LaTeX course at ICT School — Tutorial 1

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1 Bibliography

Question 1
Build a little bibliography with your preferred books or articles. Fabricate if necessary. Cite only part of your references. (Don't forget to declare `\bibliographystyle{plain}`)

Question 2
Use `cite` with two references in it. Is the output as expected? If yes, switch the two references and observe. Take a look at the `cite` package and try to use it.

Question 3
Try the following bibliography styles and understand the difference between them: `plain`, `abbrv`, `alpha`, `unsrt`. These are standard styles of BibTeX. Find two other and explain in which way they differ.

2 Basic mathematics

Many of the following questions are based on exercises from the TeXbook.

Question 4
Explain how to type the following formulae:

$10^{10^{10}}$	2^{n+1}	$(n+1)^2$	$\sqrt{1-x^2}$
$\overline{w+\overline{z}}$	$p_1^{e_1}$	$a_{b_{c_{d_e}}}$	$\sqrt[3]{h_n''(\alpha x)}$
$(O,\vec{\imath},\vec{\jmath})$	2×3	$3+4$	$\frac{3}{2}$

Question 5
Explain how to type the following joke from Leslie Lamport: "Producing Greek letters is as easy as π."

Question 6
A little more formulae to type:

$\widehat{xyz}$	$\widetilde{xyz}$	$\overrightarrow{xyz}$
e^{-x^2}	$D \sim p^{\alpha} M + l$	$\hat{g} \in \left(H^{\pi_1^{-1}}\right)'$

Question 7

Considering that you will need $\hat{g}$ more than 10 times in your manuscript, explain why it may be a good idea to define a `\ghat` command directly producing the accented letter. Propose such a definition.

Question 8

Typeset the following matrix product:

$$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$$

3 Intermediate mathematics

Question 9

Produce the following formula:

$$\begin{aligned} \sum_{k=1}^{\infty} \frac{1}{k^2} &= \lim_{n\to\infty} \left(\sum_{k=1}^{n} \frac{1}{k^2} \right) \\ &= \frac{\pi^2}{6} \end{aligned}$$

Question 10

Same idea:

$$\begin{aligned} (x+y)^n &= \sum_{k=0}^{n} \binom{n}{k} x^k y^{n-k} \\ \text{with} \qquad \binom{n}{k} &= \frac{n!}{k!(n-k)!} \end{aligned}$$

(Hint: first try to get each formula separately, then align them and add the text.)

Question 11

Some integrals, considering that $\mathcal{S} = \mathbf{R}_+ \times [0, 2\pi]$:

$$\begin{aligned} \left(\int_{-\infty}^{\infty} e^{-x^2} \, \mathrm{d}x \right)^2 &= \iint\limits_{(x,y)\in\mathbf{R}^2} e^{-(x^2+y^2)} \, \mathrm{d}x \, \mathrm{d}y \\ &= \iint\limits_{(r,\theta)\in\mathcal{S}} e^{-r^2} r \, \mathrm{d}r \, \mathrm{d}\theta \\ &= \int_0^{2\pi} \left(-\frac{e^{-r^2}}{2} \Big|_{r=0}^{r=\infty} \right) \mathrm{d}\theta \\ &= \pi \end{aligned}$$

Question 12

What about a determinant:

$$\det \begin{vmatrix} c_0 & c_1 & c_2 & \dots & c_n \\ c_1 & c_2 & c_3 & \dots & c_{n+1} \\ c_2 & c_3 & c_4 & \dots & c_{n+2} \\ \vdots & \vdots & \vdots & & \vdots \\ c_n & c_{n+1} & c_{n+2} & \dots & c_{2n} \end{vmatrix} > 0$$

Question 13

Only using commands seen during the lecture, find a way to produce the following multiplication:

$$\begin{array}{r} 32 \\ \times 128 \\ \hline 256 \\ 640 \\ 3200 \\ \hline 4096 \end{array}$$

Question 14

Show your reader how to compute the matrix product from question 8:

$$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

(Hint: you may need `\phantom` to get everything aligned.)

Question 15

Write some useful commands for mathematic with the following behaviour:

`\vect{x^2}{n+1}`	$(x_1^2, x_2^2, \dots, x_{n+1}^2)$
`\Id`	Id
`\vec{x}`	$\overrightarrow{x}$ or $\mathbf{x}$
`\field{C}`	$\mathbb{C}$

4 Advanced mathematics

You may want to keep this part for later.

Question 16

We will coerce LaTeX into producing the following definition of the absolute value over $\mathbf{R}$.

$$|\cdot| : \left| \begin{array}{ccc} \mathbf{R} & \longrightarrow & \mathbf{R}_+ \\ x & \longmapsto & \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x < 0 \end{cases} \end{array} \right.$$

(a) Define a command `\R` that draws either $\mathbf{R}$ or $\mathbb{R}$. You can define and use a generic `\field`. Explain why it is a good idea.

(b) Considering the following table, explain how to produce the two arrows $\longrightarrow$ and $\longmapsto$.

`\leftarrow`	`\longleftarrow`	`\xleftarrow{\textit{This is a long text}}`
$\leftarrow$	$\longleftarrow$	$\xleftarrow{\textit{This is a long text}}$

(c) Write the necessary material to produce the case construction:

$$x \longmapsto \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x < 0 \end{cases}$$

(d) Use `\phantom` to get the two 'x' aligned:

$$x \longmapsto \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x < 0 \end{cases}$$

(e) Produce the little $|\cdot|$. Note that we might want the dot to be centered.

(f) Gather the different parts of your equation into the whole definition.

Question 17

Here are challenges adapted from the TeXbook:

$$n \uparrow\uparrow k \stackrel{\text{def}}{=} n^{n^{\cdot^{\cdot^{\cdot^{n}}}}} \Big\}k$$

$$\sum_{x \in A}{}' f(x) \stackrel{\text{def}}{=} \sum_{\substack{x \in A \\ x \neq 0}} f(x)$$

Question 18

The following word cannot be recognised by a finite automaton, if n is not known:

$$\underbrace{\overbrace{a \ldots a}^{n\ a\text{'s}}\overbrace{b \ldots b}^{n\ b\text{'s}}}_{2n \text{ elements}}$$

5 Tables

Question 19

Reproduce the following table with a `tabular` environment:

	Column 1	Column 2	Column 3
First line	a	b	c
Second line	A	B	C
Third line	α	β	γ

(Hint: The array specification is `{rccc}`.)

Question 20

Add lines, as follows:

	Column 1	Column 2	Column 3
First line	a	b	c
Second line	A	B	C
Third line	α	β	γ

(Hint: Use `|` in specification and `\hline` in the body.)

Question 21

Turn first line and column bold:

	Column 1	**Column 2**	**Column 3**
First line	a	b	c
Second line	A	B	C
Third line	α	β	γ

(Hint: For the column, you have two solutions. The obvious way is to repeat the proper formatting command in each cell of the table. The clever way is to use the `>{...}` specifier.)