

Lab 4

Introduction to L^AT_EX

In this assignment, we will practice typesetting some basic math in L^AT_EX. For today, visit overleaf.com and sign up for a personal free account.¹

Change the title to **EMC2 Lab 4**, change the author to your name, change the date to `\date{\today}`, and delete the `\section` line. Then click “Recompile” to generate an updated pdf. Now read the following short crash-course in using L^AT_EX. Another excellent resource can be found at www.overleaf.com/learn. See also Prof. Doud’s [lecture notes](#).

To display

$$a \in A,$$

one would write the text

`\[a \in A\]`.

The command `\[` tells L^AT_EX that you are beginning an equation and you want it to be centered on its own line. The command `\]` tells L^AT_EX that your equation is over. The `a` and `A` are hopefully self explanatory. The `\in` is very important. Most keyboards don’t have a key with an \in , or most other non alphanumeric symbols for that matter, on it. Every symbol command in L^AT_EX begins with an `\` followed by a word. Most of the words make sense. For example, the command `\in` makes sense, since the sentence “ $a \in A$ ” can be read as “The element a is *in* the set A .”

In order to type an equation or mathematical symbol in the line of text that you are typing, you need to go into math mode. Surround the mathematics with single `$`. So if you wanted to type an equation like $ax^2 + bx + c = 0$, you would type `$ax^2+bx+c=0$`.

At this point you know very few symbols. Some of the important ones are illustrated below.

¹If you would like to download LaTeX for local use on your personal machine, visit www.latex-project.org/get/ and follow the instructions for your platform.

TeX Code	Output	
<code>\$a\in A\$</code>	$a \in A$	
<code>\$A\times B\$</code>	$A \times B$	
<code>\$A\cdot B\$</code>	$A \cdot B$	
<code>\$\$\emptyset=\{\}\\$</code>	$\emptyset = \{\}$	
<code>\$P\implies (Q\lor R)\$</code>	$P \implies (Q \vee R)$	<code>\lor</code> stands for “logical or”
<code>\$P\implies (Q\land R)\$</code>	$P \implies (Q \wedge R)$	<code>\land</code> stands for “logical and”
<code>\$2\neq 3\$</code>	$2 \neq 3$	
<code>\$x\notin\{a,b,c\}\$</code>	$x \notin \{a, b, c\}$	
<code>\$A\subseteq B\$</code>	$A \subseteq B$	
<code>\$X\subsetneq Y\$</code>	$X \subsetneq Y$	

A vertical line can be obtained by a shifted backslash (above the enter key on your keyboard). It can also be obtained by `\vert`, so you can type $|a|$ by either `$|a|$` or `$$\vert a\vert$`. If you want the vertical line for divides, as in $a \mid b$, use `\mid`. Note also that set brackets (like $\{x \in A : 3 \mid x\}$) need to have a backslash in front of them: `\{`. Brackets have a different meaning to LaTeX if the backslash is omitted.

Your assignment

Turn in a replica of the following three paragraphs (don’t worry about font size, or getting the line breaks to match up—just produce readable text that says the same thing, with the same appearance):

The Cartesian product (or simply the product) $A \times B$ of two sets A and B is the set consisting of all ordered pairs whose first coordinate belongs to A and whose second coordinate belongs to B . In other words,

$$A \times B = \{(a, b) : a \in A \text{ and } b \in B\}.$$

For example, if $A = \{x, y\}$ and $B = \{1, 2, 3\}$, then

$$A \times B = \{(x, 1), (x, 2), (x, 3), (y, 1), (y, 2), (y, 3)\};$$

while

$$B \times A = \{(1, x), (1, y), (2, x), (2, y), (3, x), (3, y)\}.$$

Since, for example, $(x, 1) \in A \times B$ and $(x, 1) \notin B \times A$, these two sets do not contain the same elements; so $A \times B \neq B \times A$. If $A = \emptyset$ or $B = \emptyset$, then $A \times B = \emptyset$.

For the sets A and B just mentioned, $|A| = 2$ and $|B| = 3$; while $|A \times B| = |B \times A| = 6$. Indeed, for all finite sets A and B ,

$$|A \times B| = |A| \cdot |B|.$$

A relation R from A to B is a subset of $A \times B$. That is, $R \subseteq A \times B$. For example, the relation

$$R = \{(x, y) \in \mathbb{R} \times \mathbb{R} : y = x^2\}$$

is the set of points in the plane \mathbb{R}^2 that forms the graph of a parabola.

Hints

1. Pay close attention to your logs and output files in Overleaf (click the button just to the right of “Recompile”). Among other things, this will help you check that you have matching open/close delimiters, e.g. `$$`, `\{\}`, `\[\]`.
2. Note that ‘ A ’ is different than ‘A’. The first is written as `A` and the second as `A`. The difference in font is the difference between a math symbol and an indefinite article.
3. To get the word ‘and’ to show up in the equation as ‘and’ and not as ‘*and*’, write `\text{ and }`.

Challenge

If there is time left, try to replicate every displayed math line (meaning all of the `\[\]` lines) on page 5 of these Analytic Number Theory lecture notes:

<http://mathdept.byu.edu/~nick/ant-notes.pdf>

Do not turn this in for credit. You may find the [Detexify](#) symbol lookup helpful.