

MPS115/MPS116 PRESENTATION LAB 1

In this lab we will use LaTeX (pronounced ‘lay-tek’) within a software bundle called MiKTeX (pronounced ‘mik-tek’) to create basic mathematical documents.

1. GETTING STARTED WITH MIKTeX

Log on to a university Windows machine, then check to see if MiKTeX is installed on the computer by typing `texworks` into the search box at the bottom of the screen. If it’s not there, you need to install it from the Software Center on the desktop.

The Software Center may take a minute or two to work properly. If it’s not responding, wait, then press F5.

Once MiKTeX is installed, start TeXWorks.

Delete any text that appears in the left-hand *source* pane and carefully type the text below.

```
\documentclass[11pt, a4paper]{amsart}
\begin{document}
Hello! This is my first document written in LaTeX.
Documents are generally made up of words, sentences
and paragraphs. This will be the first paragraph.
```

```
You tell LaTeX that you are starting a new paragraph
by putting in one or more blank lines between the
paragraphs. This will be the second paragraph.
\end{document}
```

*If you find the text hard to read on the screen then use the
Format | Font... menu item to increase the font size, to,
say, 11.*

Click on the big green triangle, but make sure it says `pdfLaTeX` and not `pdfTeX` by the side. If you’re asked to save your file, make a folder in Documents on your U: drive called `mps115_latex` (or `mas116_latex`) and use the filename `lab_1.tex`.

A PDF document should appear; note that the first run might take several seconds.

*If the green triangle has turned into a red cross and no PDF
has appeared after a little wait, click on the red cross, check
your typing carefully and try again. If you still have prob-
lems, ask for help.*

You can use `ctrl-T` as a keyboard shortcut for clicking the green triangle.

Compare your *source code* (the text you typed) with the output. You should see that where you left a blank line, LaTeX has started a new paragraph and has indented the text. That is the standard way for LaTeX to indicate new paragraphs. Note that a new paragraph does not just mean starting a new line. Usually new paragraphs indicate moving onto a new idea.

You will discover that when we start looking at typesetting mathematics in LaTeX that you can start a *newline* by using `\\` or `\newline`, however,

these must not be used in text. To create a new paragraph in LaTeX you put a blank line in your source.

Let's have a look at what we have typed. Every LaTeX file starts with a `\documentclass` command. We are using the American Mathematical Society (AMS) 'article' class, hence `amsart`. The `a4paper` part tell LaTeX to use standard A4 paper size for the document. We will come back to `11pt` later. The main content of the document is put between `\begin{document}` and `\end{document}` commands.

When processing the document, LaTeX will ignore extra spaces and new lines in your source file. Change the first paragraph so it starts as follows.

```
Hello!
This
is      my first document written in LaTeX.
```

Process the file and you should see that the output has not changed.

2. ADDING STRUCTURE TO THE DOCUMENT

We will now give the document some structure. Let's begin with a title.

- (1) Above the `\begin{document}` type `\title{A First Document}`, then process the file. Any change? See below if not.
- (2) Type `\maketitle` on a line after `\begin{document}`. Now process the file. This time it should work.
- (3) Add `\author{(your name)}` under `\title{A First Document}`, and process the file again.
- (4) See what happens if you put `\date{September 1684}` just after the `\author{...}` command. Look at the whole page. What about using `\date{\today}` instead?

It is starting to look like a proper document. We can add some sections. Before the first paragraph put the line `\section{Introduction}`. After the second paragraph add the following.

```
\section{Another Section}
This is a very short section.
```

Process the document and your output should now have sections. Add the line `\tableofcontents` after the `\maketitle` line and you should see a table of contents appear. Short documents don't always need a table of contents.

3. SOME MATHEMATICS

Now we have the basic structure of a document in LaTeX, let's look at the important idea of introducing mathematics. There are two ways in which mathematics appears in a document. You can have it *inline* like $f(x) = \frac{e^x}{1-x}$ which means having it embedded in a paragraph, or you can have it *displayed* on a line of its own like

$$f(x) = \frac{e^x}{1-x}.$$

For inline mathematics you use dollar signs `$. . $`, for displayed mathematics you use `\[. . \]`. Add the following to your document.

```

\section{Some Maths}
Here is some inline mathematics:  $f(x) = \frac{e^x}{1 - x}$ .
Here it is as displayed mathematics:
\[
f(x) = \frac{e^x}{1 - x}.
\]
Can you see the difference?

```

- (5) What is the point of the $\$$ -signs in the source code? Does it work without them? What happens if you type $f(x)$ without $\$$ -signs?
- (6) What about is the purpose of “backslash square brackets”, $\backslash[$ and $\backslash]$? (Try turning them into $\$$ -signs or vice-versa.)
- (7) What has the $\backslashfrac$ command done?

Let’s add a second paragraph to this section. What do you think you will get if you type the following line? Think carefully. Try it and see.

```

Here is an integral:
\[
\int \cos(x) \, dx = \sin(x) + c.
\]

```

Note that by typing $\backslashsin$ and not $\sin$ you are telling LaTeX to treat it as a trigonometric function and not the product of three variables: $s \times i \times n$.

Let’s do some more experimenting.

- (8) What happens if you change the $\backslashint$ command into $\backslashint_0^{\pi}$? Finish off the calculation of the definite integral in your document (including something like “ $\dots = [\sin(x)]_0^{\pi} = \dots$ ”).
- (9) Change the first paragraph of the section so it reads
“Let $f(x) = \frac{e^x}{1-x}$. Then

$$f'(x) = \dots,$$

completing the line by calculating the derivative of f by hand and typing it in. Show the steps in your workings by including them as part of the line beginning “ $f'(x) = \dots$ ”.

- (10) Change the second paragraph so it reads
“Because the derivative of $\sin(x)$ is $\cos(x)$, it follows that

$$\int_0^{\pi} \cos(x) dx = \dots$$

where the last line is finished as in question 8.

- (11) Did you remember to use $\$$ -signs and backslashes with the $\sin(x)$ and $\cos(x)$ in the previous question, as in $\backslashcos(x)$?

This document is nearly finished. Add a new section called ‘Formulas’ and try to write a couple of paragraphs which give the main three differentiation rules (product, quotient and chain) along with the formula for integration by parts. Look them up if you’ve forgotten them! Don’t forget to write in sentences.

HOMEWORK

In response to a homework question, a student handed in the following.

$$\begin{aligned}
 e^x \cos x &\rightsquigarrow e^x - \sin x + e^x \cos x \text{ (chain rule)} \\
 e^x(\cos x - \sin x) \\
 &= 0 \\
 \cos x = \sin x &= \tan x = 1
 \end{aligned}$$

$\pi/4$

Your job is to try and work out what question was asked, then write a much better solution using LaTeX, correcting errors and improving the solution above as much as possible. Be sure to read through the first lecture again before doing this.

Your document should have two sections, ‘Question’ (where you state your guess at the question) and ‘Solution’. Your solution doesn’t need to be long, but should include significantly more words than the badly written one above.

- Remember to use full sentences, with full stops and capital letters.
 - You should present the solution more like the second rewrite in the first lecture than the first rewrite.
 - Use ‘MPS115: Presentation Homework 1’ (or ‘MPS116’) as the title and your name as the author.
 - Remember to use commands like $\sin$ and $\cos$ in your solution.
 - Try to write in paragraphs and avoid using displayed mathematics (backslash square brackets).
 - Print out both your PDF output and your original .tex LaTeX file.
- You must hand then in at the begining of next week’s computer lab.

This homework counts towards the homework component of your module mark, as do all the weekly presentation homeworks. As such this must be all your own work: you must not plagiarise or collaborate with other students, and you must not use AI tools.

If you have problems then feel free to use the Discussion Board on Blackboard or Simon Willerton’s office hour.