Using graphics and pictures in $\LaTeX 2_\varepsilon$

1 The picture environment

The picture environment is very useful when it comes to creating figures in documents. A length-scale for the picture must be established before the environment can be used and this is accomplished by using the `\setlength{\unitlength}{1cm}` command. The length can be set in units of cm, mm, in (inches) and even pt (points). I prefer to use `1cm` because I have a good feeling for that length.

Having chosen a suitable length-scale, the picture is created by using the command `\begin{picture}(x,y)`, where `x` is the width and `y` is the height of the picture, in the previously defined units (in my case `x` cm). Hence, a picture that is 3cm wide and 4cm high can be created with the sequence of commands:

```
\setlength{\unitlength}{1cm}
\begin{picture}(3,4)
```

Once a picture environment has been created, you can locate things within it using the `\put(x,y){...}` command, which prints whatever is in the braces `{...}` at the position `(x,y)` in units of the picture. For example the following sequence of commands was used to generate Figure 1.

```
\setlength{\unitlength}{1cm}
\begin{center} %% Make sure the picture is nicely centered
\begin{picture}(6,1.5)
\put(0,0){This is}
\put(2,1){an odd way}
\put(3,2){to write} %% Note that you can put things ``outside'' the picture
\put(4,3){$x = \int y \mbox{ d}y$.}
\end{picture}
\end{center}
```

$x = \int y \mbox{ d}y$.

to write

an odd way

This is

Figure 1: An example of positioning in the picture environment.

1.1 Drawing commands

LaTeX contains a limited set of drawing commands that can be used inside a picture environment to construct simple figures.

`\framebox(x,y){...}`	puts a box of width `x` and height `y` around the contents of the braces `{...}`
`\line(x,y){L}`	a line of length `L` in the direction `(x,y)`
`\vector(x,y){L}`	an arrow of length `L` pointing in the direction `(x,y)`
`\circle{D}`	an open circle of diameter `D`
`\circle*{D}`	a filled circle of diameter `D`

Figure 2 was generated using the following commands:

```
\setlength{\unitlength}{1cm}
\begin{center}
\begin{picture}(12,3)
\put(0,0){\vector(1,1){1}}
\put(3,1.5){\circle{1.5}}
\put(5,2){\circle*{1}}
\put(7,1){\framebox(4.2,1)
        {$\mbox{e}^{i\theta} = \cos\theta + i\sin\theta$}}
\end{picture}
\end{center}
```

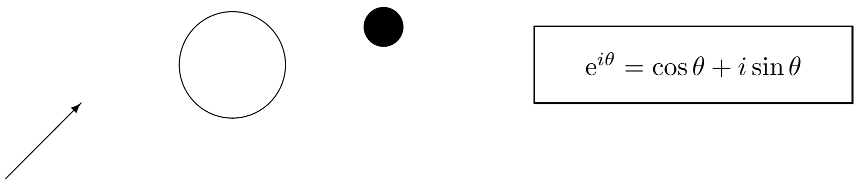

Figure 2: A picture involving some of the basic drawing commands.

2 Importing external graphics

It is possible to include graphics that have been generated by another program, such as xfig, gnuplot, matlab, etc. It is best if these figures are generated in eps (encapsulated post script) format. The package `graphicx` must be included in the preamble via the command `\usepackage[dvips]{graphicx}`. Note that the dvips argument **must** be included if you are going to print the file on the departmental printers.

An external file may then be imported by the command `\includegraphics{file.eps}`, which can be included in a picture environment for precise positioning. A number of options may be passed to the includegraphics command including `scale`, `width`, `height` and `angle`, with the obvious meanings. For example Figure 3 was generated by the commands below.

```
\setlength{\unitlength}{1cm}
\begin{center}
\begin{picture}(12,8)
\put(0,0){\includegraphics[scale=0.4]{sin.eps}}
\put(2,4){\includegraphics[scale=0.2]{sin.eps}}
\put(2,6.5){\includegraphics[height=1cm,width=10cm]{sin.eps}}
\put(8,0){\includegraphics[scale=0.5,angle=90]{sin.eps}}
\end{picture}
\end{center}
```

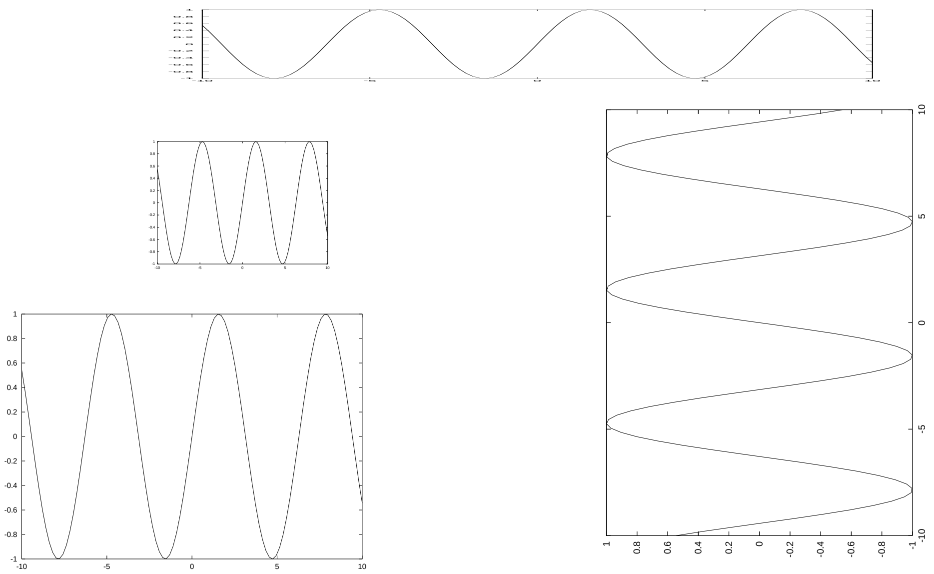

Figure 3: Importing, rotating and scaling an external file — sin.eps.