

CAB402 Programming Paradigms

Quantum Computing

Thanat Chokwijitkul n9234900

Contents

1	Introduction	2
1.1	How to read this document	2
1.2	Aim	3
1.3	Driving Latex	3
1.4	Software Environment	4
1.4.1	Occam	4
2	Short Chap title	5
2.1	Image processing	5
2.2	Low level operations	5
2.3	Creating Diagrams	5
2.4	Screen Dumps	6
3	Making a bibliography	8
	References	9
A	Example of operation	10
A.1	Example input and output	10
A.1.1	Input	10
A.1.2	Output	10
A.1.3	Another way to include code	10

1. Introduction

The theory of computation has been extensively developed during the last few decades. Computers have provided reliable solutions for a myriad of community's seemingly unsolvable problems. Notwithstanding, various complicated problems have been continuously introduced to society as it never stops growing and becomes more complex. Even though technology nowadays has been steady advancing to approach the demands of society, whereas such steady progress has its limitation since many of those problems are intricate to model or appear to require time-intensive solutions. This phenomenon implies to the necessity of a new computing revolution since classical computation no longer has an ability to reach the increased demand.

According to Moore's law, the computational power of computers would dramatically increase approximately every two years. The theory can be proven real since the size of transistors has rapidly become smaller to a few nanometres. This results in a higher number of transistors mounted on an integrated circuit. The laws of classical physics do not function with objects with such small size. Thus, quantum computing becomes a next solution to deal with these complex problems.

Quantum computing is the revolution. It is a relatively new field of research which has the potential to introduce the world of computing to a new stage where certain computationally intense problems can be solved with a shorter amount of processing time. One can consider quantum computing as the art of utilising all the possibilities that the laws of quantum physics contribute to solving computational problems while classical computers merely use a minuscule subset of these possibilities. However, quantum computers are not a replacement for conventional computers as quantum mechanics only improve the computing efficiency for certain types of computation.

This research report delivers a brief glimpse into the world of quantum computers and the laws of quantum mechanics applied to this entirely new type of computer. It will also introduce the fundamental concepts of the field along with exploring quantum computing in practice using Language-Integrated Quantum Operations (LIQUi|)). This report concludes with experience evaluation in the quantum computing research in relation to the content of the unit (Programming Paradigms).

1.1 How to read this document

This document attempts to do two things

- Provide a starting point from which you can construct your report.

- Explain how one or two useful \LaTeX tricks work.

This means that you actually need to read it in two ways

- Read a printed, or previewed version to see *what* can be done.
- Read the source to see *how* it's done.

If you have any comments on this document, please post them to the QandA site `qanda.cs.man.ac.uk`.

1.2 Aim

The aim of the project is to create a wonderful gismo.

A blank line is used to separate paragraphs. The chapters, sections and subsections are numbered and added to the table of contents automatically.

1.3 Driving Latex

\LaTeX is not a WYSIWYG system. You first prepare source files, `report.tex` etc., similar to the ones here, using your favourite text editor.

The UNIX commands you need to drive \LaTeX are:

1. `latex`. Output from `latex` can be previewed on the screen with `xdvi` or `gsprev` (under X), and printed on the laserprinter using `dvips`. `latex` produces `.dvi` files which are used by `xdvi` or `gsprev` and `dvipr`. To get all the cross references and the table of contents correct you sometimes need to run this command twice in succession. Keep on re-running until the advice to rerun at the end of the output goes away.

Many people now use `pdflatex` instead of `latex` to produce pdf files directly.

2. `xdvi` or `gsprev`. Previews the document on the screen, again the parameter is `report`.
3. `dvips`. This is used to print on the laserprinter. The parameter is again `report`.
4. `xfig`. Can be used to produce diagrams, see section 2.3.

There are on-line manual pages for each of the commands described above.

The set of files used to produce this document is in `/opt/info/doc/latex` (in one of the subdirectories `3rd-yr` or `MU-Thesis`). They are also on the web at `http://csis.cs.manchester.ac.uk/software/contrib/latex/`.

You will find that for more detailed points you will need to refer to Lamport's ' \LaTeX a document preparation system' [Lamport, 1994] (Copies in the library in Blackwell's). This example has been written using the most recent version of \LaTeX (LaTeX2e), which is described in the *2nd edition* of Lamport's book. Buying a cheap copy of the 1st edition is probably not a good investment. An alternative to Lamport's book, which some people prefer, is 'A guide to \LaTeX 2 ϵ ' by Kopka and Daly [Kopka and Daly, 1995]. The older 'A guide to \LaTeX ' [Kopka and Daly, 1993] by the same authors is now obsolete. There is also plenty of support material for \LaTeX on the web.

1.4 Software Environment

1.4.1 Occam

Here is some more example text, showing various \LaTeX facilities you may need. The project was mostly programmed in **Occam** [D.Pountain and D.May, 1987]. (A citation has been created here to an entry in the bibliography at the end of the report. See chapter 3 for more details on how to do this).

Note the way of getting boldface, *textit* is used for italic. *emph* is used for emphasis and is the same as italic except when already in italic. Note the cross reference to the bibliography. This is how you create a footnote: DMA¹.

Here is a reference to a figure. See figure 1.1. The picture in this figure was created the hard

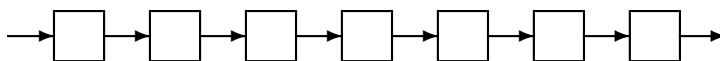


Figure 1.1: A Pipeline of processors

way using the picture facility of \LaTeX . It is *much* easier to use `xfig`, as described in section 2.3. Whatever its contents, a figure ‘floats’ to a ‘suitable’ point in the text and is never split across a page boundary. (\LaTeX ’s idea of what constitutes a suitable point may not coincide with yours)

Now we have a verbatim environment; this is a useful way of including snippets of program, printed in a fixed width font exactly as typed:

```
{{{ An example of some folds
... This is some folded code
  {{{ This is another fold
    This is text within the fold that has now been
    opened so that the text can be read.
  }}}
}}}
```

¹Direct Memory Access. Footnotes can stretch over more than one line if you have a lot to say, but be careful not to overdo them.

2. This chapter has a very long title that would be too long for using in headers and table of contents

2.1 Image processing

Because Image processing is such a large topic no attempt will be made here to describe the entire subject here but only areas directly relevant to the project as a whole. Note how we can cross reference sections of the document such as section 2.2

2.2 Low level operations

Here is an example of a list with bullets:

- *Mean* Take the mean value of the neighbourhood.
- *Median Filter* Take the median value of the neighbourhood.

Here are a couple of mathematical formulae:

$$\Delta_1 = I(x, y) - I(x + 1, y + 1)$$
$$(x - a)^2 + (y - b)^2 = R^2$$

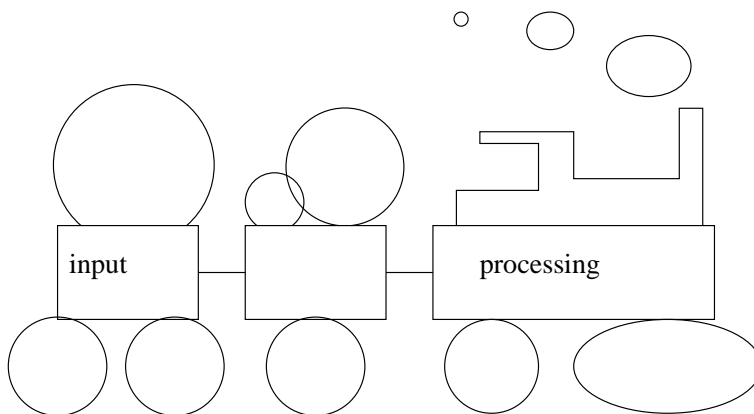
A table is just like a figure. Table 2.1 uses the tabular environment. Environments such as tabular can be used in ordinary text as well.

2.3 Creating Diagrams

Figure 2.1 is a figure previously prepared using the `xfig` interactive drawing package. With the latest version of `xfig` it is quite easy to incorporate `xfig` diagrams. The `xfig` package is menu driven and reasonably self explanatory.

place	1991	1992	1993
CS Dept	1	99	199
Owens Park	1876	22	0
Academy	0	0	99999

Table 2.1: Distribution of Wombats in Greater Manchester



A caption for the picture

Figure 2.1: Final version of the system

Use the *Export* menu option to save an encapsulated PostScript version of your figure, which can then be included in the document using the `\includegraphics` command. Choose the *Portrait* orientation option. For example, if the figure is in the file `figure1.fig`, the exporting process will create a file `figure1.eps`, which can then be included, scaled to whatever height or width you want.

Note that, if you want to use such graphics facilities in some other document, which does not use either the `third-rep` or `muthesis` document class, you will need to put the command `\usepackage{graphicx}` after the `\documentclass{...}` command in the main file.

2.4 Screen Dumps

Screen dumps can often enhance the appearance and clarity of a report, although care should be taken not to overuse them. When using screen dumps it is useful to make use of L^AT_EX's capability for using compressed PostScript files, as in the example shown in figure 2.2.

The image is first captured using, for example, `xv`, and saved in a file, e.g. `screen.ps`. Next, extract the bounding box information from the head of this file. In this case it is

```
%%BoundingBox: -100 -16 697 860
```

and create a file with name given by adding `.bb` to the original file name (in this case the name is `screen.ps.bb`) which contains just this bounding box. You can now compress the original file, using `gzip`. The command `\includegraphics[width=12cm]{screen}` will look for either `screen.ps` or `screen.ps.gz`, so you can compress or uncompress the `ps` file without changing the latex source.

Alternatively, save as `.png` if using `pdflatex`.

The `draft` option can be used to exclude the actual figure, but leave an appropriate amount of space.

You may not be able to see the screen dump if you are viewing this file from WWW. This is due to an unfortunate ‘feature’ of the previewer `xdvi`. If you view the files directly from `/opt/info/doc/latex/3rd-yr`, things should work properly.

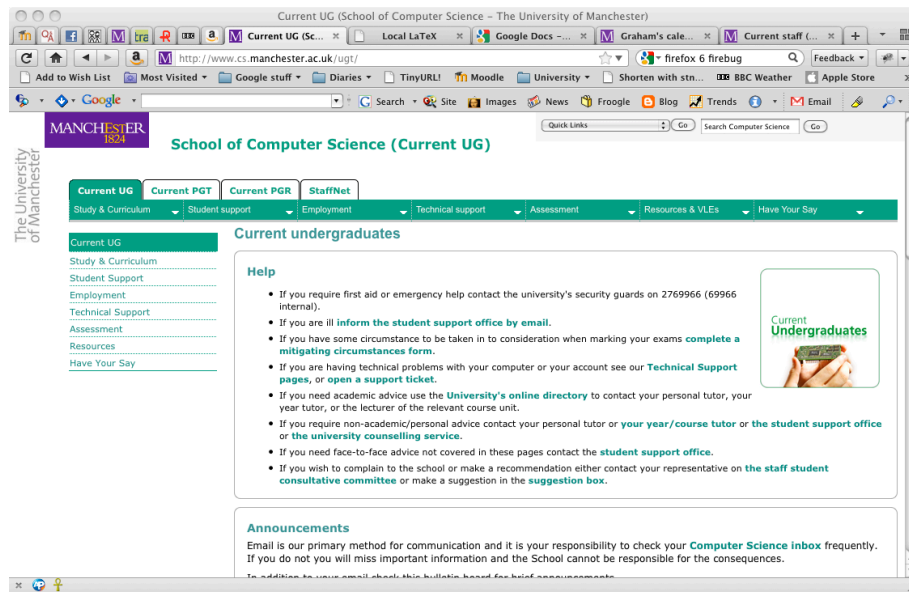


Figure 2.2: A screen dump

3. Making a bibliography

Whenever you wish to refer to books or articles relevant to your report you should use a citation such as [Lamport, 1994]. You can also force entries to appear in the bibliography without a citation appearing in the document, by using `\nocite`.

Each document cited must have an entry in a `.bib` file. For this document we have only one, called `refs.bib`. These files are listed in the `\bibliography` command at the end of `report.tex`. Note that the `.bib` files can (and often do) contain many more entries than are actually cited in a particular document; the only ones that appear in the bibliography are those that have been referenced using `\cite` or `\nocite`.

In order to generate the appropriate reference entries, you will need to run `bibtex` after `latex` has been run, using the command `bibtex report`. This will generate a file `report.bbl`, which contains the bibliography entries. Once that file is there, you do not need to run `bibtex` again unless you add new citations, but you will probably have to run `latex` twice after running `bibtex` the first time.

The `TEX` FAQ ([Team, 2012]) gives tips on how to cite URLs.

The file `refs.bib` provides an example of what can be done with Bib`TEX`. You can find much more information in any book on `LATEX`, for example [Lamport, 1994, Goosens et al., 1994, Kopka and Daly, 1995]

References

- [Boyle and Thomas, 1988] Boyle, R. D. and Thomas, R. C. (1988). *Computer Vision - A First Course*. Blackwell Scientific Publications.
- [D.Pountain and D.May, 1987] D.Pountain and D.May (1987). *A tutorial introduction to oc-cam programming*. Blackwell Scientific Publications.
- [Dyke, 1994] Dyke, W. (1994). The nutter’s guide to L^AT_EX. *Read Only*, (7).
- [Goosens et al., 1994] Goosens, M., Mittelbach, F., and Samarin, A. (1994). *The E_TX Companion*. Addison-Wesley.
- [Kopka and Daly, 1993] Kopka, H. and Daly, P. W. (1993). *A guide to E_TX*. Addison-Wesley.
- [Kopka and Daly, 1995] Kopka, H. and Daly, P. W. (1995). *A guide to E_TX 2_ε*. Addison-Wesley, 2nd edition.
- [Lamport, 1994] Lamport, L. (1994). *E_TX – A document preparation system*. Addison-Wesley, 2nd edition.
- [Team, 2012] Team, L^AT_EX. (2012). URLs in BibTeX bibliographies. <http://www.tex.ac.uk/cgi-bin/texfaq2html?label=citeURL>.

A. Example of operation

An appendix is just like any other chapter, except that it comes after the appendix command in the master file.

One use of an appendix is to include an example of input to the system and the corresponding output.

One way to do this is to include, unformatted, an existing input file. You can do this using `\verbatiminput`. In this appendix we include a copy of the C file `hello.c` and its output file `hello.out`. If you use this facility you should make sure that the file which you input does not contain TAB characters, since \LaTeX treats each TAB as a single space; you can use the Unix command `expand` (see manual page) to expand tabs into the appropriate number of spaces.

A.1 Example input and output

A.1.1 Input

(Actually, this isn't input, it's the source code, but it will do as an example)

```
/* Hello world program */

#include <stdio.h>

int main(void)
{
    printf("Hello World!\n") ;
    return 0 ;
}
```

A.1.2 Output

A.1.3 Another way to include code

You can also use the capabilities of the `listings` package to include sections of code, it does some keyword highlighting.

```
/* Hello world program */

#include <stdio.h>

int main(void)
```

```
{  
    printf("Hello _World!\n") ;  
    return 0 ;  
}
```