

TABLE OF CONTENTS MACROS

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Automatically generated tables of contents are a convenient side effect of many computerized document preparation systems. Of course, the style of a table of contents is highly dependent on the style of chapter and section headings and whether lists of figures and tables are included. This article describes one set of TeX macros used to number chapters and sections and to produce tables of contents, lists of figures, and lists of tables. While many users will prefer other formats than the one used here, macro writers may wish to adapt this package to other conventions. The technique used involves writing one or more auxiliary files with TeX's `\send` feature as a document is formatted. These auxiliary files contain the information needed to produce a table of contents and lists of figures and tables.

The structure of a document prepared with this package is specified with the following macros:

- `\chapter {<chapter title>}` starts a new numbered chapter with the indicated heading placed at the top of the next page and entered into the table of contents. This macro automatically capitalizes all letters in its argument. In the rare situations where lowercase letters are needed, the construct

`\lowercase {<lowercase letters>}`

can be used to preserve capitalization.

- `\section {<section title>}` starts a new section with the indicated heading placed on the current page and entered into the table of contents. The heading is preceded by the chapter number and the section number separated by a period (e.g., the first section in the second chapter is labelled "2.1 Section Title"). No automatic capitalization of section titles is performed—the user should capitalize the first letter of each word. Section numbers are stored in macro `\sectioncount`.
- `\subsection {<subsection title>}` starts a new subsection with the indicated heading placed on the current page and entered into the table of contents. Subsections are labelled with the chapter number, section number, and subsection number, all separated by periods. No automatic capitalization of subsection titles is performed. Subsection numbers are stored in `\subsectioncount`.
- Some documents require more than three levels of headings. The macro `\subsub {<sub-subsection heading>}` allows for additional levels. The specified heading is placed on the current page and entered into the table of contents. However, sub-subsections are not automatically numbered. If the user wants a number to appear with the title in the text or in the table of contents, he must include it explicitly in the argument to `\subsub`.

- The macros `\figure {<figure title>}` and `\table {<table title>}` generate numbered figures and tables with the title centered in the current page. An appropriate entry is made in the list of figures or list of tables. Figures and tables are numbered relative to each chapter. Each is labelled with the chapter number and the figure or table number separated by a hyphen (*e.g.*, the first table in the second chapter is labelled 2-1). The number of the next figure to be generated is stored macro `\figurecount` and that of the next table in macro `\tablecount`.
- `\enddoc` to end the document

When processing a document in this format, TeX optionally writes one or more files of TeX input that can be processed later to generate a table of contents, list of figures, or list of tables. These auxiliary files are generated when the original input contains a call to the macro `\enablecontents`. This call must appear before the first macro that would generate a table of contents entry, *i.e.*, before the first chapter.

The default name for the table-of-contents file is CONTENTS. When the user wishes to use another file, he can specify its name with the control sequence `\contentsfile {<filename>}`. Analogously, the control sequences `\figuresfile {<filename>}` and `\tablesfile {<filename>}` govern the names of the files used for the lists of figures and tables. Defaults for the latter are FIGURES and TABLES. If any of the default names are changed, the appropriate macro calls must appear in the input before the call to `\enablecontents`. As with the names of all TeX input files, these generated files have names with the extension ".TEX". This extension is automatically supplied, whether or not the default name is used.

In order for pages to be properly numbered, the user must reserve an appropriate number of pages for the table of contents and lists of figures and tables and must, in addition, indicate where this space should be reserved. The macro `\contentshere` reserves space for the table of contents and for any lists of figures and of tables. The number of pages required for the table of contents is specified with the control sequence `\numbercontentspages {<number>}`. There are analogous control sequences `\numberfigurespages {<number>}` and `\numbertablespages {<number>}`. The default numbers of pages are 1 for the table of contents and 0 for both the list of figures and the list of tables. Since the auxiliary files for the lists of figures and tables are created only when the corresponding number of pages is nonzero, any changes to these defaults must be made before the call to `\enablecontents`. When each auxiliary file is processed, an error message is issued if the actual number of pages generated does not match the estimate.

The macros always produce a table of contents first and any list of figures before a list of tables. Two or more of the lists can be printed on one page. With the macro calls `\numberfigurespages{-1}` or `\numbertablespages{-1}`, the user indicates respectively that the list of figures or list of tables is not to start on a new page.

In general, the user must run the TeX processor separately to format the auxiliary file corresponding to each of these lists that appear in a particular paper. An exception occurs when two or more lists fit on a single page. In this case, the user must invoke TeX only for the first list on a page; lists that follow on the same page are processed automatically.

These constructs are illustrated in Figure 1, which shows a portion of the TeX input used to produce one document. The input for the two-page table of contents is stored in file `MACROCON.TEX`, that for the list of figures in `MACROFIG.TEX`, and that for the list of tables in `MACROTAB.TEX`. The lists of figures and tables are printed on the same page. The TOPS-20 command

```
⊙TEX MACROCON
```

formats the table of contents while the command

```
⊙TEX MACROFIG
```

was used to format both the list of figures and the list of tables. If the latter two lists did not appear on the same page, they would have been processed separately.

Table of Contents Macros

```

\contentsfile{macrocon} % Contents go in MACROCON.TEX
\figuresfile{macrofig} % List of Figures in MACROFIG.TEX
\tablesfile{macrotab}  % List of Tables in MACROTAB.TEX
\numbercontentspages{2} % 2 pages for Table of Contents
\numberfigurespages{1} % 1 page for List of Figures
\numbertablespages{-1} % List of Tables on same page as List of Figures
\enablecontents        % Produce a table of contents

                          % Continue with rest of document
.
.
.

```

Figure 1. Preparing the Table of Contents

In rare cases, the table-of-contents file may require editing. This situation is most likely to occur when long titles are used or when macro calls occur within table-of-contents entries. Sometimes, *e.g.*, when a nonstandard font is required in a table of contents entry, the user may find it convenient to explicitly `\send` information to the table of contents or list of figures or list of tables files. These macros use character output file 1 for the table of contents, file 2 for the list of figures, and file 3 for the list of tables.

The user who is unable to recover from a TeX error received while processing a table-of-contents file should consult a TeX wizard.

The following macros provide chapter and section structure and cause the auxiliary files to be created. The auxiliary files also access these macros and assume them to be stored in a file called TUGCHAP.TEX.

```

% Chapter, figure, table, and table of contents macros
\input basic

% \neg and \ifzero from Appendix X
\def\neg#1{\setcount#1-\count#1}
\def\ifzero#1#2\else#3{\ifpos#1{#3}\else{\neg#1
  \ifpos#1{\neg#1 #3}\else{\neg#1 #2}}}
% Arguments to \ifeq can be constants of counters
\def\ifeq#1#2#3\else#4{\setcount9 #1 \advcount9 by -#2
  \ifzero9{#3}\else{#4}}

% Macro to advance pseudo-counters (i.e., macros defined to be integers
% in order to bypass TeX's limited number of counters
\def\advcounter#1#2{\setcount9 #1\advcount9 by #2\edef#1{\count9}}

\def\firstpage{T}
\def\chaptercount{0}
\def\figurecount{1}
\def\tablecount{1}

\def\break{\vfil\vfilneg}

% End of Document

```

```

\def\enddoc{
  \par\vfill
  % Check If Figures and Tables Lists on Same Page as TOC
  \if 0\enablecont{} \else{
    \if 0\figurespages{          % no LF
      \if 0\tablespages{}       % no LF or LT
        \else{                  % TOC, but LT
          \setcount9\tablespages
          \ifpos9{}\else{\writecon0{\Ainput \tables}} % LT on same page as TOC
        }
      }
    }
    \else{                      % LF
      \setcount9\figurespages
      \ifpos9{}
      \else{
        \if 0\figurespages{}
        \else{\writecon0{\Ainput \figures}} % LF on same page as TOC
      }
      \setcount9\tablespages
      \ifpos9{}
      \else{
        \if 0\tablespages{}
        \else{\writecon1{\Ainput \tables}} % LT on same page as LF
      }
    }
  }
}

% Close TOC files
\closecon0\contentspages{Table of Contents}
\closecon1\figurespages{List of Figures}
\closecon2\tablespages{List of Tables}
\vfill\ject\end
}

% Chapters and sections

% \chapnum prints right-justified chapter number
\def\chapnum#1#2{\xdef\curchap{#2}\save9\hbox{#1}\save8\hbox{#2}\hskip
  1wd9\hskip-1wd8 #2}
\setcount 0 1 % Page number
\def\chapter#1{
  \if T\firstpage{}\else{\vfill\ject} % Eject unless this is the first chapter
  \gdef\firstpage{F}
  \gdef\sectioncount{0}
  \gdef\figurecount{1}
  \gdef\tablecount{1}
  \vbox to 16ex{
    \hbox{\bf\advcounter\chaptercount1\chapnum{1.}\{\chaptercount.}\quad
      \uppercase{#1}}
    \writecon0{\vskip 2ex}
    \writecon0{\AitemincontB\bf\Achapnum{1.}\{\curchap}\quad\uppercase}
    \writecon0{\#1}\E\B\count0\#E}
    \vskip 2ex}
}

```

Table of Contents Macros

```

\def\section#1{
  \par\vskip 4ex\break
  \gdef\subsectioncount{0}
  \advcounter\sectioncount1\hbox{\chapnum{1.1}{\chaptercount.\sectioncount}
  }\quad\it#1}
  \writeconO{\AitemincontB\save9\hbox{\bf1.\quad}\hskip 1wd9
  \Achapnum{1.1}{\curchap}\quad\B\it}
  \writeconO{\#1\T\T\B\countO\T\T}
  \penalty 1000
  \vskip 1ex
}

\def\subsection#1{
  \par
  \vskip 4ex
  \break
  \advcounter\subsectioncount1
  \hbox{\chapnum{1.1.1}{\chaptercount.\sectioncount.\subsectioncount}\quad
  \it#1}
  \writeconO{\AitemincontB\save9\hbox{\bf1.\quad\rm1.1\quad}\hskip
  1wd9\Achapnum{1.1.1}{\curchap}\quad\B\it}
  \writeconO{\#1\T\T\B\countO\T\T}
  \penalty 1000
  \vskip 1ex
}

\def\subsub#1{
  \par
  \vskip 4ex
  \break
  \hbox{\it#1}
  \writeconO{\AitemincontB\save9\hbox{\bf1.\quad\rm1.1\quad1.1.1\quad}\hskip
  1wd9\B\it}
  \writeconO{\#1\T\T\B\countO\T\T}
  \penalty1000
  \vskip 1ex
}

% Table of Contents
% Note: to avoid immediate evaluation of some macros, and to be able to
% write lines with unbalanced grouping characters to the table of contents
% files, CTRL-A is used as an escape character (\) and CTRL-B and CTRL-E are
% used as grouping characters (left and right braces, respectively).

\def\writecon#1#2{\if T\enablecon {\send#1{#2}} \else {}}

% macros for defining file names and estimated page counts
\def\contentsfile#1{\gdef\contents{#1}}
\def\figuresfile#1{\gdef\figures{#1}}
\def\tablesfile#1{\gdef\tables{#1}}
\def\numbercontentspages#1{\gdef\contentspages{#1}}
\def\numberfigurespages#1{\gdef\figurespages{#1}}
\def\numbertablespages#1{\gdef\tablespages{#1}}

```

```

% set defaults
\contentsfile{CONTENTS}
\figuresfile{FIGURES}
\tablesfile{TABLES}
\numbercontentspages{1}
\numberfigurespages{0}
\numbertablespages{0}

% Numcon writes on contents files information needed to determine the
% page number on which the contents or list of figures or tables should
% start. It also makes table of contents entries for the contents,
% and lists of figures or tables. The first parameter is 0, 1, or 2
% to indicate which list is involved; the second is the number of
% pages that list is supposed to take; the third is the title of the list.
\def\numcon#1#2#3{
  \if 0#2{}
  \else{
    \writecon0{\fAstartpage
      {\count0}{\contentspages}{\figurespages}{\tablespages}{#1}}
    \setcount9 #2
    \ifpos9{
      \writecon#1{\fAstartpage
        {\count0}{\contentspages}{\figurespages}{\tablespages}{#1}}
      \writecon#1{\fAsetcount0 \fAccount9}
      \writecon#1{\fAxdef\fAsavestart{\fAstart}}
      \advcount0 by #2
    }
    \else{}
    \writecon0{\vskip 2ex}
    \writecon0{\fAitemincon{{\bf #3}}{\fAstart}}
  }
}

\def\contentshere{
  \if T\firstpage{}\else{\vfill\object} % Eject unless this is the first page
  \numcon0{\contentspages}{CONTENTS}
  \numcon1{\figurespages}{LIST OF FIGURES}
  \numcon2{\tablespages}{LIST OF TABLES}
  \def\firstpage{T}
}

% Initialize a particular table of contents file (called from \enablecontents)
% Parameter 1 indicates which list, parameter 2 is title of list,
% parameter 3 is estimated number of pages, parameter 4 is file name on
% which list is to be written
\def\initcon#1#2#3#4{
  \if 0#3{}
  \else{
    \if T\enablecon {\open#1=#4.TEX } \else {}
    \setcount9 #3
    \ifpos9{
      \writecon#1{\input tugchap}
    }
  }
}

```

Table of Contents Macros

```

    \writecon#1{\chcode`001_0}
    \writecon#1{\chcode`002_1}
    \writecon#1{\chcode`005_2}
    \writecon#1{\input tugtoc}
    \writecon#1{\Adef\Atarget{#3}}
  }
  \else{}
  \writecon#1{\Aheading\B#2\E}
}
}

\def\enablecon{F} % flag indicates whether table of contents files are enabled
\def\enablecontents{
  \gdef\enablecon{T}
  \initcon0{CONTENTS}\contentspages\contents
  \initcon1{List of Figures}\figurespages\figures
  \initcon2{List of Tables}\tablespages\tables
}

% Close a table of contents file, write code to check whether estimated
% number of pages was correct
\def\closecon#1#2#3{
  \if 0#2{}
  \else {
    \setcount9 #2
    \ifpos9{
      \writecon#1{\vfill\eject}
      \writecon#1{\Asetcount9 \Asavestart}
      \writecon#1{\Aadvcount 9 by \Atarget}
      \writecon#1{\Aadvcount 9 by -\Account0}
      \writecon#1{\Aadvcount 9 by -1}
      \writecon#1{\Aifzero 9 {} \Aelse{\Asend9{#3 Page Estimate Incorrect}}}
      \writecon#1{\end}
    }
    \else{}
  }
}

% Figures and Tables

\def\figtab#1#2#3#4{
  \vskip 3ex
  \xdef\tabnum{\chaptercount-#3}
  \vbox{\ctrline{#4 \tabnum\quad #2}
  \if T\enablecon {
    \writecon#1{\Aitemincont\B\Achapnum{i-1}{\tabnum}\quad#2\E\B\count0\E}}
  \else {}
  }
  \advcounter{#3}1
  \vskip 3ex
}

```

```
\def\figure#1{\figtab1{#1}\figurecount{Figure}}
\def\table#1{\figtab2{#1}\tablecount{Table}}
```

The following macros, assumed to be stored in a file called TUGTOC.TEX are required by the auxiliary files.

```
% Table of contents macros
\def\lead{\leaders\hbox to 8pt{\hfill}\hfill}
\def\heading#1{\vbox to 16ex{}\ctrline{\bf #1}\vskip 2ex}

% Advance counter 8 by value in counter 9 (used in calculating starting
% page number
\def\adveight#1{\setcount9 #1 \ifpos9{\advcount8 by -\count9}\else{}}

\def\startpage#1#2#3#4#5{ % Compute page # where current list starts
  \setcount8 #1 % # of first page after TOC, LF, LI
  \adveight{#4} % - # of pages for LI
  \if 2#5{\setcount 7 #4 % doing LI, check if not on new page
    \neg7\ifpos7{\advcount8 by -1}\else{}}
  \else{\adveight{#3}} % - # pages for LF unless doing LI
  \if 0#5{\adveight{#2}} \else{} % - # pages for TOC if doing TOC
  \if 1#5{\setcount 7 #3 % doing LF, check if not on new page
    \neg7\ifpos7{\advcount8 by -1}\else{}} \else{}
  \xdef\start{\count8}
  \advcount 8 by -1
}

\def\itemincon#1#2{\hbox to size{#1}\lead\hbox to 1wd0{\setcount9 #2
  \advcount9 by -1\hfill\count9}}

\save0\hbox{1000} % Set box 0 to a very large page number to determine
% maximum width
```