FMF LaTeX Workshop!

1. Write the following text (the opening of *The restaurant at the end of the universe*) within a LaTeX document and compile it.

"The story so far: In the beginning the Universe was created. This has made a lot of people very angry and been widely regarded as a bad move."

2. Edit the text above using `\textbf` and `\textit` so that every word starting with a 't' is in **bold**, and every word ending in an 's' is in *italic*.

3. Write the famous identity $1 + \frac{1}{4} + \frac{1}{9} + \cdots = \frac{\pi^2}{6}$, using `\dots`, `\pi`, `^`, and `\frac{}{}`. Every Greek letter has a command like this one. Also write it in 'big math mode' using two dollar signs: `$$...$$`.

4. Mathematicians may write $X \xrightarrow{f} Y$ when they mean to write $f : X \to Y$. Write both versions, where the first arrow is `\xrightarrow{f}`, and the second is `\to`. An error message might've appeared, what now?

5. Often, writing out long computations can look ugly on the page, so we make it more readable using the `\begin{align*}...\end{align*}`. A new line is started using `\\`, and they are aligned along the ampersand `&`. Copy the following computation with the same alignment:

$$\begin{aligned}(x+1)^3 &= (x+1)(x+1)(x+1)\\ &= (x^2+2x+1)(x+1)\\ &= x^3+3x^2+3x+1\end{aligned}$$

6. Remco and Robin are having an argument. Remco thinks $\sin^2(x)+\cos^2(x) = 1$ looks better, while Robin believes $sin^2(x) + cos^2(x) = 1$ looks better. Copy both versions. Who do you agree with? To write Remco's version, use `\sin` and `\cos`.

(NB: Generally, people prefer Remco's version, but if you want to use Robin's then make sure you're consistent throughout your document! Similarly, people often prefer 'straight' letters for $\log(x)$, $\mathrm{Range}(A)$, and others, as opposed to $log(x)$ or $Range(A)$.)

7. Copy the following in math mode: $A = \{x \in \mathbb{R} : x > \frac{1}{2}\}$. To get the curly brackets, you have to use `\{` and `\}`. How would you figure out how to get the '$\in$' and '$\mathbb{R}$' symbols?

8. Matrices can be a hassle to write out, but very important. Generally we write matrices within an environment of the form `\begin{bmatrix} ... \end{bmatrix}` (or `pmatrix` if you prefer). Within the environment, you write individual entries per row delineated by `&`, and start a new row using `\\`. Copy the following equation in big math mode:

$$A - \lambda I = \begin{bmatrix} 1-\lambda & 2 & 3 \\ 4 & 5-\lambda & 6 \\ 7 & 8 & 9-\lambda \end{bmatrix}.$$

Tables are defined similarly, using `\begin{tabular}` instead.

9. Many projects have a figure in them somewhere: whether it's a geometric shape or a graph showing some numerical results. Using the `graphicx` package we can put them in our LaTeX files. The top left of the Overleaf screen has an 'Upload' button to use to upload an image file. Find an image of your choosing and upload it, then put it on the page using the `\includegraphics` command. Below is an example, with the code added.

Figure 1: High-res image of Jaap Top

```
\begin{figure}[h]
\centering
\includegraphics[scale=0.6]jaap.jpg
\caption{High-res image of Jaap Top}
\end{figure}
```

There are various ways to edit images within the LaTeX file itself, including getting multiple images next to each other. The `[h]` means 'here' and places the image in this point of the text, and not at the top of the page. This can sometimes be a little finicky. Look up the `graphicx` documentary, or on the Overleaf website for guidance. Does it still not quite look right? Google is your friend!

10. Sometimes we want to refer in the text to a previous table, equation, theorem, figure, etc., without having to copy the number ourselves. Because if we later want to put this specific item at another point in the text, the numbering might change and then manually changing the referencing is a pain. Add the `\label` command to your above figure and use `\ref` to refer to it.

Example: "See figure 1 for a cool picture." (The 1 would change to a 2 automatically if we put another figure before figure 1).

11. One of the most important aspects to a good project is a correct bibliography. The most common way people do this is using a fork of LaTeX called BibTeX. This can be difficult to figure out at first, but try to follow the following steps:

(a) Create a new file within the Overleaf project called `ref.bib`

(b) add the following three commands at the end of your regular LaTeX file:

`\newpage`, `\bibliographystyle{alpha}`, `\bibliographyref`

(c) Add references in the `ref.bib` file, and cite them in the text with `\cite`. Any cited reference will now appear in the bibliography.

Most journals will include a button to export a citation to a big BibTeX command to put in the bibliography file. Below is an example for the following paper: [TT25].

```
@article{TAFAZOLIAN2025427,
title = {Corrigendum to "On certain maximal
hyperelliptic curves related to Chebyshev polynomials"
[J. Number Theory 203 (2019) 276–293]},
journal = {Journal of Number Theory},
volume = {269},
pages = {427-428},
year = {2025},
issn = {0022-314X},
doi = {https://doi.org/10.1016/j.jnt.2024.10.011},
url = {https://www.sciencedirect.com/science/article/pii/
S0022314X24002312},
author = {Saeed Tafazolian and Jaap Top}
}
```

Figure 2: BibTeX code to reference a paper by Jaap Top.

The `@article` part denotes what kind of reference it is, and determines how BibTeX prints it. For example, whether the authors are mentioned before or after the title, or if the journal is italicized. What information to add in a citation (title, author, year, url, DOI, Journal, etc) depends on what standardization the paper is written in. The most popular one is APA, but so long as you are consistent it doesn't really matter all that much. BibTeX will make sure that the citations are written consistently. Like with anything in LaTeX, there is a lot you can customize yourself here, so experiment!

12. To finish the project, you might be asked to give a presentation. PowerPoint or similar tools aren't very good at making nice looking math presentations, but LaTeX has a neat tool for it: Beamer!

Create a new `.tex` file and replace the first line by `\documentclass{beamer}`. Each slide sits within a `\begin{frame}...\end {frame}` environment. There is a *lot* to say about creating good looking slides, so try to see what others are doing in this regard. The actual LaTeX here can be tricky to figure out, but the Overleaf article on Beamer gives a nice step-by-step to get the ball rolling.

Some closing thoughts: LaTeX can seem very overwhelming at first, but I promise you with enough practice you will get comfortable with it. Nobody starts with that comfortability, and the mathematicians that use LaTeX spent many many moons struggling over error messages and StackExchange forums to figure out how to get their document to look *just* right. If you want to get faster and more efficient at using LaTeX, you're gonna have to write a lot in LaTeX. So if you have the time: do so! Write your homeworks in LaTeX, your course summaries, your lab reports, all of it! Slowly but surely you'll notice you don't have to keep Googling certain questions because you'll know what to do by heart. Good luck!!

– Milène and Tijmen

Extra! If you're up for a challenge to test your LaTeX (and Google) skills, try these exercises:

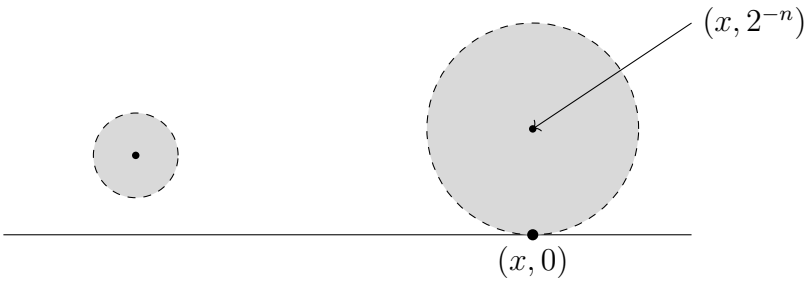
(a). Copy the following in big math mode:

$$f(x) = \begin{cases} 1, & \text{if } x \in \mathbb{Q}; \\ 1+x, & \text{if } x \notin \mathbb{Q}; \end{cases}$$

(b). Laurens uses the LaTeX code
`\operatorname{Spec}(\mathbb{C}[X,Y]/\mathfrak{p}`,
which prints $\operatorname{Spec}(\mathbb{C}[X,Y]/\mathfrak{p})$, a lot. He doesn't want to write this long piece of code so many times, and would rather use his shorter custom command `\laurensSpec` instead. How can we define this custom command so LaTeX recognizes it?

(c). Your professor suddenly uses the symbol $\wp$ a lot, but you have no idea what it's called. Use the website Detexify to decipher what it is.

(d). `tikz` is the de-facto package to draw pictures in LaTeX itself. The following is an example of a picture you can make in Tikz:



It takes some practice to get comfortable enough to draw pictures like these, but try to see if you can decipher the code that generates this specific one. What does each line do? What do all the pairs of numbers mean?

```
\begin{center}
\begin{tikzpicture}[scale=0.7]
\draw (-1,0) -- (12,0);

\filldraw[fill=gray!30, dashed] (1.5,1.5) circle (0.8);
\fill (1.5,1.5) circle (2pt);

\filldraw[fill=gray!30,dashed] (9,2) circle (2);
\fill (9,2) circle (2pt);

\fill (9,0) circle (3pt);

\node[below] at (9,0) {$(x, 0)$};

\draw[->] (12,4) -- (9,2);

\node[right] at (12,4) {$( x, 2^{-n} )$};
\end{tikzpicture}
\end{center}
```

Figure 3: Tikz code that draws the above picture.

(e). Your document has page numbers included by default. Can you change it so that the numbering starts at 42 and counts down 41, 40, and so on?

References

[TT25] Saeed Tafazolian and Jaap Top. Corrigendum to "on certain maximal hyperelliptic curves related to chebyshev polynomials" [j. number theory 203 (2019) 276–293]. *Journal of Number Theory*, 269:427–428, 2025.