

Ph3 LaTeX Week 4: References, citations, footnotes, and hyperlinks

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1 Internal references

Last week we covered the *figure* environment, and we saw that when you start typing the command `\begin{figure}`, Overleaf offers to auto-complete your code with the commands `\centering`, `\includegraphics{}`, `\caption{Caption}`, and `\label{fig:my_label}`. At the time we covered everything but `\label{fig:my_label}`, and I told you we would cover that one in the next lesson. Well, this is the next lesson, and now it's time to cover that command.

The `\label` command assigns a (you guessed it) *label* to an object in your document. This object can be just about anything you might want to refer to that has a number associated with it, like figures, tables, equations, or sections. The argument (`fig:my_label` in our example) is a variable that latex uses to keep track of its objects. These can be named with any string (within reason) and can even include a few special characters. It is good practice (but not necessary) to begin your labels with a short word that describes what the thing is. In this example it is “fig,” which helps you remember that this label refers to a figure. I like to use “sec” for section labels and “eq” for equation labels, but again this is not required. It just helps you keep track of your own code when your document becomes large and unwieldy.

You use the label to refer back to an object in the text with the `\ref{label}` command. For example, last week I included a plot in your handout, and I called it `fig:damped_sine`. When I wanted to refer to that figure in the text I did so like this in the source code.

```
Once you have populated the arguments to your commands
your output should look something like Figure
\ref{fig:damped_sine}. Like Figure \ref{fig:damped_sine}
it will probably be at the top or bottom of your page, ...
```

The `\ref{fig:damped_sine}` command essentially extracts the value of the variable `fig:damped_sine` and displays that value, rather than the name of the variable, in the output. In that case the value was 2 because that was the second figure in my document.

In this way latex keeps up with your figures, equations, sections, and any other object that gets a number associated with it. Each time you recompile your source code, latex counts these objects and assigns the appropriate value to your label variables. That way you can refer to these objects by their labels in your source code, and all the editing, deleting, adding, or moving around of text and objects won't screw up your numbering system and keeps your references accurate.

Even though I was importing the same file over and over, each figure was unique and different and thus got its own label. The smaller one (Figure 4 in last week's handout) was called `fig:scaled_fig`, and the little one I rotated by 45° was called `fig:scaled_and_rotated`.

1.1 Why you need to compile more than once to get references right

It is vitally important to understand this process, because if you do you will understand why you have to compile your document twice before it can get the references right. The first time latex compiles, it counts numbered objects. It then stores that information in a log file, and the second time it compiles it assigns the correct numbers to the objects and references. In some cases, *i.e.* when there are references to references, for example, you may have to compile three times to fill in all the numbers.

1.2 Numbered equations

In the first week I introduced you to the *math* environment for equations that appear in a line of text and showed you some shorthand notation, dollar signs ($\$ \$$), to establish it. We also talked about the *equation* environment, for equations that stand alone, outside of the flow of text. Formulae in the equation environment get numbers, so you can include a label if you want.

```
\begin{equation}
  \label{eq:schroedinger}
  i \hbar \frac{d\psi}{dt} = H \psi
\end{equation}
```

Exercise 1: Add a new section to your hello world document. Give it a label, and put the Schrödinger equation in it with its own number. Add a line of text like “This is Section #, and that is Equation #,” that refers to both by their correct numbers using labels.

Exercise 2: Add another line of text that will tell the reader what page to find your equation on (and will spell its name correctly) with the following text.

```
The Schr\{o\}dinger equation is on Page
\pageref{eq:schroedinger}.
```

2 Footnotes and line-break suppression

Footnotes are easy. All they require is the command `\footnote{the footnote}`. I don't normally use them, but you need to know how to make them even if you never do it. More useful, though, is the knowledge of how to suppress a line break, which you usually want to do if you are creating a footnote. It would look awkward if the symbol to reference the footnote fell in just the wrong place¹ in the text so that it got bumped to the beginning of the next line. You can, of course just call out the footnote right after the word you want it associated with,² or you can *suppress* the line break using the tilde character (`~`), which will force the footnote to appear on the same line as the word that its reference is “attached” to by the tilde. The three options are coded like so.

```
Footnote with space \footnote{Like this.}
Footnote without space\footnote{Like this.}
Footnote with space and suppressed line
break~\footnote{Like that.}
```

Suppressing line breaks is much more useful for references and citations than for footnotes, and you will use it much more often in those contexts.

3 Internal and external hyperlinks

Hyperlinks are easy too, but you need to use the *hyperref* package to access them. Once you have done that the command to include a link is straightforward.

```
\href{address}{displayed text}
```

Here *address* refers to the actual web address, and *displayed text* is what gets shown in your document. For example, to link to the Canvas page for ph3, as I just did, you could use the command

```
\href{https://caltech.instructure.com/courses/901}{ph3}
```

This works, but it has the disadvantage of not clearly distinguishing a link from regular text. Mouse over the word “ph3” in my text above to see what I mean. It's a link, but could you have known that just by looking at it? You can change this behavior and make links more obvious by calling the `\hypersetup` and `\urlstyle` commands in the preamble of your document, but I don't want to go into that here. See Overleaf's reference on the subject for more detail [1].

What I usually do, because I'm lazy, is just use the `\url` command to make a clickable link, like so

```
\url{https://www.overleaf.com/learn/latex/hyperlinks}
```

¹Like that, which you must admit is awkward.

²Like this, which is much better.

This source code produces a clickable link in the output that has an obvious font, as you can see in the reference at the end of this document that I called out above. (I can call it out again, by the way [1]. You can call out a reference or citation as many times as you want.) You don't get to disguise the address with a cute (or short) word, but it gets the job done. When I want to format documents for the web I use html.

One benefit of using the hyperref package is that it makes references and links *inside* your document clickable. It is not limited to calling out links to external websites. For example, my reference to the Overleaf documentation on the hyperref package above is actually a link to that reference inside the document. Try it, and you'll see what I mean.

Exercise 3: Use the hyperref package in your hello world document, and then make a reference to your Schrödinger equation somewhere in your text. Click on your reference, and verify that it takes you to your equation.

Finally, when you use the hyperref package and generate a table of contents using the `\tableofcontents` command in your preamble, all of the entries in your table of contents become clickable links. Your hello world document isn't large enough to practice this on yet, but I want you to be aware of what is possible here. You can also generate lists of figures and tables with the commands `\listoffigures` and `\listoftables`.

4 Bibliographic references (citations)

Giving proper credit is essential to every academic discipline, as is the ability to look up the articles referenced. Latex is very good at managing references, and there are basically two ways to do it. You can make a small bibliography at the end of your document, which I'm going to show you how to do today, or you can use a separate program that comes with your latex distribution called *bibtex*. Bibtex is by far the more powerful of the two choices, and we will cover it in a separate lesson later in the term. For now, let's see the quick and easy way to do it.

A basic bibliography consists of a numbered list of sources (papers, books, websites, or anything else you want to refer to) at the end of your paper, with references to those sources by number inside the text. You make the list of sources with the *thebibliography* environment, and in that list each item is labeled with the `\bibitem` command. Inside the text you use `\cite` to cite a source. The logic is the same as that for internal references, except that in this case `\bibitem` does the job of `\label`, and `\cite` takes the place of `\ref`. The source code for my bibliography in this document looks like this.

```
\begin{thebibliography}{99}

\bibitem{Overleaf_hyperref}
\url{https://www.overleaf.com/learn/latex/hyperlinks}
```

```

\bibitem{Lampport}
Lampport, Leslie \emph{\LaTeX: A Document Preparation System
User's Guide and Reference Manual 2ed.}, Addison-Wesley
Publishing Company 1994.

\end{thebibliography}

```

This is all very straightforward and exactly what you would expect, except for the extra argument at the end of the `\begin` command, the `{99}`. That helps latex format the numbers at the beginning of each item in the bibliography and should be, according to latex's creator,

...a piece of text the same width as or slightly wider than the widest item label in the source list. ... In most type styles, "99" is at least as wide as all other two-digit numbers. [2]

If you have more than a hundred sources, you would use "999". If you use Harvard-style references ([Author, Year]), then you would put the widest item in that field, rather than a number, and you would add your own label as an option to each of your bibliography items.

```

\begin{thebibliography}{Lampport 94}
...
\bibitem[Lampport 94]{Lampport}

```

In this style of bibliography you would still make citations in your source code by referring to the bibitem's label, `Lampport` or `Overleaf_hyperref` in my example here.

One more thing you may have noticed is my use of the `\emph` command, which just italicizes (*emphasizes*) whatever text is in its argument field, in this case the title of the book.

Exercise 4: Make a bibliography at the end of your hello world document, and then add a line of text to the body of your document that cites this handout. Make the entry for this reference in the bibliography a clickable link, as I have done with Reference [1].

References

- [1] <https://www.overleaf.com/learn/latex/hyperlinks>
- [2] Lampport, Leslie *LaTeX: A Document Preparation System User's Guide and Reference Manual 2ed.*, Addison-Wesley Publishing Company 1994.