Images and Tables in LaTeX

Visuals are an integral part of almost any kind of document. Scientific reports specifically often heavily rely on well placed diagrams or descriptory photos. LaTeX provides a simple way to embed, and more importantly label images and charts into your pdfs. It is also equipped with very specific options for image placement.

Adding images is not part of the "base" set of LaTeX commands. We will therefore need to import them from a separate package. So far we have only been able to place images on their own separate line before or after paragraphs. It is often useful to be able to wrap text around images. For this purpose, we can use the wrapfigure environment.

In LaTeX a package is a set of predefined custom commands. It can be imported with the following command:

\usepackage{packagename}

This command should be placed before the **\begin{document}** command.

The package for adding images, is called "graphicx". We will therefore add the following command before the begin document command:

\usepackage{graphicx}

Adding Images

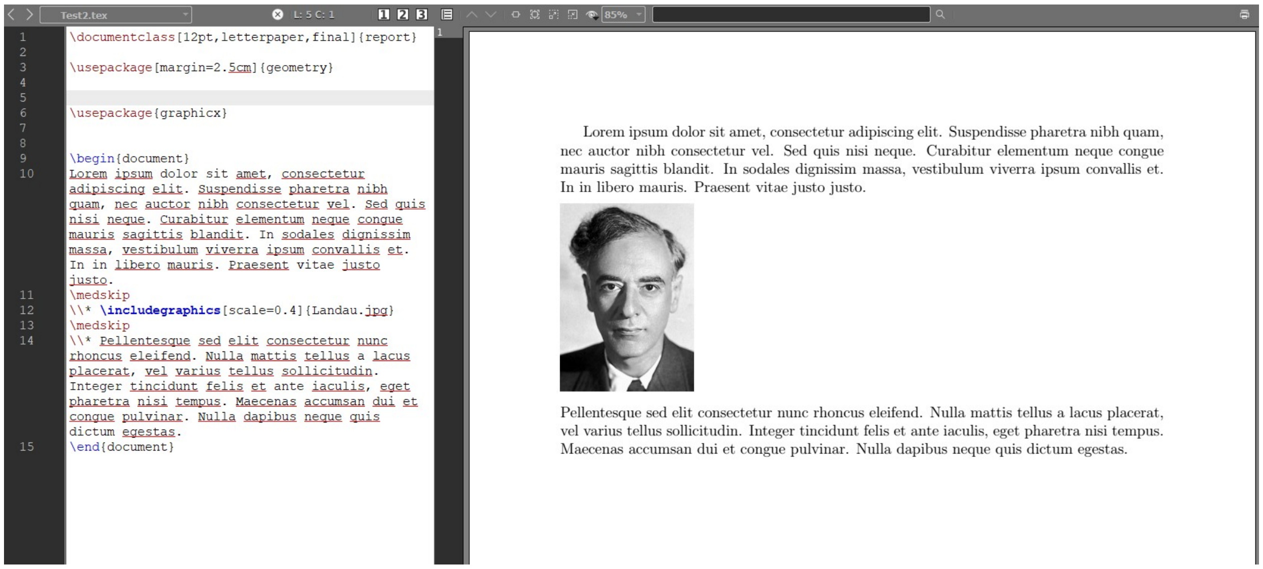
On the most basic level, you can directly input an image into your document with the include graphics command:

\includegraphics[options]**{file path to your graphic}**

If your graphic is in the same folder as your .tex file, only the name of the graphic is required (not the full file path.). If it is in a subfolder of the folder the .tex file is currently in, only that specification is required.

This command can take multiple options. Probably the most useful one is "scale". You can use it to set the size of the image relative to the original size, with the number 1 representing 100 % size. For example: This command on its own is very limited in its capabilities. With it, we are unable to specify the placement of the image, nor add a caption.

To solve this, we will need to use the "figure" environment.



```latex
\documentclass[12pt,letterpaper,final]{report}

\usepackage[margin=2.5cm]{geometry}


\usepackage{graphicx}


\begin{document}
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mauris sagittis blandit. In sodales dignissim
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justo.
\medskip
\\* \includegraphics[scale=0.4]{Landau.jpg}
\medskip
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rhoncus eleifend. Nulla mattis tellus a lacus
placerat, vel varius tellus sollicitudin.
Integer tincidunt felis et ante iaculis, eget
pharetra nisi tempus. Maecenas accumsan dui et
congue pulvinar. Nulla dapibus neque quis
dictum egestas.
\end{document}
```

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Pellentesque sed elit consectetur nunc rhoncus eleifend. Nulla mattis tellus a lacus placerat, vel varius tellus sollicitudin. Integer tincidunt felis et ante iaculis, eget pharetra nisi tempus. Maecenas accumsan dui et congue pulvinar. Nulla dapibus neque quis dictum egestas.

Figure 1: Adding an image between two paragraphs using includegraphics command

Figure Environment

The figure environment is a special container, within which images can be placed using the same includegraphics command. It has the following structure:

\begin{figure} [*options*]
Put your image with includegraphics here
\end{figure}

This container has options that can be used to specify placement. They are:

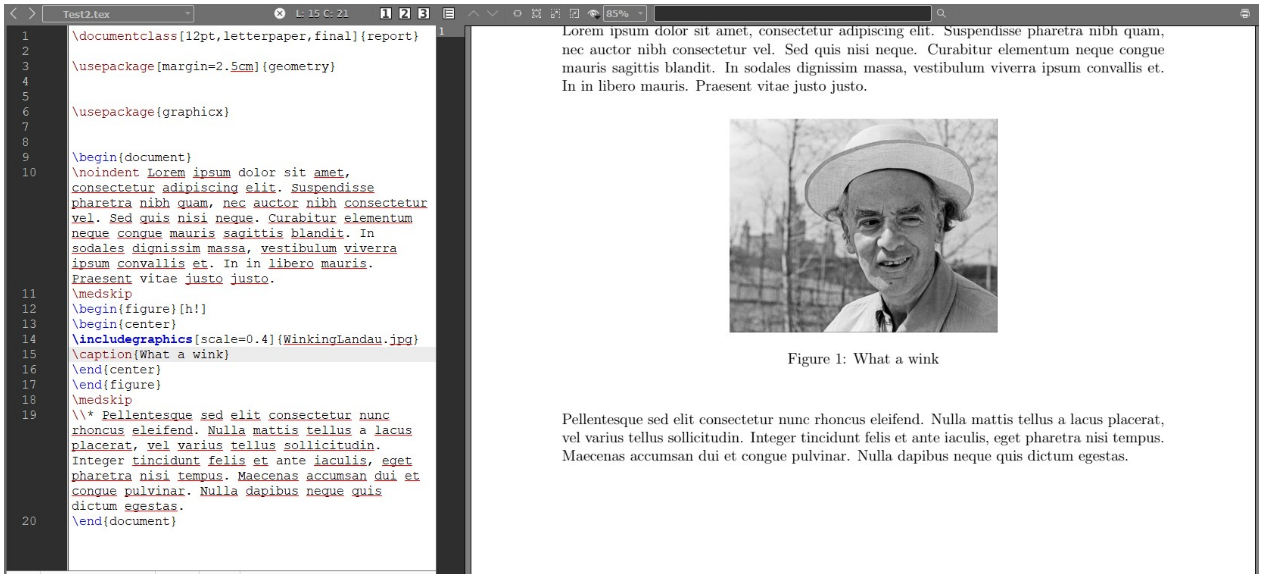
- h - place the figure environment approximately where it appears in the text
- t - place figure environment at top of page
- b - place figure environment at bottom of page
- p - put on a separate page made specifically for images
- ! - override the internal parameters of LaTeX on positioning.
- H – places image directly where written (figure environment is no longer treated as a float). This option however, requires the "float" package. Remember to place \usepackage{float} before the begin document statement.

To add a caption we can use the command:

\caption{Your caption here }

Depending on where this command is written(before or after the include graphics command) the caption will be printed below or after the image on the pdf.
The caption command will also automatically assign your Figure a number and print: “Figure n” in front of your caption.

It is also useful to center your image (enclose the includegraphics command with the center environment.



```
\documentclass[12pt,letterpaper,final]{report}

\usepackage[margin=2.5cm]{geometry}


\usepackage{graphicx}


\begin{document}
\noindent Lorem ipsum dolor sit amet,
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vel. Sed quis nisi neque. Curabitur elementum
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Praesent vitae justo justo.
\medskip
\begin{figure}[h!]
\begin{center}
\includegraphics[scale=0.4]{WinkingLandau.jpg}
\caption{What a wink}
\end{center}
\end{figure}
\medskip
\\* Pellentesque sed elit consectetur nunc
rhoncus eleifend. Nulla mattis tellus a lacus
placerat, vel varius tellus sollicitudin.
Integer tincidunt felis et ante iaculis, eget
pharetra nisi tempus. Maecenas accumsan dui et
congue pulvinar. Nulla dapibus neque quis
dictum egestas.
\end{document}
```

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Figure 1: What a wink

Pellentesque sed elit consectetur nunc rhoncus eleifend. Nulla mattis tellus a lacus placerat, vel varius tellus sollicitudin. Integer tincidunt felis et ante iaculis, eget pharetra nisi tempus. Maecenas accumsan dui et congue pulvinar. Nulla dapibus neque quis dictum egestas.

Figure 2: A centered winking Landau with a caption

Wrapfigure environment

So far we have only been able to place images on their own separate line before or after paragraphs. It is often useful to be able to wrap text around images. For this purpose, we can use the wrapfigure environment.

This environment is not part of the “graphicx” package in LaTeX, and must be separately imported.

The wrapfigure package has a label of “wrapfig”. So we will add the following command in the beginning of our document:

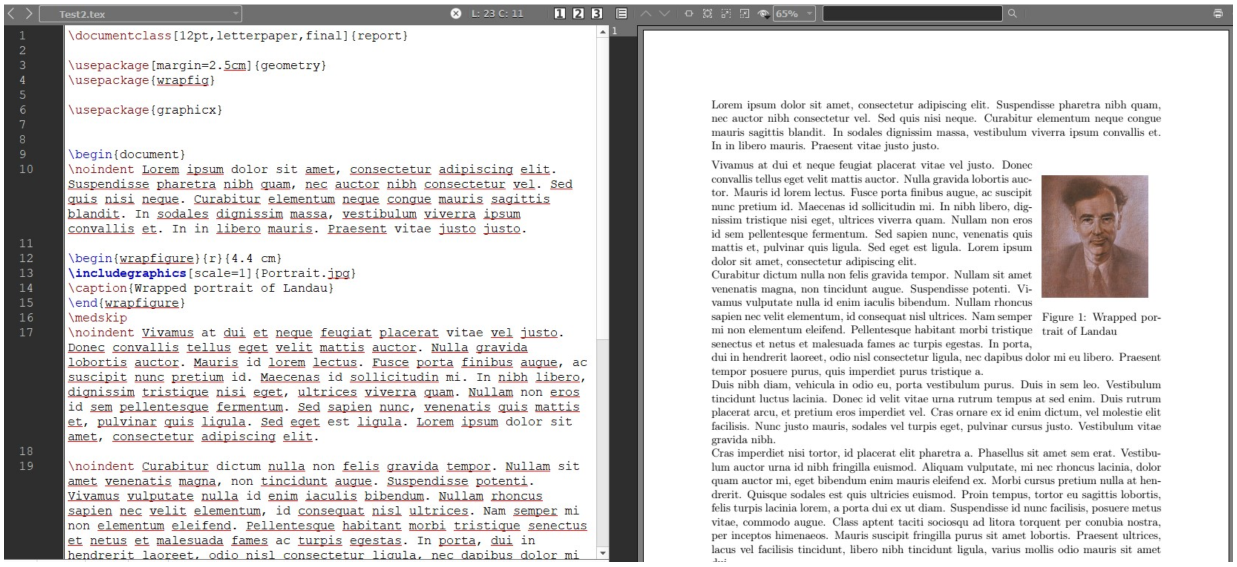
\usepackage{wrapfig}

This would allow us to use the wrapfigure environment. It has the following structure:

\begin{wrapfigure}[option]**{side to place image on}{Distance from page edge}**
Your image with includegraphics and caption here
\end{wrapfigure}

Here is a breakdown of the environment's input:

- Side to place image on
  - r/R - places image on right of page
  - l/L - places image on left of page
  - i/I - inside edge near binding (for books only)
  - o/O - outside edge away from binding
  - Lowercase letter tells LaTeX to place the image directly where you tell it to. Uppercase letters make LaTeX treat the environment as a float and allow it to tweak the position of the image to make it fit better (half the time this pushes it to a completly different page.
- Distance from page edge
  - How much horizontal space LaTeX can use to place the image , counting the edge of the page (right or left, depending on what you selected previously).
  - Remember to always add units to this value. E.G. 1.5 in or 2.54 cm.
- Option
  - The wrapfigure evnironment can sometimes leave excessively large white spaces around or below the image. In the option, you can enter the exact number of lines you want to wrap around the image. This number can be less than the actual size of the image, in this case text would simply display over the image.



```
\documentclass[12pt,letterpaper,final]{report}

\usepackage[margin=2.5cm]{geometry}
\usepackage{wrapfig}

\usepackage{graphicx}


\begin{document}
\noindent Lorem ipsum dolor sit amet, consectetur adipiscing elit.
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\begin{wrapfigure}{r}{4.4 cm}
\includegraphics[scale=1]{Portrait.jpg}
\caption{Wrapped portrait of Landau}
\end{wrapfigure}
\medskip
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Figure 1: Wrapped portrait of Landau

Figure 3: Text wrapped around figure

Image Placement Trouble Shooting

Image placement can sometimes be difficult. LaTeX can choose to move around your figures (E.G. Push them to the next page, the end of the document, add excessive white blank space around or below your wrapfigure etc.). To fix these issues, it is always helpful to understand why they exist in the first place.

Figure and wrapfigure environments, unless specified, are treated as “float” containers. These can be freely “moved” around the page by the LaTeX compiler. It is important to note, that LaTeX does not actually try to execute your commands exactly. It interprets them more as a set of “suggestions” in order to produce the pdf in a way that it thinks would looks best. If the compiler “feels” that there is not enough space to place an image where you requested, it will disregard your input and move it where it the program says is best.

Even the special options in figure and wrapfigure (E.G. h,h!,r, etc.) are sometimes ignored.

Here are some common problems and solutions

- Enforcing image placement (preventing LaTeXfrom moving your image)
  - In most cases, this has to do with your image not being given enough space. In the case of a figure you can try and use the “h!” option and add a couple of lines of blank space above and below the image. In the case of the wrapfigure, you should first try and increase the distance from page edge value.
  - One fool proof way is to use the “\FloatBarrier” command from the placeins package. Add \usepackage{placeins} before your begin document statement. Then place the “\FloatBarrier” (capitalization matters) right after you write the code from your image. This will prevent the image from being placed anywhere below the point where it appears in your code.
  - It is also important to avoid placing images next to lists and itemize or enumerate (these create bullet point lists like the one you are reading from right now) environments (especially do not try to wrap the text from one of these around a figure). LaTeX simply does not allow that to happen. In this case it is worth trying to add the image just above or just below these environments.
- White space around wrapfigure
  - This mostly can be solved with filling out the option. It says how many lines of text should be wrapped around the figure.
  - This can also be solved by manually setting the size of the wrapfigure’s margins. You can read more about that **here**. This solution does not always work.
- No line to end here
  - Sometimes if you begin a new line with “\\” or “\\*” right after your figure or wrapfigure environment, your compiler may give a “you cannot end a line here” and the pdf will not be generated.
  - The solution is simple. Don’t start a new line after the figure environment.

- Badbox (overfull \hbox etc.)
  - Sometimes LaTeX doesn't find quite enough space, but can still fit an image. In this case it will give a badbox warning. To avoid these, try and use \textwidth as a unit of measurement wherever appropriate. 1 textwidth is the normal width of the text on a page.
  - For example, instead of using scale = in your include image, set the size by changing with width. E.G. \includegraphics[width=1 \textwidth]{image path}. This will also cale the image vertically (but avoids badbox errors)

Tables

You can also create create tables with LaTeX. They are created with the tabular environment.

\begin{tabular}{column setup}
Your table contents here
\end{tabular}

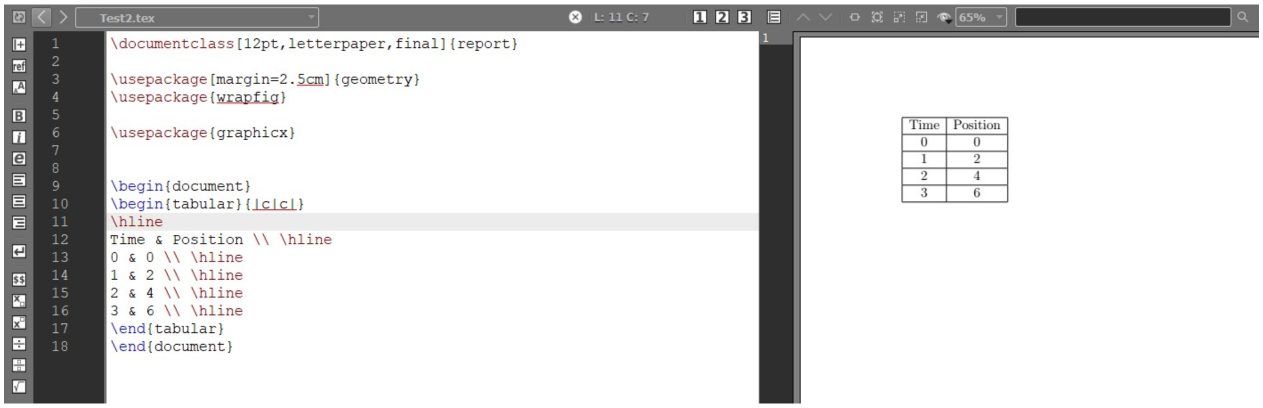
The column setup specifies the types of cell in that column, the number of columns and if there are vertical lines between columns (how many).

Here are the types of cells:

- l
  - The contents of the cell are left aligned.
  - You can only add 1 line of content. (If you add more text, they will not break to a new line but extend the cell horizontally to accommodate for extra text)
- c
  - The contents of this type of cell are centered
  - You can only add 1 line of content. (If you add more text, they will not break to a new line but extend the cell horizontally to accommodate for extra text)
- r
  - The contents of this type of cell are right aligned.
  - You can only add 1 line of content. (If you add more text, they will not break to a new line but extend the cell horizontally to accommodate for extra text)
- p{cell width}
  - This is a paragraph type cell. As you add more text to it, the cell will break to a new line and increase

  - This is the only column type that requires a width input (remember to include units).

Let's look at how the input works using an example:



```
\documentclass[12pt,letterpaper,final]{report}

\usepackage[margin=2.5cm]{geometry}
\usepackage{wrapfig}

\usepackage{graphicx}


\begin{document}
\begin{tabular}{|c|c|}
\hline
Time & Position \\ \hline
0 & 0 \\ \hline
1 & 2 \\ \hline
2 & 4 \\ \hline
3 & 6 \\ \hline
\end{tabular}
\end{document}
```

Time	Position
0	0
1	2
2	4
3	6

Figure 4: A 2 column table, with centered contents

In Figure (4), we begin by declaring the types of cells in columns. We created two columns with centered content by typing two "c"s. The vertical lines " | " are used to indicate where vertical lines between columns should be placed (You can have multiple vertical lines between 2 columns). For example, if there was no vertical line between the two "c"s, the table would look like this:

Time	Position
0	0
1	2
2	4
3	6

Table 1: This table has the layout of: |c c|.

\hline - prints a horizontal line between rows.

Here is an example of a table that is missing the first and second hlines.

Time	Position
0	0
1	2
2	4
3	6

Table 2: This table is missing the first two \hline commands

\\ - used to signify an end of a line.

& - used to signify the end of a cell. (LaTeX moves onto the cell in the next column in the same row).

Unfortunately LaTeX does not have a centered paragraph type cell (write paragraphs in the cell, but they are centered). You can "define" this type of cell manually by adding the following package and command before begin document:

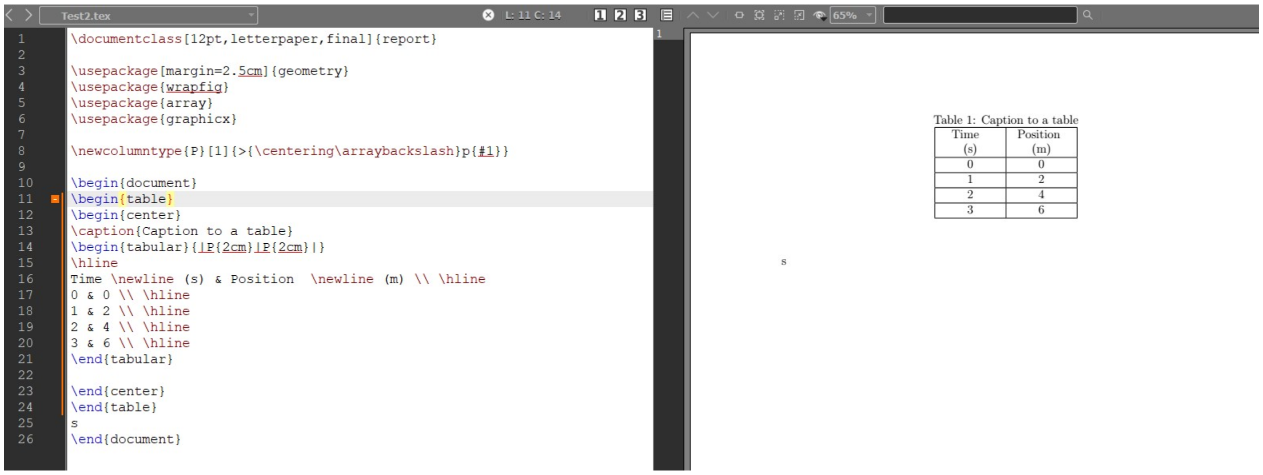
\usepackage{array}

\newcolumntype{P}[1]{ > {\centering \arraybackslash}p{# 1}}

This cell type is declared just like the "p" type, but has a capital P.

It is also better to place the tabular inside of a table environment. This allows you to give it a caption (just like for a figure).

Let's put this together in an example:



```latex
\documentclass[12pt,letterpaper,final]{report}

\usepackage[margin=2.5cm]{geometry}
\usepackage{wrapfig}
\usepackage{array}
\usepackage{graphicx}

\newcolumntype{P}[1]{>{\centering\arraybackslash}p{#1}}

\begin{document}
\begin{table}
\begin{center}
\caption{Caption to a table}
\begin{tabular}{|P{2cm}|P{2cm}|}
\hline
Time \newline (s) & Position  \newline (m) \\ \hline
0 & 0 \\ \hline
1 & 2 \\ \hline
2 & 4 \\ \hline
3 & 6 \\ \hline
\end{tabular}

\end{center}
\end{table}
s
\end{document}
```

Table 1: Caption to a table

Time (s)	Position (m)
0	0
1	2
2	4
3	6

s

Figure 5: Table with two columns, with paragraph cells with centered content. Note that the caption has been added before the tabular environment, and is therefore above the table. It also begins with the word "table" and not the word "figure" automatically. Table and Figure numbering are separate by default.

As you can see, inside of the cells I can start a new line as if it were a paragraph. The content stays centered.

If you do not like generating tables manually, there is a website that can do it for you: `https://www.tablesgenerator.com/`. This however solves the paragraph cell issue in a "weird" way.