Assignment 1

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Note: This is by no means a full and complete introduction to LATEX. Its purpose is to introduce some of the symbols and notation used in various courses, and demonstrate how you can accomplish common tasks in LATEX. We encourage you to use this document as a template for your solutions.

Exercise 1

(a) My solution to this exercise is a bunch of **logical symbols**:

\lor	$\lor$	\land	$\land$
\Rightarrow	$\Rightarrow$	\Leftrightarrow	$\Leftrightarrow$
\neg	$\neg$	\neq	$\neq$
\equiv	$\equiv$	\not\equiv	$\not\equiv$

Although we usually use them inline: $\frac{x}{2} - y > 4 \Rightarrow x > 2(y+4)$, or in a block:

$$\frac{x}{2} - y > 4 \Rightarrow x > 2(y+4).$$

(b) Can't forget the *set operations* and so forth: $P \cup \varnothing \not\subseteq Q$.

\cap	$\cap$	\cup	$\cup$
\setminus	$\setminus$	A^\text{c}	A^{c}
\mathcal{P}	$\mathcal{P}$	\mathcal{U}	$\mathcal{U}$
\in	$\in$	\not\in	$\notin$
\subseteq	$\subseteq$	\not\subseteq	$\nsubseteq$
\subset	$\subset$	\not\subset	$\not\subset$
\emptyset	$\emptyset$	\varnothing	$\varnothing$

You may also want to define sets explicitly: $4 \notin \{1, 2, 7\}$.

(c) Some basic mathematical notation: normally, one needs to write \mathbb{R} to get $\mathbb{R}$, but we have defined shortcuts for you: \R works!

$$\mathbb{R} \quad \mathbb{N} \quad \mathbb{Z} \quad \mathbb{Q} \quad < \quad > \quad \leq \quad \geq \quad \neq \quad x^2 \quad \sqrt{y}$$

$$3 \cdot 3 = 3^2 = 9$$

(d) Here's a math table-like environment for setting up a series of derivations.

$$
\begin{array}{cl}
& T \\
\equiv & \{\text{rule to be proven } \Rightarrow\} \\
& ? \\
\equiv & \{\text{rule to be proven } \land\} \\
& F
\end{array}
$$

But if you don't want to use (a lot of) math inside a table, a normal table also works:

left	center	right
l	c	r
$x + y$	$\equiv$	$y + x$

$$\frac{a \vee b \qquad \neg a}{\therefore \quad b}$$

Exercise 2

(a) Regular expressions can be written as: $(a + \varepsilon)^*(a + b)ab$.

(b) Useful for writing about Turing machines, but also for concluding a proof: $\square$.
In fact, we can write a proof as follows.

Proof. It can easily be seen that this statement is concluded with a \qed symbol. $\qquad\square$

Exercise 3

We can specify an algorithm in pseudo-code as follows.

MYINCREDIBLEALGORITHM(A, v)
Input: an array A of n numbers and a number v
Output: an index i such that $A[i] = 42$, or NOTFOUND if no such index exists
1 $i \leftarrow 1$
2 **while** $i \leq n$ **and** $A[i] \neq 42$ **do**
3       $A[i].update()$
4       $i \leftarrow i + v^2$
    /* the following loop runs over all of A */
5 **for** $j \leftarrow 1$ **to** n **do**   // use a different indicator variable here
6   something useful   // you can write text if that's more succinct
7   **if** j *is even* **then**
8           $A[j].flip()$
9 **if** $i > n$ **then return** NOTFOUND **else return** i

For analysis, you may want to know $O, \Theta, \Omega(n \log n)$ (not to be confused with o, ω).

Exercise 4

A figure (such as Figure 1) can be inserted, PDF format is preferred.
To insert a figure precisely where you want it to appear, you can leave away the `figure` environment. You will then however not be able to add a caption or refer to it.
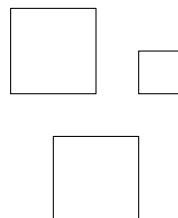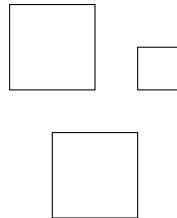

Figure 1: Three axis-aligned squares.

Table 1: Courses taught by members of the Applied Geometric Algorithms group.

Course code	Course name
2IL50	Data Structures
JBI020	Foundations of Computing

The caption of Figure 1 can be left away completely, but you will not be able to refer to the figure anymore if you do that; the \label only works right after a \caption. Note how LaTeX can automatically fill in the figure number for you, making it easy to refer to figures. The same approach works for tables, although it is common practice to put the caption before the table instead of below it; this can be seen in Table 1.

(a) As you can see, you can put text before the first subexercise as well, if you wish.

Exercise 6

(b) You can explicitly state the exercise too. This is useful if you cannot answer all questions.

(a) Further subexercises can be numbered automatically again.

Exercise 5

The numbering will continue where it left off.