

MPS115/MPS116 PRESENTATION LAB 5

Start a new document in your preferred editor, using the default preamble on the module webpage or one from a recent document. Make sure you include the AMS packages, as usual.

1. CITATIONS AND REFERENCES

Here we look at how to cite books or internet pages. Citations are important for attributing results to the people who did them and allowing the reader to check material themselves. Citations should appear naturally in the text. Here are some examples.

- **Theorem 4** (Due to Wiles [1].) *Let x be a number...*
- Wikipedia [2] provides some interesting biographical details about Maryam Mirzakhani.
- The following equation was first written down by Maxwell [3].

The citations refer to entries in the bibliography at the end of this lab-sheet. Have a look.

Notice that the reference to the website in the bibliography in this document contains both the date it was visited and the date it was updated. This is to allow the reader to check out the exact pages that you are referring to.

Let's create a bibliography to cite from.

- (1) Create a section in your document called 'Recommended fiction'. In it, type the sentence 'A friend recommended I read some books by Doris Lessing, starting with one of her most famous books.'
- (2) Enter the following at the *end* of your $\text{\LaTeX}$ document, just before the `\end{document}` command.

```
\begin{thebibliography}{99}
  \bibitem{Lessing:Notebook}
    D.~Lessing,
    \emph{The Golden Notebook},
    HarperCollins Publishers, 2012.
\end{thebibliography}
```

- (3) Go back to your section on recommended fiction, and replace the word `books` with `books~\cite{Lessing:Notebook}`. Process your document twice and check that the citation has appeared. If you are using the `hyperref` package then your citation markers should be clickable links.

Note that the `99` just informs LaTeX of the widest number it is expecting for the citation label; you do not need to worry about it, it is not doing anything interesting.

- (4) Think of a favourite book and find its details by searching the web. Add this to the bibliography, then add a sentence to your section on recommended fiction, referencing this new book.
- (5) Change the order of the two `\bibitems`. Process the document twice.

It is good style to use the citation markers like footnote markers and not as a grammatical part of the sentence. So good style would be "If you look at Mirzakhani's Wikipedia article [2] then..."; by contrast, bad style would be "If you look at [2] then...".

You can refer to a specific part of the reference by using an optional parameter in square brackets in the `\cite` command. For instance “Wiles was the person who proved Fermat’s Last Theorem [1, Theorem 2.1].” is obtained with the following code.

```
Wiles was the person who proved Fermat’s Last
Theorem~\cite[Theorem~2.1]{Wiles:fermats-theorem}.
```

Use this feature to add a reference to a specific page or chapter of your book.

2. TABLES

Creating tables with LaTeX is straightforward, and uses the `tabular` environment. Create a section called ‘Tables’, try the following. Note that the `{llr}` bit consists of lowercase ‘L’s and ‘R’s as it stands for ‘left left right’, as you will see.

```
\begin{center}
\begin{tabular}{llr}
\hline
Name & Location & Height (m)\\
\hline
Arts Tower & Bolsover Street & 78\\
St.~Georges Church & Broad Lane & 43\\
Hicks Building & Hounsfield Road & 40\\
\hline
\end{tabular}
\end{center}
```

This should give you a table. Think about the following.

- (6) What do the `&` signs do here? What about the `\\` commands? (The `\\` command must not be used in normal paragraphs.)
- (7) Try changing the `{llr}` to `{ccr}`, or `{llc}`, or any other three-letter combination of l, c and r. Here c is for ‘centred’.
- (8) Change the parameters again to `{l|lr}`. What has changed? Change it back to `llr`. Most style guides recommend *avoiding* the use of vertical lines in tables.

If we want to put a caption on a table we need to ‘float’ it as we did with figures in the `figure` environment last time: here we use a `table` environment. Enclose the `tabular` environment you had above with the following code, where the ‘...’ represents the `tabular` environment.

```
\begin{table}[tbh]
\begin{center}
...
\caption{The heights of some buildings at the
University of Sheffield}
\label{table:building-heights}
\end{center}
\end{table}
```

You can now refer to this table via `Table~\ref{table:building-heights}`. Try putting a mention of this table in your document.

This table is okay, but the default tables in LaTeX are a little too squashed. We can improve this with the `booktabs` package, which makes tables look more professional, like Table 1 in this document. In your preamble put the following code.

Name	Location	Height (m)
Arts Tower	Bolsover Street	78
St. Georges Church	Broad Lane	43
Hicks Building	Hounsfield Road	40

TABLE 1. The heights of some buildings at the University of Sheffield

```
\usepackage{booktabs}
\newcommand{\otoprulr}{\midrule[\heavyrulewidth]}
```

Now in your tabular environment, replace the first `\hline` with `\toprule`, the second with `\otoprulr` and the bottom one with `\bottomrule`. Process the document, you should have a better looking table.

3. MORE LATEX COMMANDS

Start a section ‘More commands’.

3.1. Aligned equations. Start a section called ‘Aligned equations’ and add the following.

```
The Binomial Theorem says that for  $n \in \mathbb{N}$  we have
\begin{align*}
&(a + b)^n \\
&= \sum_{i=0}^n \binom{n}{i} a^i b^{n-i} \\
&\\
&= a^n + n a^{n-1} b + \binom{n}{2} a^{n-2} b^2 \\
&\quad + \dots + b^n .
\end{align*}
```

Here, the `align*` environment has switched to displayed maths and has lined up all of the equals signs. Note that each line is ended with `\\` and the things that are lined up on each line are preceded with an ampersand `&`.

3.2. Text in maths. Start a subsection ‘Text in maths mode’. Enter the following code.

```
Let
\[
x = u + v \quad \text{and} \quad y = u - v.
\]
```

Process this and look at the result. Now remove the `\quad` commands and process it again. What do you notice? Now put `\qquad` where the `\quad` commands were. What difference does this make?

The term *quad* comes from traditional printing and it just means a space whose width is that of the letter ‘M’. In LaTeX the commands `\quad` and `\qquad` should only be used to separate maths from text in displayed maths.

3.3. Correctly sized brackets. Compare the following two versions of the same expression:

$$\left(\frac{x}{y} + 1\right) \quad \text{and} \quad \left(\frac{x}{y} + 1\right).$$

You should see the left-hand version is clearly wrong: brackets need to be the correct size for the job. Enter the following code and process it. Then remove the `\left` and `\right` commands and compare the result.

```
\[
  \left(\frac{x}{y} + 1\right)
\]
```

Each `\left` command needs to have a corresponding `\right` command. Both need to be followed by a *delimiter* which will be something like `(`, `\{`, `\angle` or `\vert`. LaTeX will pick an appropriate size for the delimiters.

- (9) Typeset the following using `\left` and `\right` appropriately; note that you want $\langle w, z \rangle$ and not $< w, z >$.

$$\sin(x) \left[\frac{y - (x + \langle w, z \rangle^2)}{x + 7} \right]$$

HOMEWORK

Finish off the sheet and look at the attempt on the module webpage if necessary. Look over the lecture again.

Create a document with title ‘MPS115: Homework 5’ (or ‘MPS116’) and your name as author. Your task is to type up the question and a solution for Problem 1 of the Week 4 hand-in from the core maths module. The problem involves Fibonacci numbers.

You should create `problem` and `solution` environments by putting the following in your preamble.

```
\theoremstyle{definition}
\newtheorem{problem}{Problem}
\newenvironment{solution}
  {\begin{proof}[Solution]}
  {\end{proof}}
```

In your document you should enter the problem and solution as follows.

```
\begin{problem}
  (Type the question here.)
\end{problem}
\begin{solution}
  (Type solution here.)
\end{solution}
```

Print and hand in your PDF and LaTeX files as usual. Note the following.

- Your solution must be written in full paragraphs and full sentences.
- Your LaTeX must not look like a photocopy of your handwritten version.
- Your solution must be in your own words.
- Your solution must not be a copy of the ‘official’ solutions. The official solution is trying to stay close to a handwritten solution and this is not what you are aiming for in this homework.
- Use displayed maths only when appropriate.

REFERENCES

- [1] A. Wiles, *Modular elliptic curves and Fermat’s Last Theorem*, *Annals of Mathematics* **141** (1995) 443–551.
- [2] Wikipedia contributors, *Maryam Mirzakhani*, Wikipedia. Visited 13 October 2022, updated 13 October 2022, https://en.wikipedia.org/wiki/Maryam_Mirzakhani.
- [3] J. C. Maxwell, *A Treatise on Electricity and Magnetism Volume 1*, Dover Publications Inc., 3rd edition, 2003.