Almost Real: An investigation into the metaphysics of virtual reality.

Example Independent Study Thesis

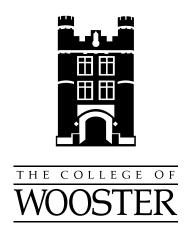
Presented in Partial Fulfillment of the Requirements for the Degree Bachelor of Arts In Computer Science and Philosophy in the Department of Math and Computer Science at The College of Wooster

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ABSTRACT

This interdisciplinary independent study thesis is divided into five chapters. The first chapter âĂIJOn Virtual RealismâĂİ will outline the authorâĂŹs unique formulation of virtual realism, the ontological thesis that experiences in virtual reality are non-illusory, and that virtual objects truly exist in an equivalent sense to physical objects. Next, âĂIJdealism and Virtual RealityâĂİ will describe the metaphysical implications of the idealism of British empiricist George Berkeley and the YogÄAcÄAran school of Mahayana Buddhism with respect to a virtual realist project. Although Berkeley and the YogÄĄcÄĄran philosopher Vasubandhu differ in several respects, both authorâÁŹs projects are ultimately sympathetic to the aims of virtual realism. However, the YogÄAcÄAran idealism ultimately proves to be the superior choice for the virtual realist. The next chapter âĂIJVirtual physicalismâĂİ will posit a physicalist reply to the idealism of Vasubandhu and argue for a physicalist account of reality and virtual reality using Occam's razor as inspired by Saul KripkeâĂŹs argumentation in his article Mad pain and Martian pain. Having established the merits of physicalist account of reality over the idealist standpoint, the remainder of this section will focus on how the metaphysical commitments of physicalism impact a virtual realist worldview. The fourth chapter will describe the implementation of an immersive virtual environment using physicalist principles and discuss how awareness of the virtual nature of a virtual reality environment impacts an agentâĂŹs experience of said environment. Of specific interest to this project is how ideas from physicalist metaphysics can aid virtual reality designers in crafting non-player character experiences which do not fall victim to the uncanny valley phenomenon (Masahiro Moriâ Á Zs hypothesis that very human-like but slightly imperfect digital entities elicit feelings of eeriness and revulsion among some observers). The fifth chapter describes the methodology and results of a usability study which attempts to measure the effectiveness of these philosophical principles in helping designers remedy the uncanny valley phenomenon in their creations.



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V_{ITA}

Publications

Fields of Study Major field: Computer Science and Philosophy

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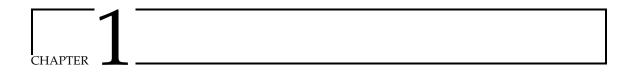
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PREFACE

THE purpose of this document is to provide you with a template for typesetting your IS using LATEX. LATEX is very similar to HTML in the sense that it is a markup language. What does this mean? Well, basically it means you need only enter the commands for structuring your IS, i.e., identify chapters, sections, subsections, equations, quotes, etc. You do not need to worry about any of the formatting. The woosterthesis class takes care of all of the formatting.

Here is how I plan on introducing you to LaTeX. The Introduction gives some reasons for why one might find LaTeX superior to MS WordTM. Chapter 3 will demonstrate how one starts typesetting a document and works with text in LaTeX. Chapter 4 discusses the creation of tables and how one puts figures into a thesis. Chapter 5 talks about creating a bibliography/references section and an index. There are three Appendices which discuss typesetting mathematics and computer program code. The Afterword will discuss some of the particulars of how a LaTeX document gets processed and what packages the woosterthesis class uses and are assumed to be available on your system.

Hopefully, this document will be enough to get you started. If you have questions please refer to ?????], or?].

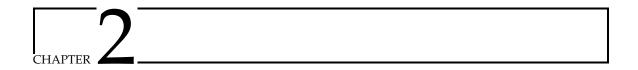


Introduction

So why would you want to use LaTeX instead of Microsoft WordTM? I can think of several reasons. The main one for this author is that LaTeX takes care of all of the numbering automatically. This means that if you decide to rearrange material in your IS, you do not have to worry about renumbering or references. This makes it very easy to play around with the structure of your thesis. The second reason is that it is ultimately faster than WordTM. How? Well, after a week or so of using LaTeX you will begin to remember the commands that you use frequently and won't have to use the LaTeX pallet in TeXShop or TeXnicCenter. So you can just type everything including the mathematics, where with WordTM you would have to use the Equation Editor.

I have also tried to make things more efficient by organizing the example folder as follows. There is a username.tex file which you will want to rename using your username and which is what you will enter all of the information about your IS into. username.tex also has explanations about other files that you might need to edit. In addition there are folders for chapters, appendices, styles, and figures. This structure is there to try and reduce file clutter and to help you stay organized. There should also be a .bib file which you can use as a model for your own .bib file. The .bib file has your bibliographic information.

LATEX is really easy to learn. For an average IS, the author will only need to learn a handful of commands. For this small bit of effort, you get a tremendous amount of flexibility and a very beautiful document. The following chapters will introduce some of the common things a student might need to do in a thesis.



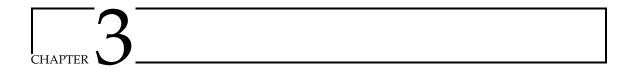
YOGACARAN IDEALISM AND VIRTUAL REALITY

2.1 A Brief introduction to Yogacaran Metaphysics

One of the two major schools in Mahayana Buddhism, Yogacara is a form of Buddhistism noted for its denial of the existence of external objects [1] . Literally translated, the term Yogacara means "the practice of yoga", this name reflects the school's origins in metaphysical speculation into the nature of yoga and mediation practices. Many advanced mediation practices involve focusing on ones awareness of purely mental entities, the connection between these expertises and the achievement of Enlightenment motivates the Yogacara's idealist understanding of the universe. Yogacaran metaphysics can be characterized by the term Cittamatra (English: "consciousness only"), one of the school's other names. Yoagacarans believe that nothing exists besides mental things. This radical form of idealism seems highly counterintuitive and illogical. However, there are many persuasive arguments for this abnormal view. When somebody suffering from cataracts looks at the moon, they have the experience of seeing the moon as if it were covered in hairs. But clearly a hairy moon is no more real than a moon made out of cheese. Yet for individual suffering from cataracts, their experience of a hairy moon is just as real as the experience of a desolate rocky moon was for the crew of Apollo eleven. So how do we account for what the person is seeing? Yogacaran philosopher Vasubandhu argues that the person with cataracts is aware of a mental image (deemed an impression) that manifests itself as an external object when there is no such thing outside of the mind. This view is motivated by representationalism, the notion that we "what we are directly aware of in waking memory sensory experience is not the external object, but rather a mental image that resembles the object and is caused by sense-object contact" [1]. In contrast to the "impression only" idealism of the Yogacara, the representationalist viewpoint is compatible with the existence of external objects

3

(i.e. a realist standpoint). Vasubandhu argues that the world is nothing but unreal impressions, analogous to the unreal hairs on the moon *seen* by the cataract sufferer. Vasubandhu continues by denying the existence of spatial locations. Both realists and idealists like Vasubandhu describe experiences in terms of physical objects, but these experiences could also be explained in terms of images containing colors and shapes. Each of these color/shape images can be described as baring different relations to each other(left, right, etc) [1]. This visual change will change over time, but an observer will eventually discover that certain visual features will reoccur periodically in a predicable manner. From these patterns, an agent can construct a phenomenal language that maps onto the all of the visual elements we typically describe in spatial terms. This language may be awkward, but it is the only means to describe these types of experiences in a manner that is amicable to both realists and idealists. This phenomenal language mirrors how computer systems describe and represent entities within a virtual space. Using this language, the realist can object to Vasubandhu's claim with the intersubjective agreement [1]. Barring special cases in which the experience is solely an impression (i.e: in the hairy moon example) agents seem to have remarkably similar sensory experiences. The realist claims that the different between these special impression-only experiences and *normal* sensory experience is that there is only a intersubjective agreement in the latter scenario. In other words, the majority of observers are in agreement about the nature of the sensory experience and there are publicly accessible signifiers that can explain the minority's differences in sensory experience of the phenomena in question. From these facts, the realist claims, we can infer that normal sensory experience is independent of the observer's mind and therefore physical objects must exist. Another reply to Yogacaran idealism available to the realist is the argument from efficacy. This counterargument involves comparing sensory experiences which are known to be merely impressions with what are said to be normal sensory experiences. The normal sensory experiences will have clearly observable casual effects on the observer while the impressions have no lasting casual impact on the agent or their surroundings. Vasubandhu counters these realist arguments by



In the beginning: Knuth said "Let there be T_EX "

Now that I've tried to convince you that LaTeX is going to be better than WordTM for your IS, you're saying, "So how do I use it?" Well let's start with some basic things. First, how is a document structured in LaTeX?

A document for LATEX is all the stuff that comes between the \begin{document} and \end{document} and \end{document} tags. "OK, but how do I get my chapters to print?" You save the chapters in the chapters folder and put an \include{chapters/chaptername} command in username.tex after the \begin{document} and before the \end{document} tag. username.tex already has some examples of including chapters; you can just alter them to have your chapter names. I should also mention that the % symbol is used for comments. The username.tex file has a number of comments that are intended for you and try to explain what is happening. Oh, and if you need a % symbol enter \%.

Now to write your first chapter. I would recommend saving this chapter (chapter1.tex) under a different name and making changes to the new copy. The most basic structural elements that you need to know are the paragraph, \chapter, \section, and \subsection. A new paragraph is obtained by putting a blank line in the source file. The other commands are very easy to use. If I want to start a new section I enter \section[My new section] {An example of making a new section and giving it a short name} (the part in square brackets is optional) and get

3.1 An example of making a new section and giving it a short name

The \chapter and \subsection commands work in exactly the same manner. Each new chapter must have \chapter[short name] {chapter name} as its first line.

"Hey, wait a minute. What if I need to refer to that section? How can I do that?" It's actually as simple as adding\label{labelname} at the end of the \chapter command like\section[My new section]{An example of making a new section and giving it a short name}\label{sec:newsec}. Now I can refer to Section 3.1 by typing \ref{sec:newsec}. You can label just about anything and refer to the label to get an automatically generated number for the item. This means that you need to come up with a labeling scheme before you start writing and stick with it.

Some other things you'll need to be able to do include italicizing and bolding text and creating lists. These are also easy to accomplish. For example I can use \emph or \textit to italicize text. To italicize homework I would enter \emph{homework} or \textit{homework} to produce homework. To obtain bold text you would use the \textbf command. And what about lists?

There are several kinds of lists (enumerated, itemized, and descriptive) and each has its own place and environment. An enumerated list is good for outlining or ordered lists:

```
\begin{enumerate}
\item First main idea
\begin{enumerate}
\item First subpoint
\item\label{enum:1b} Second subpoint
\end{enumerate}
\item Second main idea
\end{enumerate}
```

1. First main idea

(a) First subpoint

(b) Second subpoint

2. Second main idea

The itemized list is good for unordered lists or bullet points:

```
\begin{itemize}
\item Idea
\item Idea
\item Idea
\item Idea
\item Idea
\end{itemize}
```

• Idea

• Idea

Idea

• Idea

And the descriptive list is good for definitions; however, amsthm already has a definition environment, and you will most likely not need the description environment. In any event, here is an example:

```
\begin{description}
\item[First item:] Idea
\item[Second item:] Idea
\item[Third item:] Idea
\end{description}
```

First item: Idea
Second item: Idea
Third item: Idea

Notice the use of brackets in the last example. The brackets are optional and the text in the brackets is used as the label for the item. You should also note that you can label an item for later reference see 1b. There are several options for changing the format of the list environments and a package, paralist, for customizing lists which are described in section 3.3 of?].

3.2 Theorems, definitions, examples, oh my!

The next thing you'll probably need to do is enter definitions, theorems, and examples. Below you will find some examples. On the left you will see the text typed into the document and on the right what it looks like when formatted. These examples are intended to give you a sense of what type of mathematical expressions LATEX handles. You should look at Appendix ?? for a more complete discussion of entering mathematics. In the beginning you will not know all of the commands that you need to enter. Don't worry. Each of the suggested editors has a palette that shows you a picture of what you want and puts the correct commands into the document when you click the picture. As you look at these examples, keep it in mind that some of them use some user defined commands which can be found in styles/personal.tex. Now lets look at Definition 3.1 ??, Theorem 3.1, and equation 3.3.

\begin{defn}[One of Ramanujan's
 third order mock theta
 functions]\label{def1}
 \begin{equation}\label{introf(q)}
 f(q)=1+\sum_{y=1}^{\infty}
 \frac{q^{y^2}}{(1+q)^2(1+q^2)^2}
 \cdots (1+q^y)^2}.
 \end{equation}\end{defn}

Definition 3.1 One of Ramanujan's third order mock theta functions:

$$f(q) = 1 + \sum_{y=1}^{\infty} \frac{q^{y^2}}{(1+q)^2 (1+q^2)^2 \cdots (1+q^y)^2}.$$
 (3.1)

\begin{thm}[Watson's
transformation of
\$f(q)\$]\label{introwatthm}
\begin{equation}\label{introf}
\qrfac{q}{\infty}
\sum_{y=0}^{\infty} q^{y^2}
\qrfac[-2]{- q}{y}=1+
\sum_{y=1}^{\infty}
\frac{(-1)^{y}}
4q^{(3/2)y^2+
(1/2)y}{(1+q^{y})}.
\end{equation}\end{thm}

Theorem 3.1 (Watson's transformation of f(q)).

$$(q)_{\infty} \sum_{y=0}^{\infty} q^{y^2} (-q)_y^{-2} = 1 + \sum_{y=1}^{\infty} \frac{(-1)^y 4q^{(3/2)y^2 + (1/2)y}}{(1+q^y)}.$$
 (3.2)

This is a more complicated example which uses the \substack command to have multiple summation criteria.

```
\label{label_m.1diasumtwo} $$ \left[NUM \right]_1^{(fl)}(q;b; \bvec\{x\})=& q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum_{0\leq r,t\leq \ell-1} s_{(b,\lambda)}(x). \end{align} $$ \left[NUM\right]_1^{(\ell)}(q;b;x)=q\sum_{0\leq r,t\leq \ell-1} q^{r+t} \sum
```

Another thing that one might need to do is create piecewise definitions. This can be accomplished by using the cases environment. This example also uses the \intertext command to put text between displayed equations.

```
\begin{subequations}\label{2c1BP}
\begin{alignat}{2}\label{2c1BPa}
A_{y_1}:=\&\left( \cos \left( \cos \right) \right)
 1 &\text{for $y_1=0$},\\
                                                                                      A_{y_1} := \begin{cases} 1 & \text{for } y_1 = 0, \\ \frac{-1)^{y_1} 4q^{y_1} q^{\binom{y_1}{2}}}{(q)_{2y_1} (1+q^{y_1})} & \text{for } y_1 > 0 \end{cases}
\frac{-1}{y_1}
                                                                                                                                    (3.4a)
4q^{y_1}q^{\binom{y_1}{2}}
{qfac{q}{2y_1}(1+q^{y_1})}
\scriptstyle x = 1>0} \end{cases} \
                                                                       and
\intertext{and} B_{y_1}:=&
\qrfac[-1]{-q}{y_1}\qrfac[-1]
                                                                                       B_{y_1} := (-q)_{y_1}^{-1} (-q)_{y_1}^{-1} = (-q)_{y_1}^{-2}
                                                                                                                                    (3.4b)
{-q}{y_1}=\sqrt{-2}{-q}{y_1}
&.\label{2c1BPb}\end{alignat}
\end{subequations}
```

Finally, if you need to incorporate examples into your thesis you can do it using the example environment, as seen in Example 3.1.

```
\begin{ex}[An example example]
\label{ex:ex}
This is an example of including an example. Kind of silly isn't it.
\end{ex}

Example 3.1 (An example example). This is an example of including an example. Kind of silly isn't it.
```

3.3 Putting code in the main body of the thesis

There is one last textual item which Computer Science majors and probably some Mathematics majors will need to incorporate, pseudocode. To do this I would suggest using the \lstlisting environment.

Below is an example set up for the listings package. You could put your modifications to this set up into the personal.tex file in the styles folder. Documentation on the listings package can be found in the doc folder with the documentation for the other packages.

```
\lstset{
    language =Pascal, % pick a language style
    emph={return,natural, numbers, integers, increasing},
    emphstyle={\bfseries},% choose other keywords and a format
    linewidth=.95{\textwidth}, breaklines=true,commentstyle=\textit,
    stringstyle=\upshape,showspaces=false,numbers=left,
    numberstyle=\tiny,basicstyle=\small,xleftmargin=30pt,
    breakautoindent=true,captionpos=b
}
```

The listing in Listing 3.1 gives an algorithm for finding the largest even integer in a given list of n integers. I have used the mathescape option to be able to incorporate mathematics in the listing. The actual code put in the thesis is given first and the formatted output follows.

```
\begin{lstlisting} \mathescape, caption= Find the location
of the largest even integer in a list, label=largesteven]
procedure $largestevenlocation$($a_1, a_2, \ldots, a_n$: integers)
k:=0
$largest$:=-$\infty$
for $i$:=1 to $n$
  if ($a_i$ is even and $a_i>largest$) then
  beain
    $k$:=$i$
    $largest$:=$a_i$
  end
end
return $k$
\end{lstlisting}
   procedure largestevenlocation (a_1, a_2, ..., a_n): integers
   _{2} k := 0
   largest:=-\infty
   4 for i=1 to n
        if (a_i \text{ is even and } a_i > largest) then
         begin
           k := i
           largest := a_i
         end
   10 end
   11 return k
```

Listing 3.1: Find the location of the largest even integer in a list

The code in Listing 3.2 is an improvement on Binary search. The algorithm reduces the size of the search by a factor of four at each iteration. It provides another example of using the \lstlisting environment.

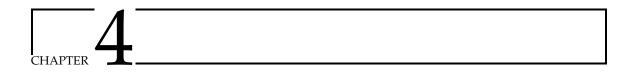
```
\begin{lstlisting}[mathescape,caption=Quartary search,
label=quartsearch]
procedure $quartarysearch$($x$: integer, $a_1, a_2,
 \ldots, a_n$: increasing integers)
$i$:=$1$
$j$:=$n$
while $i<j-2$
begin
  $1:=\lfloor(i+j)/4\rfloor$
  $m:=\lfloor(i+j)/2\rfloor$
  u:=\1floor3(i+j)/4\rfloor
  if x>a_m then
    if x\leq a_u then
    begin
      i:=m+1
      $j:=u$
    end
    else
     $i:=u+1$
  else if $x>a_1$ then
    begin
      $i:=1+1$
      $j:=m$
    end
    else $j:=1$
if $x=a_i$ then $location:= i$
else if $x=a_j$ then $location:= j$
else if x=a_{\left(i+j\right)/2\right}\ then
 $location:= \lfloor(i+j)/2\rfloor$
else $location:= 0$
return $location$
\end{lstlisting}
    procedure quartary search (x: integer, a_1, a_2, ..., a_n: increasing integers)
    _{2} i := 1
      j := n
      while i < j - 2
    5 begin
         l := \lfloor (i+j)/4 \rfloor
         m := \lfloor (i+j)/2 \rfloor
         u := \lfloor 3(i+j)/4 \rfloor
         if x > a_m then
            if x \le a_u then
   10
            begin
   11
              i := m + 1
   12
              j := u
   13
            end
   14
            else
   15
             i := u + 1
   16
         else if x > a_l then
   17
            begin
   19
              i := l + 1
              j := m
   20
            end
   21
            else j := l
   22
   23 end
   if x = a_i then location := i
```

```
else if x = a_j then location := j
else if x = a_{\lfloor (i+j)/2 \rfloor} then location := \lfloor (i+j)/2 \rfloor
else location := 0
return location
```

Listing 3.2: Quartary search

3.4 What is in username. Tex

Before we move on let's talk a little bit about what is at the beginning of username.tex. The file starts with \documentclass{woosterthesis}, which must be at the beginning of every IS. In the brackets are options for the woosterthesis class. The options are the same as for the book class with some additional options abstractonly, alltt, blacklinks, code, dropcaps, euler, guass, index, kaukecopyright, palatino, picins, verbatim, and xetex. The kaukecopyright option will put the arch symbol with the word mark on the copyright page. The blacklinks option will make the hyperlinks in the PDF version of the thesis black and suitable for printing; normally the links are colored to provide visual clues to the reader. The code option will use listings style to format program code examples. The abstractonly option will allow you to print just the Abstract. The palatino option will use the pxfonts package which uses the Palatino fonts. The picins option will use the floatflt package to allow text to wrap around images. index will allow the makeidx package to be loaded so that if you have index entries they will be added to an index (this regires additional steps). dropcaps loads the letterine package for doing dropped capitals and alltt loads the alltt for using typewriter type in various ways. verbatim allows one to set verbatim what is entered. euler and guass load the woofncychap package with the named option which will change the look of chapter headings. Finally xetex will allow you to use the XeTeX extension of TeX for easy use of system fonts. Adding or deleting options from the comma separated list will change the appearance of the document and some options should only be used after consulting your advisor. Now let's move on to some other things that you'll need to deal with: figures, pictures, and tables.



Working with figures and tables

4.1 GETTING A SIMPLE FIGURE IN THE DOCUMENT

In this chapter we want to talk about including figures and tables in the document. To insert a simple

figure you can enter something like

\begin{figure}[!ht] \begin{center} \woopic{picture3}{.8} \end{center} \caption{Our first picture}\label{first} \end{figure}

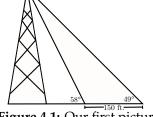


Figure 4.1: Our first picture

The !ht tell LATEX to try and place the figure here no matter what or at the top of the next page. The \woopic command takes the name of the picture as the first argument and the scaling factor as the second argument. The scaling factor must be between zero and one and the figure name must have no spaces. Your figures can be in one of three formats: jpg, tif, or pdf. Captions are placed below the figure and your label should be placed after the caption.

In the next example we are using the woosterthesis option picins to typeset a picture inside a paragraph and have the text wrap around the figure. This option loads the wrapfig package. One thing to note is that the figures placed in this manner do not float with the other figures and as such numbering could get out of sequence. Keep an eye out for such behavior. This technique should be used sparingly in your thesis.

```
\newcommand{\sample}{Some text that is reused over and over
   again in the example. }
\begin{\wrapfigure}{r}{2.2in}
\woopic{\picture2}{.4}
\caption{Conchoid.}
\end{\wrapfigure}
\sample\sample\sample
```

Some text that is reused over and over again in the example. Some text that is reused over and over again in the example. Some text that is reused over and over again in the example. Some text that is reused over and over again in the example. Some text that is reused over and over again in the example. Some text that is reused over and over again in the example. Some text that is reused over and over again in the example. Some text that is reused over and over again in the example. Some text that is reused over and over again in the example.

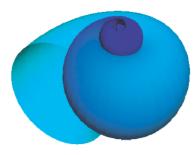


Figure 4.2: Conchoid.

4.1.1 MINIPAGES

You can also create minipages in your documents to accomplish more complicated formatting. For example you could try the following which produces Figure 4.3.

```
\begin{minipage}[t][3 in][t]{1 in}
This is a minipage which is 3 in tall and 1 in wide.
  Top Text Text Text.\end{minipage}\hfill
\begin{minipage}[t][3 in][c]{1 in}
This is a minipage which is 3 in tall and 1 in wide.
  Center Text Text Text.\end{minipage}\hfill
\begin{minipage}[t][3 in][b]{1 in}
This is a minipage which is 3 in tall and 1 in wide.
  Bottom Text Text Text.\end{minipage}
```

In the example above, the syntax \begin{minipage}[t][3 in][t]{1 in} follows the convention \begin{minipage}[minipageposition][height][textposition]{width}

4.1.1.1 How to get more than one picture in the same figure

You can use minipages to put more than one picture in a figure. Here is an example of how to do this.

```
\begin{minipage}[!ht]{6cm}
\woopic{picture1}{.4}
```

This is a minipage which is 3 in tall and 1 in wide. Top Text Text Text Text.

This is a minipage which is 3 in tall and 1 in wide. Center Text Text Text.

This is a minipage which is 3 in tall and 1 in wide. Bottom Text Text Text Text.

Figure 4.3: Minipage example

\par
\caption[What goes in the List of Figures]{Left}
\end{minipage}
\hfill
\begin{minipage}[!ht]{6cm}
\woopic{picture2}{.4}
\end{picture}\par
\caption{Right}
\end{minipage}

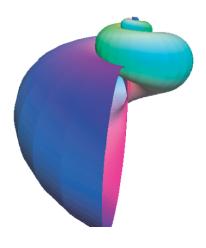


Figure 4.4: Left

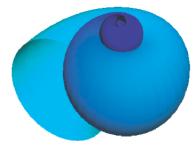


Figure 4.5: Right

You can also use the subfigure package to do this.

```
\begin{figure}[!ht]\centering
\subfigure[What goes in the List][Large conchoid]
{\woopic{picture1}{.4}\label{fig3:left}}
\qquad
\subfigure[What goes in the List][Small conchoid]
{\woopic{picture2}{.4}\label{fig3:right}}
\caption{Two pictures in one figure}\label{fig3}
\end{figure}
```

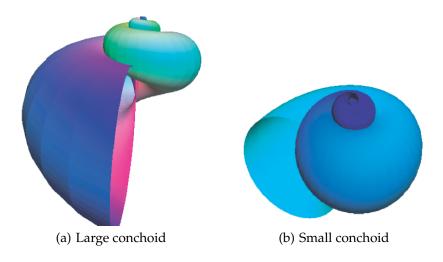


Figure 4.6: Two pictures in one figure

We should now be able to refer to either Figure 4.6 (a) or Figure 4.6 (b) using the labels we gave to the left and right images.

The reader is referred to Chapters 8, 9, and 16 of ?] or to Chapters 6 and 10 of ?] for a complete discussion of figures and graphics.

4.2 Tables

Tables are fairly easy to set up. Here is a simple table

```
\begin{table}[!ht]
\begin{center}
\begin{tabular}{r 1}
    $\underline{\textnormal{District}}$ &
    $\underline{\textnormal{Population}}$\\
    Applewood & 8280 \\
    Boxwood & 4600 \\
    Central & 5220
    \end{tabular}\caption{Our first table}
    \end{center}
\end{table}
```

<u>District</u>	Population
Applewood	8280
Boxwood	4600
Central	5220

Table 4.1: Our first table

In \begin{tabular}{r 1} the two "r" and "l" indicate that we have two columns with right and left aligned entries and no lines dividing cells or around the table. I can make the table look more like a spreadsheet by doing

```
\begin{table}[!ht]
\begin{center}
\begin{tabular}{|r|1|}
\hline
    {\textnormal{District}} &
    {\textnormal{Population}}\\ \hline
    Applewood & 8280 \\ \hline
    Boxwood & 4600 \\ \hline
    Central & 5220\\ \hline
    \end{tabular}\caption{Our first table again}
    \end{center}
\end{table}
```

District	Population
Applewood	8280
Boxwood	4600
Central	5220

Table 4.2: Our first table again

Here is a more complicated example of a table.

```
\begin{table}[!ht]
\centerline{
\begin{tabular}{||||r|r|r||} \hline
\emph{Reprojection} & \multicolumn{3}{|c|}{\emph{Largest} Reduction of Curvature}}
    & \emph{Average} \ \cline{2-4}
\emph{Method} & \emph{Original} & \emph{Reprojected} & \emph{at} & \emph{Reduction} \\
    & \emph{Reduction} \\
    & \emph{Rotation} & \emph{Curvature} & \emph{Rotation} & \emph{of Curvature} \\
    \hline \hline
ZEEL & 0.0358 & 0.0245 & \\degree{45}$ & 0.0050 \\ hline
```

```
ZEEL ext.\ & 0.0358 & 0.0245 &
    $\degree{45}$ & 0.0059 \\ \hline
Regridding & 0.0428 & 0.0166 &
    $\degree{75}$ & 0.0159 \\ \hline
Block & 0.0358 & 0.0103 &
    $\degree{45}$ & 0.0163 \\ \hline
\end{tabular}}
\caption{Reduction of curvature by each
    reprojection method\label{tbl:kreduce}}
\end{table}
```

Reprojection	Largest Reduction of Curvature			Average
Method	Original Reprojected		at	Reduction
	Curvature	Curvature	Rotation	of Curvature
ZEEL	0.0358	0.0245	45°	0.0050
ZEEL ext.	0.0358	0.0245	45°	0.0059
Regridding	0.0428	0.0166	75°	0.0159
Block	0.0358	0.0103	45°	0.0163

Table 4.3: Reduction of curvature by each reprojection method

Please refer to Chapter 6 of?] for a complete discussion of tables and tabular environments.

Chapter 5

Working with bibliographies and indicies

I would highly recommend that you use BibTEX to create your bibliography. BibTEX processes a special .bib file. The .bib file is where you enter your bibliographic information. A sample entry looks something like

```
@article{feu02,
author= {Thomas~Feuerstack},
title= {Introduction to pdf{\TeX{}}},
journal= {TUGboat},
volume= \{23\},
pages= {329--334},
number= \{3/4\},
url= {http://www.tug.org/TUGboat/Articles/tb23-3-4/tb75feu.pdf},
year= 2002}
   or
@book{mgbcr04,
author= {Frank~Mittelbach and Michel~Goossens and
Johannes~Braams and David~Carlisle and Chris~Rowley},
title= {The \LaTeX\ Companion},
publisher= {Addison Wesley Professional},
edition= {2nd},
address= {New York},
year= 2004}
   For a Web site I would recommend the following
@misc{brei04,
author = {Jon~Breitenbucher},
title = {{W}ooster related {L}a{T}e{X} files},
url = {http://jbreitenbuch.wooster.edu/~jonb/latex/},
howpublished= {World Wide Web},
year= 2004,
note = \{Accessed on 03/11/2004\}\}
```

You can make a reference by typing \citet{mgbcr04} to produce?]. Other forms for citation include \citep{mgbcr04} or \citeauthor {mgbcr04} to produce [?] or? respectively. You can consult?] or?] to find out how to format entries in the .bib file and what options each reference type has.¹

Indicies are also relatively easy to create. If I wanted to have Wooster show up in the index, I would enter Wooster\index{Wooster} in my source file. I could create a subentry for User Services by entering User Services\index{Wooster!User Services}. A subsubentry for Help Desk would be entered as \index{Wooster!User Services!Help Desk}.

To create the index one needs to make sure to uncomment the \makeindex command in the username.tex file. One also needs to uncomment the makeidx entry in the styles/packages.tex file and then run the Makeindex program. Consult?] or?] for further information.

¹You could also use footnotes if your department called for that.

References

1. Mark Siderits. *Buddhism as philosophy : an introduction*. Ashgate Hackett Pub. Co, Aldershot, England Indianapolis, IN, 2007. ISBN 978-0872208735. 2, 3