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 you article, you want to refer to the first section. You assign a *key* to the first section using the command

```
\section{⟨section name⟩}\label{⟨key⟩}
```

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

```
\ref{⟨key⟩}
```

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

```
\section{Why cross references}\label{intro}
```

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

```
                 ... (see Section\ref{intro} for ...
```

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 \emph{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 \emph{premises} and statement (\ref{con}) is
the conclusion.
```

gives the following output

> In the classical *syllogism*
>
> (1) All men are mortal.
>
> (2) Socrates is a man.
>
> (3) So Socrates is a mortal.
>
> Statements (1) and (2) are the *premises* and statement (3) 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 betweeen $x$ and $y$ satisfying
the data in Table\ref{tabxy} are $y=x^3$ and
$y=6x^2-11x+6$
```

produces the following output

Value of x	1	2	3
Value of y	1	8	27

Table 12.1 Observed values of x and y

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 `\ref`ing 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 abounds 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.

Input

```
\begin{equation}\label{sumsq}
(x+y)^2=x^2+2xy+y^2
\end{equation}
Changing $y$ to $-y$ in
Equation~(\ref{sumsq})
gives the following
```

Output

$$(x + y)^2 = x^2 + 2xy + y^2 \qquad (12.1)$$

Changing y to $-y$ in Equation (12.1) gives the following

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 parantheses around the equation number and provides an italic correction before the closing parenthesis, if necessary. For example,

```
Equation~\eqref{sumsq} gives the following
```

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

Input	Output

```
\begin{align}
(x+y)^2&=x^2+2xy+y^2\\
\label{sum}
(x-y)^2&=x^2-2xy+y^2
\tag{\ref{sum}a}
\end{align}
```

$$(x + y)^2 = x^2 + 2xy + y^2 \qquad (12.2)$$
$$(x - y)^2 = x^2 - 2xy + y^2 \qquad (12.2a)$$

12.3 Pointing to a page – the package varioref

In making a reference to a table or an equation, it is more to 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

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 occurance 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 article documentclass. If the article class is used with the twoside option or if the documentclass 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 occurence 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 case considered above can be customized by redefining the commands generating them. For the article class without the twoside option, reference to the previous page use the command \reftextbefore and reference to the next page uses \reftextafter. In the case of the article class with the twoside option or the book class, the commands \reftextfaceafter and \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 \reftextvario are the phrases alternatively used in the repeated use of the reference as mentioned above.

```
\newcommand{\reftextbefore}
          {on the \reftextvario{preceding page}{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}}
```

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

If you want to refer only to a page number using \varioref, you can use the command

\vpageref{*key*}

to produce the page number of the object marked with \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 \reftextcurrenr whose default definition is

```
\newcommand{\reftextcurrent}
          {on \reftextvario{this}{the current} page}
```

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 \vpageref allows. Thus you can use the command

> \vpageref[*same page phrase*][*other page phrase*]{*key*}

to refer to the page number of the object marked with \label{*key*}. The *same page phrase* will be used if the object and the reference fall on the same page and the phrase *other page phrase* will be used, if they fall on different pages. Thus for example, the command

> see the \vpageref[*above table*][*table*]{*tabxy*}

given in this document will produce

<div align="center">see the above table</div>

if the reference occurs on the same page as Table 12.1 and

<div align="center">see the tableon page 4</div>

if they fall on different pages.

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

> \usepakage{*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

LaTeXresponds as follows

```
*******************************
* Enter input file name
*   without the .tex extension:
*******************************

\lablstfile=
```

I type in the file name as `cref` which is the source of this document. I'm presented with another query.

```
**********************************************
* Enter document class used in file cref.tex
*   with no options or extension:
**********************************************

\lablstclass=
```

So I type `article`. I am asked

```
*******************************************
* Enter packages used in file cref.tex
*   with no options or extensions:
*******************************************

\lablstpackages=
```

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

```
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.

Click here to see lablst output

File **tutor.tex** — lablst output ()

Using document class: ../tugindia
        and packages: txfonts,varioref,pdfscreen,colortbl,xspace,woodfont,tutor
                                                                                    ■ 1

Logical labels within sections

12   Cross References in LATEX   **2**

12.1   Why cross references?   2

| | intro | 12.1 | Page: | 2 |

12.2   Let LATEX do it   2

pre1	1	Page:	5
pre2	2	Page:	5
con	3	Page:	5
tabxy	12.6	Page:	6
mathref	12.2.1	Page:	6
diffcon	12.2.1.1	Page:	6
sumsq	12.1	Page:	7
sum	12.2	Page:	8

12.3   Pointing to a page – the package varioref   8

diff1	3	Page:	10
1@xvr		Page:	12
1@vr		Page:	12

12.4   Pointing outside – the package xr   12

12.5   Lost the keys? Use `lablst.tex`   13