Homework 1: Discrete Mathematics Spring 2021

Introduction to LaTeX

January 15, 2021

1 Introduction to LaTeX

LaTeX is a markup language that can be used to create well formatted PDF documents. It is widely used in science and academia. In this homework you will be asked to learn about LaTeX, use it to generate a very simple PDF document and submit your source code together with the resulting PDF. Here you can see an example (provided to you) of some LaTeX markup (`hw1_template.tex`) and the document it generates (`hw1_template.pdf`).

```
\documentclass{article}

\title{Homework 1}
\author
{
First Name, Last Name
\and UNI
}


\begin{document}
  \maketitle

  \section*{Question 1}
  Insert answer for question 1 here.
  \section*{Question 2}
  Insert answer for question 2 here.
  \section*{Question 3}
  Insert answer for question 3 here.
  \section*{Question 4}
  Insert answer for question 4 here.
  \section*{Question 5}
  Insert answer for question 5 here.
  \section*{Question 6}
  Insert answer for question 6 here.
  \section*{Question 7}
  Insert answer for question 7 here.
  \section*{Question 8}
  Insert answer for question 8 here.

\end{document}
```

2 How to compile a `.tex` file

2.1 Using Overleaf (recommended if you are a beginner)

If you want to avoid installing a TeX distribution on your computer, you can use Overleaf. It is an online LaTeX editor and compiler which also includes very good guides and tutorials. If you want to use Overleaf, you can read their introductory guide here:

https://www.overleaf.com/learn/how-to/Creating_a_document_in_Overleaf

2.2 Installing a TeX distribution in your local machine

The recommended distributions for each of the major operating systems are:

- TeX Live (http://www.tug.org/texlive) is a major TeX distribution for *BSD, GNU/Linux, Mac OS X and Windows.

- MiKTeX (http://www.miktex.org) is a Windows-specific distribution.
- MacTeX (http://www.tug.org/mactex) is a Mac OS-specific distribution based on TeX Live.

If you need more information about how to install it, you can visit the following website: https://en.wikibooks.org/wiki/LaTeX/Installation.

2.3 LaTeXiT

LaTeXiT is a small tool for writing LaTeX equations and inserting them anywhere. As a last alternative, you can write documents in Word and insert equations that have been generated with LaTeXiT. You can download LaTeXiT here:
http://www.chachatelier.fr/latexit/.

Alternatively, you can use computers at the Science and Engineering Library, which have it installed already.

3 Homework submission

In this homework, you will learn how to format mathematical expressions in LaTeX. For instance, to type the formula

$$f(x) = (x + y)^2$$

The associated LaTeX syntax is

```
\[f(x)=(x+y)^2\]
```

You can achieve a similar result using:

```
$f(x)=(x+y)^2$
```

Or using:

```
$$f(x)=(x+y)^2$$
```

In this homework, you are expected to submit two files:

- A `.tex` file with the contents of your source code.
- A `.pdf` file with the results.

The resulting PDF should contain the following: a title, your name and UNI, the date on which it was generated, and answers to the questions below. Please use the given template `hw1_template.tex` (under the files section in Canvas) to complete your homework.

Note: Please respect all alignments in all questions.

Question 1

A Pythagorean triple consists of three positive integers a, b, and c, such that

$$a^2 + b^2 = c^2$$

Write the condition $a^2 + b^2 = c^2$ in LaTeX.

Question 2

Given a quadratic equation $ax^2 + bx + c = 0$ where x is an unknown variable, a, b, and c are constants. The solution to the quadratic equation is called quadratic formula and is given by:

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

Write the quadratic formula in LaTeX.

Question 3

Use LaTeXto write the following formulas:

$$1 + 2 + 3 + 4 + \cdots + 98 + 99 + 100 = \sum_{x=1}^{100} x$$

$$x_1 + x_2 + x_3 + \cdots + x_n = \sum_{i=1}^{n} x_i$$

$$x_1 \times x_2 \times x_3 \times \cdots \times x_n = \prod_{i=1}^{n} x_i$$

$$f(x) = \int_a^b x^2 dx$$

Question 4

This semester, we will learn about functions. Use LaTeXto write the following function:

$f : \mathbb{Z} \mapsto \mathbb{N}$ defined by

$$f(x) = \begin{cases} 2x & \text{if } x \geq 0 \\ -2x - 1 & \text{if } x < 0 \end{cases}$$

Question 5

We will learn about set theory in this course. Use LaTeXto write the following sets:

$$V = \{x \in \mathbb{Z} | x < 100\} \cap \{x \in \mathbb{Z} | \text{ x is prime}\}$$

$$V \subset W$$

Question 6

We will also learn about Boolean formulas and logic. Use LaTeXto write the following Boolean formula:

$$((\alpha \to \beta) \wedge (\beta \to \gamma)) \to (\alpha \to \gamma)$$

Question 7

Consider the following statements about integers:

1. For every x, there is a y, such that $x + y = 0$
2. There is a y, such that for every x, we have $x + y = 0$

In symbols, these statements are written respectively:

1. $\forall x\ \exists y\ x + y = 0$
2. $\exists y\ \forall x\ x + y = 0$

Use LaTeXto write these two statements.

Question 8

Use LaTeXto write the following proof verbatim (as is) including the square, mark of end of proof:

If x is even, then x^2 is even.

Proof. x is an even number.
$\exists a \in \mathbb{Z}$ such that $x = 2a$
$x^2 = (2a)^2 = 4a^2 = 2(2a^2)$
Let $c = 2a^2$, $c \in \mathbb{Z}$
$x^2 = 2c$
Therefore, x^2 is even. □

Question 9

Use LaTeXto write the following truth table:

x	y	$x \vee y$
TRUE	TRUE	TRUE
TRUE	FALSE	TRUE
FALSE	TRUE	TRUE
FALSE	FALSE	FALSE