\LaTeX\ exercises

Reproduce each example as shown. Don't worry about exact font size unless explicitly specified.

Text exercises

Easy
1. A simple test sentence: the quick brown fox jumps over the lazy dog.
2. Bold and italic fonts may be used to add emphasis to the text. It is also possible to use \texttt{sans-serif} and \texttt{typewriter-style} fonts.
3. The \LaTeX\ language uses some special characters that must be preceded by a \texttt{\textbackslash} or they will not be printed. These include: $\&$ $\%$ $\#$ $\{}$ $\}$
4. Leaving a blank line between sentences marks a break between paragraphs.
A new paragraph should contain a new idea, of course.
5. It's possible
to break the lines
wherever you like. You can move the text
horizontally using the \texttt{\space} command. (The gap is 3 cm in this case.)

You can also move the text vertically using the \texttt{\vspace} command (Now the gap is 1.5cm).
This only works between paragraphs.
6. Font size can be varied from \texttt{\tiny} up to the normal size and then up to \texttt{Huge}. This is an example in which font size matters.

Medium
1. \LaTeX\ uses environments to perform useful functions; for example,
   \begin{itemize}
   \item \texttt{center} \texttt{(note US spelling)} environment,
   \item \texttt{flushleft} environment,
   \end{itemize}
2. Environments can also be used to make lists:
   \begin{itemize}
   \item \texttt{itemize} does not number list entries
   \item \texttt{bullet} points are used
   \end{itemize}
1. enumerate does number the entries
2. in fact, enumerate was used to generate the example numbers on this sheet.
3. In the \texttt{verbatim} environment, text will be printed directly \texttt{\emph{(latex commands will not be executed)}} and spaces are important.
4. Tables can also be generated easily using environments
   \begin{tabular}{|c|}
   \hline
   \texttt{Table}\texttt{1} & \texttt{Table}2 & \texttt{Table3} \\
   \hline
   \end{tabular}

Tricky stuff
1. Quite tricky tables can be constructed

<table>
<thead>
<tr>
<th>Famous Dead Mathematicians</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Archimedes</strong></td>
<td>Geometry, Bath water, Ways of killing Romans</td>
</tr>
<tr>
<td><strong>Euler</strong></td>
<td>You name it, he studied it</td>
</tr>
<tr>
<td><strong>Gauss</strong></td>
<td>integration, integers</td>
</tr>
</tbody>
</table>

2. You can also make beautiful patterns with text
   but then again
   Why?
Mathematics Exercises

Easy

1. Any equation can be directly inserted into text, \( x^2 + 1 = 0 \).

2. Longer (or taller) equations are best inserted using the equation environment

\[ \int \frac{x^2 + 3x + 1}{2x + 7} \, dx. \]  \hspace{1cm} (1)

An advantage is that your equations will be automatically numbered.

3. Traditional mathematical typesetting demands that variables are italicised and this is the default in math-mode. The \texttt{\textbackslash mbox} or \texttt{\textbackslash text} (part of the amsmath package) commands must be used to generate normal text. Compare

\[ a = b + c \quad \text{if} \quad b > c, \] \hspace{1cm} (2)

\[ a = b + c \quad \text{if} \quad b > c. \] \hspace{1cm} (3)

4. There are some special commands function names

\[ \sin^2 x + \cos^2 x = 1, \quad f'(x) = \ln x. \]

5. Lots of mathematical symbols are easily accessible

\( Y \notin [1, \infty), \quad R \times C^2, \quad \text{as} \quad C \rightarrow \infty, \quad \sum_{k=1}^{\infty} (-1)^{k+1} \frac{1}{k^2} = \frac{\pi^2}{12}. \)

6. Vectors may be denoted using the \texttt{\textbackslash boldmath} command; i.e. the vector, \( \mathbf{z} \). Boldmath remains on until turned off with the \texttt{\textbackslash noboldmath} command. Check this now \( a^2 + b^3 = c^4 \).

7. Brackets change size automatically

\[ |A + B|, \text{ is smaller than } \left| \frac{A + B}{C + D} \right|. \]

Medium

1. Matrices are written by combining the array environment and brackets

\[
\begin{pmatrix}
  a & b & c \\
  d & e & f \\
  g & h & i \\
\end{pmatrix}.
\]

2. This structure can also be used in the following example

\[ y = \begin{cases} 
0 & \text{if} \, x > 0, \\
1 & \text{if} \, x < 0, \\
\infty & \text{if} \, x = 0.
\end{cases} \]

3. There are no automatic line breaks in equations, you must specify them by hand

\[
\int_{\Omega} i_q^{\psi} \, dV = \int_{\Omega} \int \int p \left[ \frac{\partial \psi}{\partial x_i} - \left( \frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right) \frac{\partial \psi}{\partial x_j} \right] \, dV - \int_{\Omega} p \psi \, n_i \, dS \\
- \frac{1}{C_0} \int \psi \, n_i \, dS.
\] \hspace{1cm} (4)

4. It’s not obvious how to generate bold symbols in formula

\[
\int \int \int \nabla \cdot \mathbf{u} \, dV = \int \int \mathbf{u} \cdot \mathbf{n} \, dS,
\]

but the amsmath package includes a useful command to help \texttt{\textbackslash boldsymbol}.

Tricky Stuff

1. There are some custom maths fonts, which must be included in the preamble, such as the bmm font, \( x \in \mathbb{R} \). Another useful font is the calligraphic font \( x = 1 + 2e + \mathcal{O}(e^2) \), and some people like the Fraktur font \( \mathfrak{f} \).

2. Splitting brackets across lines can break the automatic sizing. Try

\[
\int_{\Omega} i_q^{\psi} \, dV = \int_{\Omega} \int \int p \mathbf{u} \psi \, dV - \frac{1}{C_0} \int \psi \, n_i \, dS - \int \int \int p \psi \, n_i \, dS + \int \int \int p \left[ \frac{\partial \psi}{\partial x_i} - \left( \frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right) \frac{\partial \psi}{\partial x_j} \right] \, dV
\]

3. The theorem environment can be useful, but needs to be defined in the preamble.

\textbf{Theorem 1 (The \texttt{\textbackslash \LaTeX} 2\textbackslash S Law)} Backslash is the most overused key in \texttt{\textbackslash \LaTeX}.

\textbf{Theorem 2 (The Computer’s Law)} The delete key will be used more than all other keys put together.
Picture & Figure Exercises

1. Many vectors may be created

\[ \mathbf{v} + \mathbf{w} = \mathbf{u} \]

2. It’s also easy to draw circles, lines and boxes

3. It’s also possible to import external graphics (it’s best if the file is saved in Encapsulated PostScript (eps))

4. The figure environment allows automatic labelling and captions

\[ \sin x \]

Cross-Referencing Exercise

Reproduce the following section, using automatic cross-references as often as possible. In this case, the numbers do not all start at zero as some equations, theorems and figures have appeared in previous sections.

0.1 Pythagoras’ Theorem

Pythagoras’ Theorem [1] is perhaps one of the most proven theorems in mathematics. It may be stated as follows:

**Theorem 3**. In a right-angled triangle, the sum of the squares of the lengths of the sides containing the right angle is equal to the square of the hypotenuse.

It may also be expressed symbolically (equation 3)

\[ a^2 + b^2 = c^2, \]

where \(a\), \(b\) and \(c\) are shown in Figure 2

\[ \frac{b}{a} \]

Figure 2: A right-angled triangle

This section, 0.1, contains most of the cross-referencing commands you will ever need. The next section, 0.2, is included to show that references can be made forwards as well as backward.

0.2 Notes

Note that you need to run the latex command twice in order to get the cross-references correct. This is because latex stores the references in an intermediate file which is generated on the first run and read-in on the second. Any missing references will show up as notes when compiling the latex sources. *P.T.O. for the bibliography, which is automatically placed on a new page.*
Bibliography