The fibnum package

Heiko Oberdiek*

2016/05/16 v1.1

Abstract

The package fibnum provides expandable fibonacci numbers for both \LaTeX{} and plain TeX.

Contents

1 Documentation 1

2 Implementation 3

2.1 Identification 3

2.2 Package resources 5

2.3 Setup precalculated values 5

2.4 Macros for precalculating values 6

2.5 Expandable calculations 7

3 Installation 8

3.1 Download 8

3.2 Bundle installation 8

3.3 Package installation 8

3.4 Refresh file name databases 9

3.5 Some details for the interested 9

4 References 9

5 History 9

[2012/04/08 v1.0] 9

[2016/05/16 v1.1] 10

6 Index 10

1 Documentation

In the mailing list texhax Jan Abraham asked the question, how to get Fibonacci numbers in \TeX{} [1]:

Write a Macro in \TeX{} that compute the function \texttt{\fib{m}} All fibonacci numbers from 1 to \texttt{m} (m < 40).

This packages provides an expandable implementation for the calculation of these numbers for a much larger set of indexes. For practical reasons the index is restricted to the same limitations that apply for \TeX{} integer numbers. The range of the Fibonacci numbers, however, are not limited by the algorithm. They are only restricted to memory limitations, if they are hit.

The package is loaded as \LaTeX{} package in \LaTeX{}:

*Please report any issues at \url{https://github.com/ho-tex/oberdiek/issues}
\usepackage{fibnum}

and as file in plain \TeX:
\input fibnum.sty

The package does not know any options and it provides the macros \texttt{fibnum} and \texttt{fibnumPreCalc}.

\fibnum{(\langle index\rangle)}

Macro \texttt{fibnum} expects a \TeX{} number as \langle index\rangle in the official \TeX{} number range from \(-(2^{31} - 1)\) up to \(2^{31} - 1\). In exact two expansion steps the macro expands to the Fibonacci number \(F_{\langle index\rangle}\). In case of a negative \langle index\rangle, the “negafibonacci” number \[F_2\] is used. Formally the Fibonacci number \(F_n\) with integer index \(n\), \(n \in \mathbb{Z}\) and \(n \in [-2^{147} 483 647, 2^{147} 483 647]\) that is returned by macro \texttt{fibnum} with numerical argument \(n\) is defined the following way:

\[
F_n = \begin{cases} 
0 & \text{for } n = 0 \\
1 & \text{for } n = 1 \\
F_{n-1} + F_{n-2} & \text{for } n > 1 \\
(-1)^{n+1}F_n & \text{for } n < 0
\end{cases}
\] (1)

Examples:
\begin{verbatim}
\fibnum{-6} \rightarrow -8
\fibnum{-5} \rightarrow 5
\fibnum{-4} \rightarrow -3
\fibnum{-3} \rightarrow 2
\fibnum{-2} \rightarrow -1
\fibnum{-1} \rightarrow 1
\fibnum{0} \rightarrow 0
\fibnum{1} \rightarrow 1
\fibnum{2} \rightarrow 1
\fibnum{3} \rightarrow 2
\fibnum{4} \rightarrow 3
\fibnum{5} \rightarrow 5
\fibnum{6} \rightarrow 8
\ldots
\fibnum{10} \rightarrow 55
\ldots
\fibnum{46} \rightarrow 1836311903
\ldots
\fibnum{100} \rightarrow 354224848179261915075
\ldots
\fibnum{200} \rightarrow 280571172992510140037611932413038677189525
\ldots
\fibnum{1000} \rightarrow 434665576869374564356885276750406258025646
\quad 60517371780402481729089536554179490518904
\quad 038798400792551692959225930803226347752096
\quad 896232398733224711616429964409065331879382
\quad 98969649928516003704476137795166849228875
\end{verbatim}

\fibnumPreCalc{(\langle index\rangle)}

The package already provides precalculated Fibonacci numbers up to index 46. That means that calculations are not necessary for Fibonacci numbers that fit
into the range of TeX numbers. Because macro \textbackslash fibnum is expandable, it cannot store calculated Fibonacci numbers for later use. Macro definitions are forbidden in expandable contexts. If larger Fibonacci numbers are used more than once, the compilation time can be shortened by calculating and storing the Fibonacci numbers beforehand. The argument \langle index \rangle is a TeX number and macro \textbackslash fibnumPreCalc ensures that the Fibonacci numbers $F_0$ up to $F_{\langle index \rangle}$ that are not already known are calculated and stored in internal macros. Internally only non-negative Fibonacci numbers are stored. If \langle index \rangle is negative, then the needed positive Fibonacci numbers are calculated and stored. Example:

\begin{verbatim}
\fibnumPreCalc{50}
% calculates and stores the values for indexes 47..50.
% (Values for 0..46 are already stored by the package.)
\fibnum{49} % uses the stored value
\fibnum{51} % only calculates $F_{51}$ from stored values $F_{49}$ and $F_{50}$
\fibnumPreCalc{100}
% calculates and stores the values for indexes 51..100
\fibnum{100} % uses the stored value for $F_{100}$
\fibnum{-100} % uses the stored value for $F_{100}$
% $F_{-100} = -F_{100}$ according to equation (1).
\end{verbatim}

2 Implementation

2.1 Identification

\begin{verbatim}
\begin{verbatim}
\catcode\=10 \relax
\end{verbatim}
\end{verbatim}

Package identification:

\begin{verbatim}
\begin{verbatim}
\def\empty{}\relax
\immediate\write-1{Package fibnum Info: The package is already loaded.}
\aftergroup\endinput
\end{verbatim}
\end{verbatim}

3
% 2.2 Package resources
\begingroup\expandafter\expandafter\expandafter\endgroup
\expandafter\ifx\csname RequirePackage\endcsname\relax
\def\TMP@RequirePackage#1[#2]{%\endinput}
\input #1.sty\relax
\fi
\endinput
% 2.3 Setup precalculated values
\def\FibNum@temp#1{\expandafter\def\csname FibNum@#1\endcsname}
\catcode46=9 % dots are ignored
\FibNum@temp{0}{0}
\FibNum@temp{1}{1}
\FibNum@temp{2}{1}
\FibNum@temp{3}{2}
\FibNum@temp{4}{3}
\FibNum@temp{5}{5}
\FibNum@temp{6}{8}
\FibNum@temp{7}{13}
\FibNum@temp{8}{21}
\FibNum@temp{9}{34}
\FibNum@temp{10}{55}
\FibNum@temp{11}{89}
\FibNum@temp{12}{144}
\FibNum@temp{13}{233}
\FibNum@temp{14}{377}
\FibNum@temp{15}{610}
2.4 Macros for precalculating values

\fibnumPreCalc
2.5 Expandable calculations

\fibnum
\def\fibnum#1{% 
\romannumeral
\expandafter\expandafter\expandafter\FibNum@Do\intcalcNum{#1}/%
}

\FibNum@Do
\def\FibNum@Do#1/{% 
\ifnum#1<\ltx@zero 
\FibNum@ReturnAfterElseFiFi{% 
\ifodd#1 % 
\expandafter\expandafter\expandafter\ltx@zero 
\else 
\expandafter\expandafter\expandafter-% 
\fi 
\romannumeral 
\expandafter\expandafter\expandafter\IntCalcInc\FibNum@max!% 
\expandafter\expandafter\expandafter/% 
\csname FibNum@\expandafter\IntCalcDec\FibNum@max!% 
\endcsname/% #1% 
}% 
\else 
\expandafter\expandafter\expandafter\ltx@zero 
\csname FibNum@#1\expandafter\expandafter\expandafter\endcsname 
\fi 
}% 
\else 
\ifnum\FibNum@max<#1 % 
\ltx@ReturnAfterElseFi{% 
\expandafter \FibNum@ExpCalc\number\expandafter\IntCalcInc\FibNum@max!% 
\expandafter\expandafter\expandafter/% 
\csname FibNum@\expandafter\expandafter\expandafter\endcsname 
\expandafter\expandafter\expandafter/% 
\csname FibNum@\expandafter\expandafter\expandafter\IntCalcDec\FibNum@max!% 
\endcsname/% 
}% 
\else 
\expandafter\expandafter\expandafter\ltx@zero 
\csname FibNum@#1\expandafter\expandafter\expandafter\endcsname 
\fi 
}% 
}\fi 
}
3 Installation

3.1 Download

**Package.** This package is available on CTAN:\footnote{CTAN:pkg/fibnum}

\texttt{CTAN:macros/latex/contrib/oberdiek/fibnum.dtx} The source file.
\texttt{CTAN:macros/latex/contrib/oberdiek/fibnum.pdf} Documentation.

**Bundle.** All the packages of the bundle ‘oberdiek’ are also available in a TDS compliant ZIP archive. There the packages are already unpacked and the documentation files are generated. The files and directories obey the TDS standard.

\texttt{CTAN:install/macros/latex/contrib/oberdiek.tds.zip}

TDS refers to the standard “A Directory Structure for \TeX\ Files” (CTAN:pkg/tds). Directories with \texttt{texmf} in their name are usually organized this way.

3.2 Bundle installation

**Unpacking.** Unpack the \texttt{oberdiek.tds.zip} in the TDS tree (also known as \texttt{texmf} tree) of your choice. Example (linux):

\begin{verbatim}
unzip oberdiek.tds.zip -d ~/texmf
\end{verbatim}

3.3 Package installation

**Unpacking.** The \texttt{.dtx} file is a self-extracting docstrip archive. The files are extracted by running the \texttt{.dtx} through plain \TeX:

\texttt{tex fibnum.dtx}
TDS. Now the different files must be moved into the different directories in your
installation TDS tree (also known as texmf tree):

fibnum.sty → tex/generic/oberdiek/fibnum.sty
fibnum.pdf → doc/latex/oberdiek/fibnum.pdf
fibnum.dtx → source/latex/oberdiek/fibnum.dtx

If you have a docstrip.cfg that configures and enables docstrip’s TDS installing
feature, then some files can already be in the right place, see the documentation
of docstrip.

3.4 Refresh file name databases
If your TEX distribution (TEX Live, MiKTeX, ...) relies on file name databases,
you must refresh these. For example, TEX Live users run texhash or mktexlsr.

3.5 Some details for the interested
Unpacking with \LaTeX. The .dtx chooses its action depending on the format:

plain TEX: Run docstrip and extract the files.
\LaTeX: Generate the documentation.

If you insist on using \LaTeX for docstrip (really, docstrip does not need \LaTeX),
then inform the autodetect routine about your intention:

latex \let\install=y\input{fibnum.dtx}

Do not forget to quote the argument according to the demands of your shell.

Generating the documentation. You can use both the .dtx or the .drv to
generate the documentation. The process can be configured by the configuration
file ltxdoc.cfg. For instance, put this line into this file, if you want to have A4
as paper format:

\PassOptionsToClass{a4paper}{article}

An example follows how to generate the documentation with pdf\LaTeX:

pdflatex fibnum.dtx
bibtex fibnum.aux
makeindex -s gind.ist fibnum.idx
pdflatex fibnum.dtx
makeindex -s gind.ist fibnum.idx
pdflatex fibnum.dtx

4 References


The Free Encyclopedia. 2012-04-08. URL: https://en.wikipedia.org/w/index.php?title=Fibonacci_number&oldid=486266088 (visited on 2012-
04-08).

5 History

[2012/04/08 v1.0]

- First version.
6 Index

Numbers written in italic refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; plain numbers refer to the code lines where the entry is used.

<table>
<thead>
<tr>
<th>Symbols</th>
<th>179, 180, 181, 182, 183, 184, 199, 203, 204, 209, 217, 219, 224</th>
</tr>
</thead>
<tbody>
<tr>
<td>@undefined</td>
<td>58</td>
</tr>
<tr>
<td>\advance</td>
<td>202, 207, 223</td>
</tr>
<tr>
<td>\aftergroup</td>
<td>29</td>
</tr>
<tr>
<td>\BigIntCalcAdd</td>
<td>217, 268, 274</td>
</tr>
<tr>
<td>\catcode</td>
<td>2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 33, 34, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 69, 70, 72, 73, 74, 78, 79, 80, 81, 82, 83, 84, 87, 88, 90, 91, 92, 93, 97, 99, 137</td>
</tr>
<tr>
<td>\countdef</td>
<td>197</td>
</tr>
<tr>
<td>\csname</td>
<td>14, 21, 50, 66, 76, 119, 122, 135, 200, 205, 219, 249, 252, 258</td>
</tr>
<tr>
<td>\empty</td>
<td>17, 18</td>
</tr>
<tr>
<td>\endcsname</td>
<td>14, 21, 50, 66, 76, 119, 122, 135, 200, 205, 219, 250, 253, 258</td>
</tr>
<tr>
<td>\endinput</td>
<td>29, 117</td>
</tr>
<tr>
<td>\endlinechar</td>
<td>4, 35, 71, 77, 89</td>
</tr>
<tr>
<td>\fibnum</td>
<td>2, 227</td>
</tr>
<tr>
<td>\FibNum@AtEnd</td>
<td>95, 96, 117, 278</td>
</tr>
<tr>
<td>\FibNum@Do</td>
<td>229, 231</td>
</tr>
<tr>
<td>\FibNum@ExpCalc</td>
<td>247, 263</td>
</tr>
<tr>
<td>\FibNum@i</td>
<td>197, 198, 200, 202, 205, 207, 219, 220, 221, 223</td>
</tr>
<tr>
<td>\FibNum@max</td>
<td>185, 194, 198, 221, 244, 247, 249, 252</td>
</tr>
<tr>
<td>\FibNum@PreCalc</td>
<td>188, 190</td>
</tr>
<tr>
<td>\FibNum@PreCalcAux</td>
<td>209, 215</td>
</tr>
<tr>
<td>\FibNum@ReturnAfterElseFiFi</td>
<td>233, 262</td>
</tr>
<tr>
<td>\FibNum@temp</td>
<td>134, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 180, 181, 182, 183, 184, 199, 203, 204, 209, 217, 219, 224</td>
</tr>
<tr>
<td>\fibnumPreCalc</td>
<td>2, 186</td>
</tr>
<tr>
<td>\ifnum</td>
<td>191, 194, 220, 232, 244, 265</td>
</tr>
<tr>
<td>\ifodd</td>
<td>234</td>
</tr>
<tr>
<td>\iftrue</td>
<td>208</td>
</tr>
<tr>
<td>\ifix</td>
<td>15, 18, 21, 50, 58, 61, 119, 122</td>
</tr>
<tr>
<td>\immediate</td>
<td>23, 52</td>
</tr>
<tr>
<td>\input</td>
<td>23, 52</td>
</tr>
<tr>
<td>\IntCalcDec</td>
<td>272</td>
</tr>
<tr>
<td>\IntCalcInc</td>
<td>247, 272</td>
</tr>
<tr>
<td>\intcalcNum</td>
<td>188, 229</td>
</tr>
<tr>
<td>\ltx@gobble</td>
<td>192, 241</td>
</tr>
<tr>
<td>\ltx@LocDimenA</td>
<td>196, 220</td>
</tr>
<tr>
<td>\ltx@one</td>
<td>223</td>
</tr>
<tr>
<td>\ltx@ReturnAfterElseFi</td>
<td>245, 266</td>
</tr>
<tr>
<td>\ltx@two</td>
<td>207</td>
</tr>
<tr>
<td>\ltx@zero</td>
<td>191, 232, 235, 237, 257, 267</td>
</tr>
<tr>
<td>\number</td>
<td>247, 272</td>
</tr>
<tr>
<td>\PackageInfo</td>
<td>26</td>
</tr>
<tr>
<td>\ProvidesPackage</td>
<td>19, 67</td>
</tr>
<tr>
<td>\RequirePackage</td>
<td>130, 131, 132</td>
</tr>
<tr>
<td>\romannumeral</td>
<td>228, 240</td>
</tr>
<tr>
<td>\the</td>
<td>77, 78, 79, 80, 81, 82, 83, 84, 89, 97, 200, 205, 219, 221</td>
</tr>
<tr>
<td>\TMPrequirePackage</td>
<td>120, 126, 127, 128</td>
</tr>
<tr>
<td>\write</td>
<td>23, 52</td>
</tr>
<tr>
<td>\x</td>
<td>14, 15, 18, 22, 26, 28, 51, 56, 66, 75, 87</td>
</tr>
</tbody>
</table>