falling back to a second, paper, submission if necessary) or submit both paper and electronic versions.

\item There may be unexpected problems with fonts.

\end{itemize}

\section{Further information}

See the Computer Lab's world wide web pages at URL:

{\tt http://www.cl.cam.ac.uk/TeXdoc/TeXdocs.html}

\cleardoublepage

\chapter{Conclusion}

I hope that this rough guide to writing a dissertation is \LaTeX\ has been helpful and saved you time.

\cleardoublepage

%%  
% the bibliography

\addcontentsline{toc}{chapter}{Bibliography}

\bibliography{refs}

\cleardoublepage

%%  
% the appendices

\appendix

\chapter{Latex source}

```

\section{diss.tex}
{\scriptsize\verbatiminput{diss.tex}}

\section{proposal.tex}
{\scriptsize\verbatiminput{proposal.tex}}

\section{propbody.tex}
{\scriptsize\verbatiminput{propbody.tex}}


\cleardoublepage

\chapter{Makefile}

\section{\label{makefile}Makefile}
{\scriptsize\verbatiminput{makefile.txt}}

\section{refs.bib}
{\scriptsize\verbatiminput{refs.bib}}


\cleardoublepage

\chapter{Project Proposal}

\input{propbody}

\end{document}

```

## A.2 proposal.tex

```

% This is a LaTeX driving document to produce a standalone copy
% of the project proposal held in propbody.tex. Notice that
% propbody can be used in this context as well as being incorporated
% in the dissertation (see diss.tex).

\documentstyle[12pt,a4]{article}
\begin{document}

\include{propbody}

\end{document}

```

## A.3 propbody.tex

```

% Draft #1 (final?)

\vfil

\centerline{\Large Diploma in Computer Science Project Proposal}

```

```

\vspace{0.4in}
\centerline{\Large How to write a dissertation in \LaTeX\ }
\vspace{0.4in}
\centerline{\large M. Richards, St John's College}
\vspace{0.3in}
\centerline{\large Originator: Dr M. Richards}
\vspace{0.3in}
\centerline{\large 21 November 2000}

\vfil

\subsection*{Special Resources Required}
File space on Thor -- 25Mbytes\\
Account on the DEC Workstations -- 15Mbytes\\
An account on Ouse\\
The use of my own IBM PC (1000GHz Pentium, 200Mb RAM and 40Gb Disk).
\vspace{0.2in}

\noindent
{\bf Project Supervisor:} Dr M. Richards
\vspace{0.2in}

\noindent
{\bf Director of Studies:} Dr M. Richards
\vspace{0.2in}
\noindent

\noindent
{\bf Project Overseers:} Dr~F.~H.~King \& Dr~S.~W.~Moore

\vfil
\pagebreak

% Main document

\section*{Introduction}

Many students write their CST and Diploma dissertations in \LaTeX\ and
spend a fair amount of time learning just how to do that. The purpos of
this project is to write a demonsatration dissertation that explains in
detail how it done and how the result can be given to the Bookshop
on an MSDOS floppy disk for printing and binding.

\section*{Work that has to be done}

The project breaks down into the following main sections:-

\begin{enumerate}

\item The construction of a skeleton dissertation with the required
structure. This involves writing the Makefile and makeing dummy files
for the title page, the proforma, chapters 1 to 5, the appendices and
the proposal.

\item Filling in the details required in the cover page and proforma.

\item Writing the contents of chapters 1 to 5, including examples
of common \LaTeX\ constructs.

```

\item Adding a example of how to use floating figures and encapsulated postscript diagrams.

\end{enumerate}

\section\*{Difficulties to Overcome}

The following main learning tasks will have to be undertaken before the project can be started:

\begin{itemize}

\item To learn \LaTeX\ and its use on Thor.

\item To discover how to incorporate encapsulated postscript into a \LaTeX\ document, and to find a suitable drawing package on Thor to recommend.

\item To discover what format the Bookshop would like for the finished dissertation, and how to deal with postscript files that are too large to fit on a single floppy disk.

\end{itemize}

\section\*{Starting Point}

I have a reasonable working knowledge of \LaTeX\ and have convenient access to Thor using an IBM PC in my office. Writing MSDOS disks is no problem.

\section\*{Resources}

This project requires little file space so 25Mbytes of disk space on Thor should be sufficient. I plan to use my own IBM PC to write floppy disks, but could use the PWF PCs if my own machine breaks down.

Backup will be on floppy disks.

\section\*{Work Plan}

Planned starting date is 01/12/2000.

\subsection\*{Michaelmas Term}

By the end of this term I intend to have completed the learning tasks outlined in the relevant section.

\subsection\*{Lent Term}

By the division of term the overall structure of the dissertation will have been written and tested.

By the end of term, example figures using encapsulated postscript will have been included.

`\subsection*{Easter Term}`

On completion of the exams I will incorporate final details into the dissertation including a bibliography using bibtex and a table of contents. The estimated completion date being 25/07/2001 to allow plenty of time should any unforeseen problems arise.

# Appendix B

## Makefile

### B.1 Makefile

```
# This is the Makefile for the demonstration dissertation
# written by Martin Richards
#
# Note that continuation lines require '\'
# and that TAB is used after ':' and before unix commands.

DISS = diss.tex refs.bib propbody.tex figs/diagram.eps makefile.txt

PROP = proposal.tex propbody.tex

help:
    @echo
    @echo "USAGE:"
    @echo
    @echo "make          display help information"
    @echo "make prop      make the proposal and view it using xdvi"
    @echo "make diss.ps   make a postscript version of the dissertation"
    @echo "make diss.pdf  make a .pdf version of the dissertation"
    @echo "make gv        view the dissertation with ghostview"
    @echo "make gs        view the dissertation with ghostscript"
    @echo "make all       construct proposal.dvi and diss.ps"
    @echo "make count     display an estimated word count"
    @echo "make pub       put demodiss.tar on my homepage"
    @echo "make clean     remove all remakeable files"
    @echo "make pr        print the dissertation"
    @echo

prop:  proposal.dvi
      xdvi proposal.dvi

diss.ps:      $(DISS)
      latex diss
      bibtex diss
      latex diss
      bibtex diss
      latex diss
      bibtex diss
```

```

dvips -Ppdf -G0 -t a4 -pp 0-200 -o diss.ps diss.dvi

diss.pdf:      diss.ps
              ps2pdf diss.ps

makefile.txt:  Makefile
              expand Makefile >makefile.txt
count:
              detex diss.tex | tr -cd '0-9A-Za-z \n' | wc -w

proposal.dvi: $(PROP)
              latex proposal

all:           proposal.dvi diss.ps

pub:           diss.pdf
              cp diss.pdf /homes/mr/public_html/demodiss.pdf
              make clean
              (cd ..; tar cfv /homes/mr/public_html/demodiss.tar demodiss)

clean:
              rm -f diss.ps *.dvi *.aux *.log *.err
              rm -f core *~ *.lof *.toc *.blg *.bbl
              rm -f makefile.txt

gv:           diss.ps
              ghostview diss.ps

gs:           diss.ps
              gs diss.ps

pr:           diss.ps
              lpr diss.ps

```

## B.2 refs.bib

```

@BOOK{Lamport86,
  TITLE = "{LaTeX} --- a document preparation system --- user's guide
and reference manual",
  AUTHOR = "Lamport, L.",
  PUBLISHER = "Addison-Wesley",
  YEAR = "1986"}

@REPORT{Moore95,
  TITLE = "How to prepare a dissertation in LaTeX",
  AUTHOR = "Moore, S.W.",
  YEAR = "1995"}

```



# Appendix C

## Project Proposal

Diploma in Computer Science Project Proposal

How to write a dissertation in L<sup>A</sup>T<sub>E</sub>X

M. Richards, St John's College

Originator: Dr M. Richards

21 November 2000

### **Special Resources Required**

File space on Thor – 25Mbytes

Account on the DEC Workstations – 15Mbytes

An account on Ouse

The use of my own IBM PC (1000GHz Pentium, 200Mb RAM and 40Gb Disk).

**Project Supervisor:** Dr M. Richards

**Director of Studies:** Dr M. Richards

**Project Overseers:** Dr F. H. King & Dr S. W. Moore

## Introduction

Many students write their CST and Diploma dissertations in  $\text{\LaTeX}$  and spend a fair amount of time learning just how to do that. The purpose of this project is to write a demonstration dissertation that explains in detail how it is done and how the result can be given to the Bookshop on an MSDOS floppy disk for printing and binding.

## Work that has to be done

The project breaks down into the following main sections:-

1. The construction of a skeleton dissertation with the required structure. This involves writing the Makefile and making dummy files for the title page, the proforma, chapters 1 to 5, the appendices and the proposal.
2. Filling in the details required in the cover page and proforma.
3. Writing the contents of chapters 1 to 5, including examples of common  $\text{\LaTeX}$  constructs.
4. Adding an example of how to use floating figures and encapsulated postscript diagrams.

## Difficulties to Overcome

The following main learning tasks will have to be undertaken before the project can be started:

- To learn  $\text{\LaTeX}$  and its use on Thor.
- To discover how to incorporate encapsulated postscript into a  $\text{\LaTeX}$  document, and to find a suitable drawing package on Thor to recommend.
- To discover what format the Bookshop would like for the finished dissertation, and how to deal with postscript files that are too large to fit on a single floppy disk.

## Starting Point

I have a reasonable working knowledge of  $\text{\LaTeX}$  and have convenient access to Thor using an IBM PC in my office. Writing MSDOS disks is no problem.

## **Resources**

This project requires little file space so 25Mbytes of disk space on Thor should be sufficient. I plan to use my own IBM PC to write floppy disks, but could use the PWF PCs if my own machine breaks down.

Backup will be on floppy disks.

## **Work Plan**

Planned starting date is 01/12/2000.

### **Michaelmas Term**

By the end of this term I intend to have completed the learning tasks outlined in the relevant section.

### **Lent Term**

By the division of term the overall structure of the dissertation will have been written and tested.

By the end of term, example figures using encapsulated postscript will have been included.

### **Easter Term**

On completion of the exams I will incorporate final details into the dissertation including a bibliography using bibtex and a table of contents. The estimated completion date being 25/07/2001 to allow plenty of time should any unforeseen problems arise.