Typesetting Mathematics

Andre Monteiro

September 21, 2025

When describing algorithms, we often use compact sigma notation to describe repeated operations. For example, the operation

```
sum = 0
for i = 1 to n:
    sum = sum + A[i]
```

would be written as $\sum_{i=1}^{n} A[i]$. In LaTeX, this is written as

```
\documentclass[12pt]{article}
\usepackage{amsmath} % for maths
\title{Typesetting Mathematics}
\author{Your name here}
\begin{document}
\maketitle
The following sigma notation represents a for loop that sums all the elements of
   an array $A$ of length $n$.
\[\sum_{i=1}^{n} A[i].\]
```

The `\sum` command takes two arguments, `lower` and `upper` each enclosed in `{...}` that define the lower and upper bound for the summation's range. However, where the elements are not ordered (i.e. a set), we should omit the `upper` argument. For example,

$$\sum_{e \in E} \text{weight}(e)$$

denotes the sum of all the edge weights in a graph (all edges $e \in E$).

Other tips you might want to be wary of:

- When quoting, be wary of orienting your inverted commas correctly. Using two inverted commas (') before and after a quote will output two inverted commas in the same direction. You should use a backtick (`) to open a quote, and a regular inverted comma to close the quote.

- It's often good to have a cheat sheet ready for commonly used control structures. There are many available online, and it might be worth writing your own as you go along. If you're unsure what command gives a particular symbol, Detexify is an helpful tool available online.
  - It's often worth asking staff about certain norms; say, usage of the `\left` and `\right` operators, and not using the asterisk for multiplication.

For this question, we want to practice using the `\sum` command. Copy the above snippet to `math.tex` and add the answers to the questions to `math.tex` in the `enumerate` environment by using the `\enumerate` command.

(a) We want to write the expression

$$\sum_{i=1}^{2n} f(i).$$

We wrote the following LaTeX code:

```
\sum_i=1^2n f(i)
```

What output does this produce? Identify and correct the errors in the code.

(i) The following expression produces:

$$\sum_{i} = 1^2 n f(i)$$

Which is incorrect as it doesn't correctly encase the mathematical components in `{}`. the correct LaTeXcode would be:

```
\sum_{i=1}^{2n} f(i)
```

Which evaluates to:

$$\sum_{i=1}^{2n} f(i).$$

(b) Using sigma notation, write an expression for the total absolute difference between each pair of adjacent elements in an array A of length n. For example, given the array $A = [1, 4, 2, 3]$, the total absolute difference is $|1 - 4| + |4 - 2| + |2 - 3| = 6$.

Note: `\abs{...}` is not a control sequence defined in base LaTeX or the maths packages, but rather a macro that we've defined in `algos-tasks.sty`. You can instead use `\abs*{...}` for bars which scale with the height of the enclosed content.

(i) The expression is:

```
\sum_{i=1}^{n-1} \abs*{A(i) - A(i+1)}\
```

Which evaulates to:

$$\sum_{i=1}^{n-1} |A(i) - A(i+1)|$$

Reminder: Don't copy and paste from the PDF, as this will add extraneous spaces and newlines. You should instead copy and paste from the source code of the task sheet (`1.02 Hello, World!.tex`), or retype the code.