On-line Tutorial on \LaTeX

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12 Cross References in \LaTeX

12.1 Why cross references?

Cross reference is the technical term for quoting yourself. This is what you do when you say something like, “As I said earlier, . . .”. More seriously, in a written article, you may often have occasion to refer the reader to something mentioned earlier (or sometimes to something yet to be said) in the same document. Thus you may have explained a new term in the second section of your article and when you use this term again in the fourth section, it is a matter of courtesy to the reader to point to the explanation. Again, in a Mathematics article, you may have to cite an earlier result in the proof of the current result.

Such references can be done by hand, but if you revise your document and insert some new sections (or theorems) then changing all cross references manually is no easy task. It is always better to automate such tedious tasks. (After all what’s a computer for, if not to do such mundane jobs?)

12.2 Let \LaTeX do it

The basic method of using cross references (see Section 12.1 for what we mean by cross referee) in \LaTeX is quite simple. Suppose that somewhere in the in the second section of your article, you want to refer to the first section. You assign a key to the first section using the command

\begin{verbatim}
\section{⟨section name⟩}\label{⟨key⟩}
\end{verbatim}

and at the point in the second section where the reference is to be made, you type the command

\begin{verbatim}
\ref{⟨key⟩}
\end{verbatim}

Thus the reference “see Section 12.1 . . . ” in the first sentence of this section was produced by including the command \label{intro} in the command for the first section as

\begin{verbatim}
\section{Why cross references}\label{intro}
\end{verbatim}

and the command \ref{intro} at the place of reference in the second section as

\begin{verbatim}
\ldots (see Section\ref{intro} for . . .
\end{verbatim}

Okay, the example is a bit silly, since the actual reference here is not really necessary, but you get the general idea, don’t you? Incidentally, the \label{key} for a section need not be given immediately after the \section{section name}. It can be given anywhere within the section.

The first time you run \LaTeX on a file named, say, myfile.tex containing cross references, the reference information in an auxiliary file named myfile.aux and at the end of the run \LaTeX prints a warning

LaTeX Warning: There were undefined references.

LaTeX Warning: Label(s) may have changed.

Rerun to get cross-references right.
A second run gets the references right. The same thing happens when you've changed the reference information in any way, say, by adding a new section.

Though the key in \label{key} can be any sequence letters, digits or punctuation characters, it is convenient to use some mnemonic (such as \label{limcon} for a section entitled “Limits and Continuity” rather than \label{sec@#*?!}). Also, when you make a reference, it’s better to type \ref{limcon} (notice the tie?) than \ref{limcon} to prevent the possibility of the reference number falling off the edge as in “……… see Section 12.1 for further details. . . .”

In addition to sectioning commands such as \chapter or \section, reference can also be made to an \item entry in an enumerate environment, by attaching a \label. For example the input

In the classical \textit{syllogism}
\begin{enumerate}
\item All men are mortal. \label{pre1}
\item Socrates is a man. \label{pre2}
\item So Socrates is a mortal. \label{con}
\end{enumerate}

Statements \ref{pre1} and \ref{pre2} are the \textit{premises} and statement \ref{con} is the conclusion.

You must be a bit careful about references to tables or figures (technically, “floats”). For them, the \label command should be given after the \caption command or in its argument, as in the example below

\begin{table}[h]
\begin{center}
\setlength{\extrarowheight}{5pt}
\begin{tabular}{|c|c|c|c|}
\hline
Value of $x$ & 1 & 2 & 3 \\
\hline
Value of $y$ & 1 & 8 & 27 \\
\hline
\end{tabular}
\caption{Observed values of $x$ and $y$} \label{tabxy}
\end{center}
\end{table}

Two possible relations between $x$ and $y$ satisfying the data in Table\ref{tabxy} are $y=x^3$ and $y=6x^2-11x+6$

produces the following output
Two possible relations between $x$ and $y$ satisfying the data in Table 12.1 are $y = x^3$ and $y = 6x^2 - 11x + 6$.

You can think of a \caption command within a figure or table environment as a sort of sectioning command within the environment. Thus you can have several \caption and \label pairs within a single figure or table environment.

You can also make forward references in exactly the same way by \refing to the key of some succeeding \label such as “see Subsection 12.2.1 for a discussion of cross references in Mathematics.”

### 12.2.1 Cross references in Math

Mathematical documents abound in cross references. There are references to theorems and equations and figures and whatnot. The method of reference is exactly as before. Thus if you’ve defined \newtheorem{thm}[subsection], then after typing

\begin{thm}\label{diffcon}
Every differentiable function is continuous
\end{thm}

to get

**Theorem 12.2.1.1** *Every differentiable function is continuous*

and you can type elsewhere in the document

The converse of Theorem \ref{diffcon} is false.

to get

The converse of Theorem 12.2.1.1 is false.

References can be made to equations as in the following examples.

\begin{align*}
\text{Input} & \quad \text{Output} \\
\begin{equation}\label{sumsq}
(x+y)^2 = x^2 + 2xy + y^2
\end{equation} & \quad (x + y)^2 = x^2 + 2xy + y^2 \quad (12.1) \\
\text{Changing $y$ to $-y$ in Equation (12.1) gives the following} & \\
\text{produces} & \\
\text{Equation (12.1) gives the following} &
\end{align*}

If you load the package amsmath, you can use the command \eqref instead of \ref to make a reference to an equation. This automatically supplies the parentheses around the equation number and provides an italic correction before the closing parenthesis, if necessary. For example,

\begin{verbatim}
\eqref{sumsq} gives the following
\end{verbatim}

produces

Equation (12.1) gives the following
References can be made to individual equations in multiline displays of equations produced by such environments as align or gather (defined in the amsmath package). The \label command can be used within such a structure for subnumbering as in the example below

\begin{align}
(x+y)^2 &= x^2 + 2xy + y^2 \\
(x-y)^2 &= x^2 - 2xy + y^2
\end{align}

\label{sum}
\tag{\ref{sum}a}

\begin{align*}
(x+y)^2 &= x^2 + 2xy + y^2 \\
(x-y)^2 &= x^2 - 2xy + y^2
\end{align*}

\begin{enumerate}
\item In making a reference to a table or an equation, it is more convenient (for the reader, that is) to give the page number of the reference also. The command \pageref{key} typesets the number of the page where the command \label{key} was given. Thus for example

see Table \ref{tabxy} in page \pageref{tabxy}

in this document produces

see Table 12.1 in page 4

\item To avoid the tedium of typing \ref{key} on page \pageref{key} every time, you can define the macro

\newcommand{\fullref}[1]{\ref{#1} on page \pageref{#1}}

and use \fullref for such references. But the trouble is that at times the referred abject and the reference to it fall on the same page (with \TeX you never know this till the end) so that you get a reference to the page number of the very page you are reading, which looks funny. This can be avoided by using the package varioref. If you load this package by including \usepackage{varioref} in your preamble, then you can use the command

\vref{key}

to refer to an object you’ve marked with \label{key} elsewhere in the document. The action of \vref varies according to the page(s) where the referred object and the reference are typeset by \TeX in the final output

(1) If the object and the reference are on the same page, \vref produces only a \ref suppressing \pageref so that only the number pointing to the object is typeset, without any reference to the page number.

(2) If the object and the reference are on different pages whose numbers differ by more than 1, \vref produces both \ref and \pageref.
(3) If the object and the reference fall on pages whose numbers differ by one (that is, on successive pages), \vref produces \ref followed by the phrase “on the preceding page” or “on the following page” depending on whether the object or the reference occurs first. Moreover, in the next occurrence of \vref in a situation of the same type, the phrases are changed to “on the next page” and the “page before” respectively.

This is the default behavior of \vref in the \texttt{article} documentclass. If the \texttt{article} class is used with the \texttt{twoside} option or if the documentclass \texttt{book} is used, then the behavior in Case (3) above is a bit different.

(1) If the object and the reference fall on the two sides of the same leaf, the behavior of \vref is as in 3 above.

(2) If the object and the reference fall on pages forming a double spread (that is, a page of even number followed by the next page), then \vref produces \ref followed by the phrase “on the facing page”. Moreover, in the next occurrence of \vref in a situation of the same type, the phrases are changed to “on the preceding page” and “on the next page” respectively.

The phrases used in the various cases considered above can be customized by redefining the commands generating them. For the \texttt{article} class without the \texttt{twoside} option, reference to the previous page uses the command \texttt{\textbackslash reftextbefore} and reference to the next page uses \texttt{\textbackslash reftextafter}. In the case of the \texttt{article} class with the \texttt{twoside} option or the \texttt{book} class, the commands \texttt{\textbackslash reftextfaceafter} and \texttt{\textbackslash reftextfacebefore} are used in the case of reference to a page in a double spread. The default definitions of these commands are given below. In all these, the two arguments of the command \texttt{\textbackslash reftextvario} are the phrases alternatively used in the repeated use of the reference as mentioned above.

\begin{verbatim}
\newcommand{\reftextbefore}{on the \reftextvario{preceding}{page before}}
\newcommand{\reftextafter}{on the \reftextvario{following}{next} page}
\newcommand{\reftextfacebefore}{on the \reftextvario{facing}{preceding} page}
\newcommand{\reftextfaceafter}{on the \reftextvario{facing}{next}{page}}
\end{verbatim}

You can customize the phrases generated in various situations by redefining these with phrases of your choice in the arguments of \texttt{\reftextvario}.

If you want to refer only to a page number using \texttt{\varioref}, you can use the command \texttt{\vpageref\{key\}} to produce the page number of the object marked with \texttt{\label\{key\}}. The phrases used in the various special cases are the same as described above, except that when the referred object and the reference fall on the same page, either the phrase “on this page” or “on the current page” is produced. The command used to generate these is \texttt{\reftextcurrent} whose default definition is

\begin{verbatim}
\newcommand{\reftextcurrent}{on \reftextvario{this}{the current} page}
\end{verbatim}

You can change the phrases “this” and “the current” globally by redefining this command. You can also make some local changes by using the two optional arguments that \texttt{\vpageref} allows. Thus you can use the command
12.4 Pointing outside – the package xr

Sometimes you may want to refer to something in a document other than the one you are working on. (This happens, for instance if you keep an article as separate files.) The package xr allows such external references.

If you want to refer to objects in a file named other.tex in your current document, load the package xr and set the external document as other.tex using the commands

\usepackage{xr}
\externaldocument{other}

in the preamble of the current document. Then you can use the \ref and \pageref to refer to anything that has been marked with the \label command in either the current document or other.tex. Any number of such external documents can be specified.

If same key is used to mark different objects in two such documents, there’ll be a conflict. To get over this, you can use the optional argument available in \externaldocument command. If you say

\externaldocument{a-}{other}

then a reference to \label{key} in other.tex could be made by \ref{a-key}. The prefix need not be a-; it can be any convenient string.

12.5 Lost the keys? Use lablst.tex

One of the conveniences of using keys for cross references is that you need not keep track of the actual numbers, but then you’ll have to remember the keys. You can produce the list of keys used in a document by running \LaTeX on the file lablst.tex. In my system, I do this by first typing

latex lablst

\LaTeX responds as follows
I type in the file name as `cref` which is the source of this document. I’m presented with another query.

```
\lablstfile=
```

So I type `article`. I am asked

```
\lablstclass=
```

Here I need give only those packages used in the article which define commands used in section titles etc. need be given. So I type

```
\lablstpackages=amsmath, array, enumerate
```

This produces a file `lablst.dvi` which I can view to see a list of keys used in the document.

Finally if your text editor is GNU Emacs, then you can use its RefTeX package to automate generation, insertion and location of keys at the editing stage.
File `tutor.tex` — lablst output

Using document class: `/tugindia`
and packages: `txfonts,varioref,pdfscreens,icolortbl,xspace,woodfont,tutor`

Logical labels within sections

12 Cross References in \LaTeX

12.1 Why cross references?

<table>
<thead>
<tr>
<th>Logical label</th>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>intro</td>
<td>12.1</td>
<td>2</td>
</tr>
</tbody>
</table>

12.2 Let \LaTeX\ do it

<table>
<thead>
<tr>
<th>Logical label</th>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre1</td>
<td>12.2</td>
<td>5</td>
</tr>
<tr>
<td>pre2</td>
<td>12.2</td>
<td>5</td>
</tr>
<tr>
<td>con</td>
<td>12.2</td>
<td>5</td>
</tr>
<tr>
<td>tabxy</td>
<td>12.6</td>
<td>6</td>
</tr>
<tr>
<td>mathref</td>
<td>12.2.1</td>
<td>6</td>
</tr>
<tr>
<td>diffcom</td>
<td>12.2.1.1</td>
<td>6</td>
</tr>
<tr>
<td>sumsq</td>
<td>12.2</td>
<td>7</td>
</tr>
<tr>
<td>sum</td>
<td>12.2</td>
<td>8</td>
</tr>
</tbody>
</table>

12.3 Pointing to a page – the package \texttt{varioref}

<table>
<thead>
<tr>
<th>Logical label</th>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>diff1</td>
<td>12.3</td>
<td>10</td>
</tr>
<tr>
<td><code>\@vr</code></td>
<td>12.3</td>
<td>12</td>
</tr>
<tr>
<td><code>10vr</code></td>
<td>12.3</td>
<td>12</td>
</tr>
</tbody>
</table>

12.4 Pointing outside – the package \texttt{xt}

12.5 Lost the keys? Use `lablst.tex`