

My Own Title

My Name

CoSc 320, Data Structures

Pepperdine University

February 24, 2019

Abstract

This is the abstract. Here is how you put in a paragraph of blind text. Be sure to remove all blind text from your final paper. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

1 Introduction

This document is produced by the TeX document processing system. It uses the LaTeX system, which runs on top of TeX, and the XeLaTeX system, which runs on top of LaTeX. It is intended for students in CoSc 230, Data Structures to use as a template for the papers they write for the course.

The TeX source for this paper is in the file `paper-template.tex`. To obtain it, download and expand the file `Paper-Template.zip` from the course web site. It will create a folder with the source file inside. Every TeX document you create should be in a separate folder.

Although this paper illustrates the LaTeX features you need to write your papers, it does not explain all the details of each feature of the LaTeX markup language. There are many LaTeX tutorials and discussion forums on the Internet that you can access to

pursue the language further. You can also download a document from the course web page titled *The Not So Short Introduction to LaTeX2e*.

To start a new paragraph, leave a blank line in the TeX source. Here is some more blind text to fill out this section. Be sure to remove all blind text from your final paper. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

1.1 Title of first subsection

Notice the automatic numbering of the sections and subsections. See the specification for the paper for the required sections and subsections.

1.1.1 Title of first subsubsection

The use of subsubsections is optional, but here is how it works. For this, and all following examples, you should compare the PDF output with the typesetting code in `paper-template.tex`.

2 Typesetting Math

Here is how to typeset math. There are two modes – inline and display.

2.1 Typesetting math in line

If you want to typeset an expression within a sentence, you enclose the expression between dollar signs. Here is the proper way to typeset some expressions for your paper. Here is n^2 . Here is $n \lg n$. Here is $\Theta(n^2)$. Here is $\Theta(n \lg n)$. Here is $O(n)$. Here is $\Omega(n)$. The TeX code for the second expression is `$n \lg n$`.

You must typeset your math as above. In particular, notice how the \lg function in the expression $n \lg n$ is not italicized while the variable n is.

2.2 Typesetting math in display mode

Display mode puts a math expression on a separate line. If you want to set an equation in display mode you enclose the expression with bashes and square brackets. For example, here is the quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

and here is the TeX source code that produced it

```
\[  
x=\frac{-b\pm \sqrt{b^2-4ac}}{2a}  
\]
```

The expression `\frac{}{}` stands for fraction with the numerator in the first pair of braces and the denominator in the second pair. The expression `\pm` stand for “plus or minus”.

Following are some math expressions in display mode you will need for your paper.

$$RSE = \sqrt{\frac{\sum (y_i - \hat{y}_i)^2}{d.f.}}$$

where the sum is over all the data points, y_i is the y value of an individual data point, \hat{y}_i is the y value of the point on the curve whose x value is the same as the x value of y_i , and $d.f.$ is the degrees of freedom. Here is the quadratic curve fit equation.

$$y = An^2 + Bn + C$$

Here is the $n \lg n$ curve fit equation.

$$y = An \lg n + Bn + C$$

Here is some more blind text to fill out this section. Be sure to remove all blind text from your final paper. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should

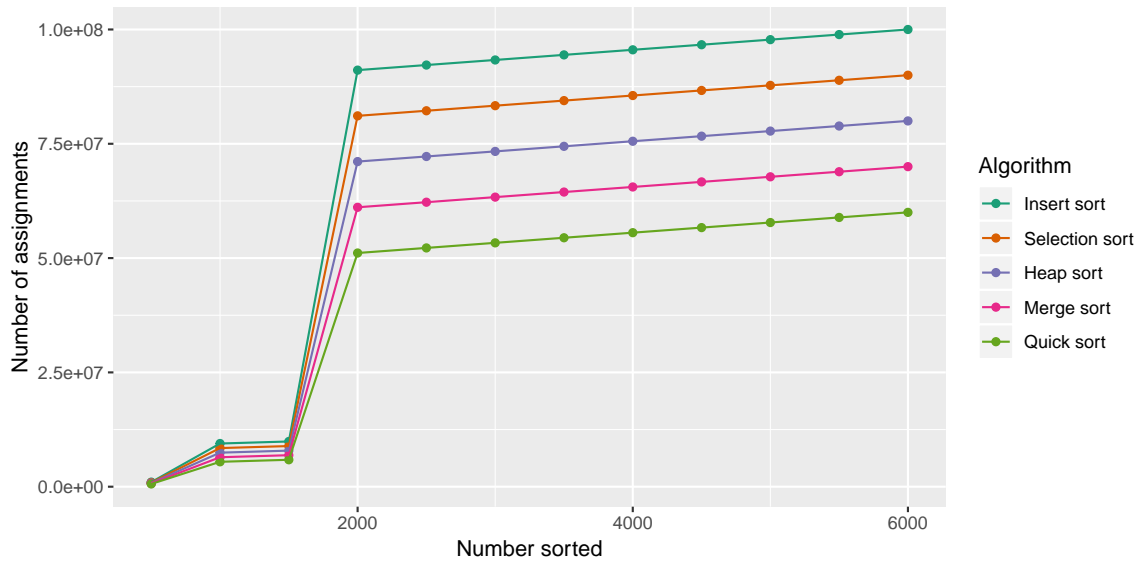


Figure 1: A pdf figure to illustrate how to include a graphic in LaTeX.

be written in of the original language. There is no need for special content, but the length of words should match the language.

3 Figures and Tables

This section describes how to incorporate figures and tables.

3.1 Incorporating figures

To incorporate a figure in your paper you need a PDF file containing the figure in the same directory (folder) as you TeX source file. As an example, suppose you have a file named `myFile.pdf` and you want to put it in your paper. (By the way, did you notice how the file name in the previous sentence is in computer font? See the TeX source for how to do that. The word `verb` in the command is an abbreviation for “verbatim”.)

The source code for including Figure 1 is as follows.

```
\begin{figure}[t]
\hspace{-.5in}\includegraphics[scale=.75]{myFile.pdf}
\caption{A pdf figure to illustrate how to include a graphic in LaTeX.}
\label{fig:inclPDF}}
```

Here is a description of the source code.

- The expression `[t]` puts the figure at the top of the page.
- The expression `\hspace{-.5in}` shifts the figure to the left (horizontally) by half an inch. Without this adjustment, the left border of the figure would align with the left border of the text.
- The expression `[scale=.75]` scales the figure by 75%.
- The expression `\label{}` gives the figure a label.

The label, defined by `\label{fig:inclPDF}`, is a programmer defined name, in this case `fig:inclPDF`. The sentence in the preceding paragraph could have been typeset like this

The source code for including Figure 1 is as follows.

But instead it is typeset like this

The source code for including Figure `\ref{fig:inclPDF}` is as follows.

The TeX compiler uses the `\ref{}` feature to automatically number the items in your document, in this case converting the expression `Figure \ref{fig:inclPDF}` to the text “Figure 1”. If you ever need to insert or delete a figure the renumbering is automatic and the references to the figure numbers are changed to the new number.

Although this feature is optional, you should always use labels for your figures. Sometimes when you change your `.tex` document the system loses the reference and puts double question marks where the reference belongs. When that happens simply typeset the document one more time to restore the reference numbers.

Figure 2 shows how to put two figures side by side. This placement requires the use of packages `caption` and `subcaption`. Here is the source code.

```
\begin{figure}[t]
\begin{subtable}[b]{.45\linewidth}
\begin{picture}(360,148)
\put(-72,0){\includegraphics[scale=0.5]{myFile.pdf}}
\end{picture}
\caption{The left figure.}
\end{subtable}
\begin{subtable}[b]{.45\linewidth}
\begin{picture}(360,148)
```

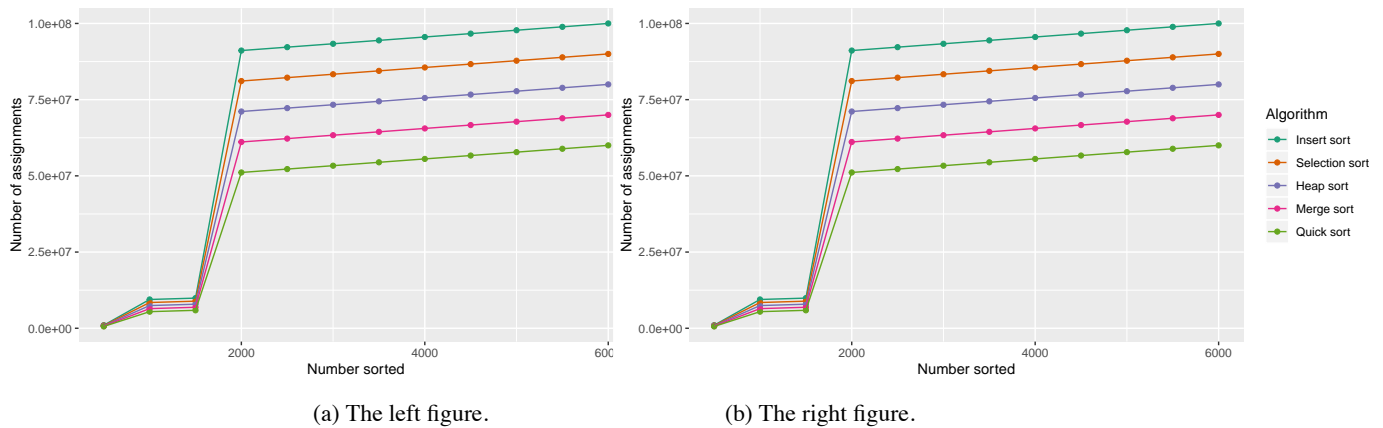


Figure 2: Two figures side by side.

```

\put(0,0){\includegraphics[scale=0.5]{myFile.pdf}}
\end{picture}
\caption{The right figure.}
\end{subtable}
\caption{Two figures side by side.}
\label{fig:twoFigs}}
\end{figure}

```

The figure consists of two subtables. Each subtable has a caption, and each subtable consists of a single item containing a picture in which the graphic is included. In the line

```
\begin{subtable}[b]{.45\linewidth}
```

the expression `[b]` places the subtable at the bottom of the figure (which is placed at the top of the page). The expression `\linewidth` is the length of a line of text, so that `.45\linewidth` is slightly less than half of a line of text. This spacing allows the two figures to be placed side-by-side.

In the line

```
\begin{picture}(360,148)
```

the numbers 360 and 148 are the width and height of the figure in points. One point is $1/72$ of an inch.

In the line

`\put(-72,0){\includegraphics[scale=0.5]{myFile.pdf}}`

the expression `\put(-72,0)` shifts the left figure one inch (72 points) to the left, which is necessary because its width is more than half of a line width.

Figure 3 shows the general Merritt taxonomy for sort algorithms. You can see in the source code that the placement expression is `[h]`, which places the figure here instead of at the top of the page

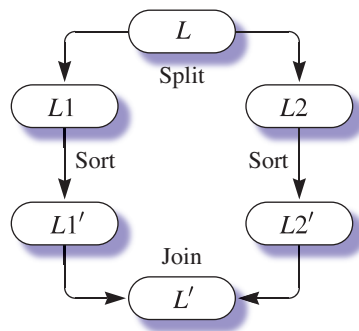


Figure 3: The general Merritt sort taxonomy algorithm.

3.2 Incorporating tables

LaTeX allows you to insert a table with the `tabular` feature within the running text of your document. However, your paper should follow the example of this document by placing a table inside of a figure. Then you will be able to caption it and give it a figure number that you will be able to reference in the text of your paper.

Figure 4 shows one of the tables for your sort analysis project. There are some dummy values in the 500 row that you will change to match your own data. Refer to the TeX source for this document to see the following features of the TeX markup language.

- Use the `itemize` environment for bullet points as in this list.
- Use the `tabular` environment for tables as in Figure 4.
- In the line

```
\centering\begin{tabular}{c | r r r r r }
```

the vertical bar `|` causes the vertical rule to be drawn after the first column, the letter `c` causes the content of the first column to be center justified, and the `r`

Number of data points	Algorithm				
	Insert	Select	Heap	Merge	Quick
500	999999	899999	799999	699999	599999
1000					
1500					
2000					
2500					
3000					
3500					
4000					
4500					
5000					
5500					
6000					

Figure 4: Number of comparisons.

causes the content of the remaining five columns to be right justified. Use the letter l to left justify a column.

- The & character separates the content of adjacent cells in the table.
- The double backslash `\\` denotes the end of a line.

Here is some more blind text to fill out the paper. Be sure to remove any blind text in your final paper. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

In the same way you can put figures side-by-side, you can put tables side-by-side. Figure 5 shows the effect. See the TeX source code for how to do this.

Head1	Data2	Data3	Head4	Data5	Data6
3	22	3	3.5	2	3
4	11	2	4.5	1	2
5	22	2 + 3	5.5	2	2
6	11	1 + 2	6.5	1	1
7	10	0	7.5	0	0
Total:	9	n^2	Total:	9	n^{-2i}

(a) Best case. (b) Worst case.

Figure 5: Meaningless data to show side-by-side tables.

3.3 Incorporating a bibliography

All LaTeX systems provide the BibTeX tool for managing your citations to the literature. BibTeX assumes that you maintain a separate `.bib` file of your bibliographic references, which could contain references for all the different TeX documents that you write. You set up a reference with a key the same way you set up a label for a figure. Then use the `\cite` command to cite the reference.

For example, if you set up the key to our textbook to be `dp4ds` in your reference file, the following TeX markup code

```
Our author shows that the sort is  $\Theta(\lg n)$ . \cite{dp4ds}
```

produces the sentence, “Our author shows that the sort is $\Theta(\lg n)$. [?]”

This paper uses a file named `myBiblio.bib` with the following content.

```
@book{clrs,
  author =
    "T.~H. Cormen and C.~E. Leiserson and R.~L. Rivest and C.~Stein",
  edition = "3rd",
  publisher = "The MIT Press",
  title = "Introduction to Algorithms",
  year = "2009",
  isbn = "978-0-262-03384-8"
}
```

```

@book{dp4ds,
  author = "Dung X. Nguyen and J. Stanley Warford",
  edition = "Prepublication manuscript",
  publisher = "Pepperdine",
  title = "Design Patterns for Data Structures",
  year = "2019",
}

@article{Gries1995145,
  title = "Equational propositional logic ",
  journal = "Information Processing Letters ",
  volume = "53",
  number = "3",
  pages = "145 - 152",
  year = "1995",
  author = "David Gries and Fred B. Schneider",
}

@book{GoF,
  author =
    {Erich Gamma and Richard Helm and Ralph Johnson and John Vlissides},
  title =
    {Design Patterns: Elements of Reusable Object-Oriented Software},
  publisher = {Addison-Wesley},
  year = {1995},
  isbn = {0-201-63361-2}
}

```

BibTeX provides many different citation types, but the two most common are books and articles. Compare the above content with the references it produces at the end of this paper. Here is a citation [?] for the text by Cormen, *et.al.* here is a citation [?] to the article by Gries, and here is a citation [?] to the book by the “Gang of Four”.

To setup the citation system, you specify the bibliography style and the bibliography source file at the end of your TeX source file just before `\end{document}`. In this paper, the specifications are

```

\bibliographystyle{plain}
\bibliography{myBiblio.bib}

```

To get the correct citations to your references the first time requires four typesetting runs. With your `.tex` source in the editor window,

- select XeLaTeX and click the Typeset button,
- select BibTeX and click the Typeset button,
- select XeLaTeX and click the Typeset button, and
- select XeLaTeX and click the Typeset button again.

The first run collects all the references from your `.tex` file. The second run uses the collected references to pull the citation information from the `.bib` file. The third run sets up the citation links in the `.tex` file. The fourth run resolves the links and produces the integer reference numbers. After setting up your references the first time, subsequent compilations require a single typeset.

BibTeX is so common that many Internet sites provide BibTeX references to the articles they provide. If you search for an article online you can frequently copy and paste its BibTeX reference into your `.bib` file.

For your paper, the only references that are in your References section should be those that you actually cite in your paper. Make sure to do the four bibliography runs after writing the text of your paper.

4 Tips

The most important advice in working with LaTeX is:

Click the typeset button **OFTEN!**

Debugging LaTeX source code is like debugging a program. It is ten times harder to find two errors than it is to find one error.

Another LaTeX tip is to use the “Trash Aux Files” option. Every time you do a typeset run the system generates a set of auxiliary files. Some errors corrupt these files, and so after you correct the error your subsequent run still might not succeed. Trashing the auxiliary files is necessary in that case. This operation is similar to the “clean and build” operation in an IDE.

One handy feature of most recent LaTeX software packages is the link they maintain between the source markup page and the PDF document page. For example, in TeXShop if you command-click on the source markup page, the corresponding point on the PDF document page is highlighted. The reverse is also true. If you command-click on the PDF document page the corresponding point on the source markup page is

highlighted. The latter case is a real time saver when you proofread your paper in the PDF page and want to make a correction.

5 Conclusion

This paper shows how to format your own papers for CoSc 320, Data Structures. It describes the LaTeX typesetting system and serves as a tutorial on how to typeset mathematical expressions and incorporate figures, tables, and bibliographies into your paper. It uses 1.5 line spacing, which you should maintain for your homework submission. To see what the final paper would look like single spaced, delete or comment out the statement

```
\onehalfspacing % Provided by the setspace package
```

in the LaTeX source code.