The **boolexpr*** package

Purely expandable boolean expressions and switch (ε-TEX).

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2009/09/03– v3.0

Abstract

boolexpr provides a purely expandable way to evaluate boolean expressions of the form:

α \AND β \OR γ ...

where α, β and γ are *atomic expressions* of one of those 8 valid forms:

$x = y$	$x <> y$ [1]	$x < y$	$x <= y$	$x > y$	$x >= y$

\if⟨*test*⟩ 0\else 1\fi	another \boolexpr evaluation

where x and y are either numeric expressions (or dimensions, glue, muglue to test using \dimexpr, \glueexpr or \muexpr – please refer to the **\boolexpr** examples) and ⟨*test*⟩ may be a switch (\iftrue / \iffalse or a conditional[2]). boolexpr abide by the precedence of \AND on \OR, and the whole expression is evaluated until the result is known (in other words, \AND and \OR are *shortcut* boolean operators).

\boolexpr will expand to **0** if the expression is **true**, making it proper to work with \ifcase Furthermore, boolexpr defines a \switch syntax which remains purely expandable.

Be aware that \boolexpr (a little like \numexpr) works only if its argument is purely expandable; the same for \switch. If you wish a more general \CASE syntax refer to this excellent paper: http://www.tug.org/TUGboat/Articles/tb14-1/tb38fine.pdf.

The boolexpr package is designed to work with an ε-TEX distribution of LATEX: it is based on the ε-TEX \numexpr primitive and requires no other package.

Contents

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* boolexpr: CTAN:macros/latex/contrib/boolexpr

This documentation is produced with the DocStrip utility.

⟶ To get the documentation, run (thrice): `pdflatex boolexpr.dtx`
for the index: `makeindex -s gind.ist boolexpr.idx`
⟶ To get the package, run: `etex boolexpr.dtx`

The .dtx file is embedded into this pdf file thank to embedfile by H. Oberdiek.

1. The choice of <> rather than != is due to Category codes considerations.
2. \if, \ifcase, \ifcat, \ifcsname, \ifdefined, \ifdim, \ifeof, \iffontchar, \ifhmode, \ifinner, \ifmmode, \ifnum, \ifodd, \ifvmode, \ifvoid, \ifx

1 Introduction – Using boolexpr: \boolexpr and \switch

`\boolexpr` {⟨*boolean expression*⟩}

`\boolexpr` is a macro that takes for unique argument a series of *atomic expressions* of the form:

numeric expr.	=	numeric expr.
numeric expr.	<>	numeric expr.
numeric expr.	<	numeric expr
numeric expr.	<=	numeric expr
numeric expr.	>	numeric expr.
numeric expr.	>=	numeric expr.
`\if`	⟨*test*⟩	0 `\else` 1`\fi`

`\boolexpr`{⟨*boolean expression*⟩}

related by **`\AND`** or **`\OR`** (with the usual logical precedence).

`\boolexpr` expands to 0 if the whole expression is true and to a non nul number if the whole expression is false.

`\boolexpr` is **purely expandable**.

Therefore, testing may be used as follow:

```
\ifcase\boolexpr{ boolean expression }
     what to do if true
\else
     what to do if false
\fi
```

It is possible to use `switches` as boolean quantities into a `\boolexpr` expression with the syntax:
`\ifswitch 0\else 1\fi`

It is also possible to use `\ifdim`, `\ifnum` etc. (although it is not necessary because other forms of atomic expression can perform those tests more easily) and `\ifdefined`, `\ifcsname` etc. with the same syntax, f.ex.:
`\ifcsname` ⟨*cs-name*⟩ `\endcsname  0\else 1\fi`

It means that if the conditional is `true` then the *atomic expression* is `true` (expands to `0`), otherwise the *atomic expression* is `false` (expands to non `0`).

It is possible to test `dimensions` (or `glue` or `muglue`) by writing `\dimexpr` (or `\glueexpr` or `\muexpr`) in front of the *atomic expression*; therefore, the following are valid atomic expressions:

`\dimexpr`	dimen expr.	<	dimen expr
`\glueexpr`	glue expr.	<>	glue expr.
`\muexpr`	mu expr.	=	mu expr.

It is allowed to group expressions inside the argument of `\boolexpr` by inserting another `\boolexpr` evaluation, f.ex.:
`\boolexpr{  \boolexpr{` α `\OR` β `} \AND` γ `  }`

The logical **NOT** operator can be achieved by writing for example:
`\ifcase\boolexpr{`⟨*boolean expression*⟩`} 1\else 0\fi`

Finally, if the ⟨*boolean expression*⟩ is missing:
`\boolexpr{  }` expands to 1 (*ie.* `false`).

`\ifboolexpr` {⟨*boolean expression*⟩} {⟨*true part*⟩} {⟨*false part*⟩}

`\ifboolexpr` is the LaTeX form of a `\boolexpr` test.

`\ifboolexpr` is purely expandable (provided ⟨*true part*⟩ and ⟨*false part*⟩ are so).

\boolexpr examples

The part of the expression that is evaluated is in blue (the remainder is not evaluated).

```
\ifcase\boolexpr{ 45 > 80 \OR 5<>5 \AND  5<4 }
      boolexpr is true
\else boolexpr is false                          ⟶ boolexpr is false
\fi
```

```
\ifcase\boolexpr{ 45 < 80 \OR 5 = 5 \AND  0<>0 }
      boolexpr is true
\else boolexpr is false                          ⟶ boolexpr is true
\fi
```

```
\ifcase\boolexpr{ \boolexpr{ 45 < 80 \OR 5 = 5 } \AND  0<>0 }
      boolexpr is true
\else boolexpr is false                          ⟶ boolexpr is false
\fi
```

```
\ifcase\boolexpr{ 12>0 \AND (4+3)*5 > 20 }
     boolexpr is true
\else boolexpr is false                          ⟶ boolexpr is true
\fi
```

```
\makeatletter
\number\boolexpr{ \the\catcode`\@=11 }           ⟶ 0
                                                 (catcode of character @ is 11)
```

```
\makeatother
\number\boolexpr{ \the\catcode`\@=11 \AND \ifdefined\@undefined 0\else 1\fi }
                                                 ⟶ 1
                                                 (catcode of character @ is 12)
```

```
\makeatletter
\number\boolexpr{ 3<4 \AND \@ifundefined{iftest}{1}{\iftest 0\else 1\fi} }
                                                 ⟶ 1: \iftest not defined
```

```
\makeatletter   \newif\iftest   \testtrue
\number\boolexpr{ 3<4 \AND \@ifundefined{iftest}{1}{\iftest 0\else 1\fi} }
                                                 ⟶ 0: \iftest is true
```

```
\ifcase\boolexpr{ \dimexpr 12pt + 1in > 8mm * 2 \AND \iftest 0\else 1\fi }
      boolexpr is true
\else  boolexpr is false                         ⟶ boolexpr is true
\fi
```

```
\ifcase\boolexpr{ 0=0 \AND \ifcase\boolexpr{1=1 \AND 5<=5} 1\else 0\fi }
      boolexpr is true                           ⟶ boolexpr is false
\else  boolexpr is false                           α \AND NOT( β \AND γ )
\fi                                              = α \AND NOT β \OR α \AND NOT γ
```

Results in green were evaluated by boolexpr at compilation time.

The \switch syntax

```
\switch
\case{⟨boolean expression⟩}  ...
\case{⟨boolean expression⟩}  ...
\otherwise  ...
\endswitch
```

boolexpr defines a syntax for \switch conditionals which remains purely expandable:

Each part of the switch is optional. That means:

```
\switch
\case{ ⟨bool expr⟩ } ...
\case{ ⟨beel expr⟩ } ...
\case{ ⟨bool expr⟩ } ...
\otherwise ...
\endswitch
```

```
\switch
\case{ ⟨bool expr⟩ } ...
\case{ ⟨beel expr⟩ } ...
\case{ ⟨bool expr⟩ } ...
\endswitch
```

```
\switch
\otherwise ...
\endswitch
```

```
\switch
\endswitch
```

are allowed by boolexpr.

\switch examples

The part of the expression that is evaluated is in blue (the remainder is not evaluated).

```
\switch
\case{6>1 \AND 6<=5}$\geq 1$ and $\leq 5$%
\case{3<10}$> 5$ and $< 10$%                    ⟶ > 5 and < 10
\case{3>10}$\geq 10$%
\endswitch
```

```
\edef\result{%
\switch
\case{6>1 \AND 6<=5}$\geq 1$ and $\leq 5$%      ⟶ result:
\case{3<10}$> 5$ and $< 10$%                    $>5$ and $< 10$
\case{3>10}$\geq 10$%
\endswitch}
```

```
\newcounter{myCounter} \setcounter{myCounter}{2}
\edef\result{%
\switch[\value{myCounter}=]
\case{1}one%
      |  ---------------------------->   |
\case{2}two% <=> \case{value{myCounter}=2}      ⟶  result:  two
\case{3}three%
\case{2}vartwo%never found%
\otherwise something else%
\endswitch}
```

```
switch[\value{myCounter}]
\case{=1}It's $1$%                              ⟶ It's >= 0
\case{=-1}It's $-1$%
                |-|  ------------------------->  |-|
\case{>=0}It's $>=0$% <=> \case{\value{myCounter}>=0}
\otherwise something else%
\endswitch
```

```
switch[\pdfstrcmp{DuMmY}]
\case{{First}}It's "First"%                     ⟶ It's "DuMmY"
                |-|  ------------------------->  |-|
\case{{DuMmY}}It's DuMmY%
\otherwise something else%
\endswitch
```

Results in green were evaluated by boolexpr.sty at compilation time.

2 Implementation

2.1 The algorithm

The *string* is the suite of *atomic expressions* connected by \AND or \OR.
The *result* must be 0 if the *string* is true, and non zero if the *string* is false.
"*go to* some macro" means: "*now expand* some macro".

A \bex@OR

1) Split the *string* into two parts:
   #1 = before the first \OR (#1 does not contain any \OR)
   #2 = after the first \OR

2) If #2 is blank: the *string* contains no \OR
   then go to \bex@AND to test \AND relations in #1
   Otherwise: test the \AND relations in #1 and keep #2 in a so called "OR-buffer" for further testing.

B \bex@AND
#1 = OR-buffer for further testing if needed

1) Split the string "before the first \OR" (*ie.* the #1 of A.1) into two parts:
   #2 = before the first \AND (#2 is an *atomic expression*)
   #3 = after the first \AND (#3 does not contain any \OR)

2) Then test #2 (the *atomic expression*):

TRUE: If #3 is blank then #2 is either:

- an atomic expression alone
- the last atomic expression in *string*, preceded by \OR
- an atomic expression preceded by \OR and followed by \OR

In each of these 3 cases, the whole expression (*ie.* the *string*) is true because #2 is true (otherwise, we had known the result of the whole *string* earlier, and were not into testing #2)
Now if #3 is not blank then #2 is followed by \AND:
go to \bex@ANDAND to test the series of \AND

FALSE: if the OR-buffer #1 is blank then #2 is either:

- an atomic expression alone
- an atomic expression followed a series of \AND (and no \OR)
- the last atomic expression of the *string*

In each or these 3 cases, the whole expression (*ie.* the *string*) is false because #2 is false (otherwise, the result would have been known earlier)
Now if the OR-buffer #1 is not blank, then we have to do more tests to get the result:
go to \bex@OR to split the OR-buffer (#1 here) and continue testing...

C \bex@ANDAND
#1 is the OR-buffer for further testing if needed

1) Split the string (*ie.* #3 in B.2.TRUE) into two parts:
   #2 : before the first \AND (#2 is an *atomic expression*)
   #3 : after the first \AND

2) Test the *atomic expression* #2:

TRUE: If #3 is blank then #2 is the last atomic expression of a series of \AND (possibly followed by \OR).
Conclusion: the whole *string* is true (otherwise, we would have concluded earlier that it was false and were not into testing #2... think about it)
Now if #3 is not blank then #2 is followed by \AND and we have to test further:
go to \bex@ANDAND to test #3.

FALSE: we do not have to test the following \AND: the \AND-connected series is false.
If the OR-buffer #1 is blank then the whole *string* is false.
Now if the OR-buffer #1 is not blank: continue testing into this OR-buffer :
go to \bex@OR.

2.2 Category codes considerations

At first glance, the author of this package wanted to test inequality with the operator !=. A problem arose because some languages make the character ! active (f.ex. french). As far as babel changes the catcodes \AtBeginDocument, the category code of ! is different in the preamble (12) than in the document (13).

After all, it was possible to change the definitions after begin document but... if you try to make the = character active, you will (surprisingly) observe that a test like:

```
\ifnum 4=4 ok\fi
```

leads you to one of the following error messages:

```
undefined control sequence =     if = is undefined
missing = inserted for \ifnum    if = is defined.
```

The same apply for < or >. Therefore: such conditionals are possible for TEX only if =, < and > have a category code of 12 (11 is forbidden too).

Thus the choice of <> is far easier and more reliable than the c-like !=.

2.3 Identification

This package is intended to use with a LATEX distribution of ε-TEX.

```
1 ⟨*package⟩
2 \ProvidesPackage{boolexpr}
3   [2009/09/03 v3.0 Purely expandable boolean expressions and switch (eTeX)]
```

2.4 Special catcode

The colon (:) will be used as a delimiter. We give it a category code of 4.

```
4 \let\bex@AtEnd\@empty
5 \def\TMP@EnsureCode#1#2{%
6   \edef\bex@AtEnd{%
7     \bex@AtEnd
8     \catcode#1 \the\catcode#1\relax
9   }%
10  \catcode#1 #2\relax
11 }
12 \TMP@EnsureCode{95}{11}% _
13 \TMP@EnsureCode{36}{12}% $
14 \TMP@EnsureCode{60}{12}% <
15 \TMP@EnsureCode{61}{12}% =
16 \TMP@EnsureCode{62}{12}% >
```

2.5 Tree helper macros

While reading the log file it is preferable to read \@firstoftwo/\@secondoftwo when the algorithm is making a choice (\ifblank) and \bex@truepart/bex@falsepart when the algorithm has just determined the result of an atomic expression.

```
\let\bex@truepart\@firstoftwo
\let\bex@falsepart\@secondoftwo
```

\bex__ifnotblank The following macro is purely expandable and its code is most probably due to D. Arseneau (url.sty)

```
\long\def\bex__ifnotblank#1#2$#3#4#5$${#4}
```

2.6 Atomic expression evaluation

The six possible numeric atomic expressions $x < y$, $x <= y$, $x > y$, $x >= y$, $x <> y$ and $x = y$ are first transformed to their zero-form:
\numexpr $x - y < 0$, \numexpr $x - y > 0$, \numexpr $x - y <> 0$, \numexpr $x - y = 0$ etc.

Before all, we need to know which relation is used in the atomic expression:

\bex@rel \bex@rel tests an *atomic expression*: first determine its type (inferior to, superior to, equality, inequality, other \boolexpr) and then use the appropriate evaluation macro:

```
\long\def\bex@rel#1{%
   \bex@test_eval#1$${\bex@eval{#1}}
      {\bex@test_neq#1<>$${\bex@neq #1$}
         {\bex@test_infeq#1<=$${\bex@infeq #1$}
            {\bex@test_inf#1<$${\bex@inf #1$}
               {\bex@test_supeq#1>=$${\bex@supeq #1$}
                  {\bex@test_sup#1>$${\bex@sup #1$}
                     {\bex@test_eq#1=$${\bex@eq #1$}
                        {\@latex@error{Unknown relation found while scanning
                           \noexpand\boolexpr!}\@ehd}$$}$$}$$}$$}$$}$$}}
```

The test macros They test each *atomic expression* in order to determine its type:

```
\def\bex@test_neq#1<>#2${\bex__ifnotblank#2$}
\def\bex@test_eq#1=#2${\bex__ifnotblank #2$}
\def\bex@test_infeq#1<=#2${\bex__ifnotblank #2$}
\def\bex@test_inf#1<#2${\bex__ifnotblank #2$}
\def\bex@test_supeq#1>=#2${\bex__ifnotblank #2$}
\def\bex@test_sup#1>#2${\bex__ifnotblank #2$}
\long\def\bex@test_eval#1#2${%
   \ifcat\noexpand#1\relax% #1 is a control sequence
        \bex@test_Eval{#1}
   \else \expandafter\@secondoftwo
   \fi}
\long\def\bex@test_Eval#1#2\fi{\fi\csname @%
   \ifx#1\the second%
   \else\ifx#1\numexpr second%
   \else\ifx #1\number second%
   \else\ifx #1\dimexpr second%
   \else\ifx #1\glueexpr second%
   \else\ifx #1\muexpr second%
   \else\ifx #1\value second%
   \else first%
   \fi\fi\fi\fi\fi\fi\fi oftwo\endcsname}
```

Evaluation macros

They evaluate each *atomic expression* according to its type:

```
\long\def\bex@true_or_false#1{\csname bex@%
   \ifnum\numexpr#1 true\else false\fi part\endcsname}
\def\bex@false_or_true#1{\csname bex@%
   \ifnum\numexpr#1 false\else true\fi part\endcsname}

\def\bex@eq#1=#2${\bex@true_or_false{#1-(#2)=0}}
\def\bex@neq#1<>#2${\bex@false_or_true{#1-(#2)=0}}
\def\bex@infeq#1<=#2${\bex@false_or_true{#1-(#2)>0}}
\def\bex@inf#1<#2${\bex@true_or_false{#1-(#2)<0}}
\def\bex@supeq#1>=#2${\bex@false_or_true{#1-(#2)<0}}
\def\bex@sup#1>#2${\bex@true_or_false{#1-(#2)>0}}
\long\def\bex@eval#1{\bex@true_or_false{#1=0}}
```

2.7 \AND and \OR management

\bex@OR

\bex@OR splits the string to evaluate into two parts: before the first \OR and after:

```
\long\def\bex@OR#1\OR#2${\bex@AND{#2}#1\AND$}
```

\bex@AND

\bex@AND splits the string to evaluate into two parts: before the first \AND and after:

```
\long\def\bex@AND#1#2\AND#3${%
   \bex@rel{#2}
      {\bex__ifnotblank #3$${\bex@ANDAND{#1}#3$}{+0}$$}
      {\bex__ifnotblank #1$${\bex@OR#1$}{+1}$$}}
```

\bex@ANDAND

\bex@ANDAND evaluate successive *atomic expressions* related by \AND until false is found or until the end if every expression is true:

```
\long\def\bex@ANDAND#1#2\AND#3${%
   \bex@rel{#2}
      {\bex__ifnotblank #3$${\bex@ANDAND{#1}#3$}{+0}$$}
      {\bex__ifnotblank #1$${\bex@OR#1$}{+1}$$}}
```

\boolexpr

\boolexpr is the entry point for evaluating boolean expressions:

```
\newcommand\boolexpr[1]{\bex__ifnotblank #1$${\numexpr\bex@OR#1 \OR$}{+1}$$}
```

\ifboolexpr

\ifboolexpr is the LaTeX form of \boolexpr tests:

```
\newcommand\ifboolexpr[1]{\bex@true_or_false{\boolexpr{#1}=0}}
```

\switch

\switch is not long to implement... see:

```
\long\def \switch#1\endswitch {\bex__ifnotblank#1$${\bex@switch_opt#1 \endswitch}{}$$}
\long\def \bex@switch_opt#1#2\endswitch {\bex_ifsinglechar [{#1}%
      {\bex@switch_opti#1#2\endswitch}{\bex@switch_opti[]#1#2\endswitch}}%]
\def \bex@switch_opti[#1]#2\endswitch {\bex@switch_otherwise[{#1}]#2\otherwise\endswitch}

\def\bex@switch_otherwise[#1]#2\otherwise#3\endswitch{%
   \bex@switch_case[{#1}]#2\case\endswitch
      {\bex__ifnotblank#3$${\bex@otherwise#3\endswitch}{}$$}
      \endswitch}

\def\bex@switch_case[#1]#2\case#3\endswitch{\bex__ifnotblank#2$$%
      {\bex@case[{#1}]#2\endcase%
         {\bex__ifnotblank#3$${\bex@switch_case[{#1}]#3\endswitch}\@firstoftwo$$}}%
      {\bex__ifnotblank#3$${\bex@switch_case[{#1}]#3\endswitch}\@firstoftwo$$}$$}
```

```
87
88 \long\def\bex@case[#1]#2#3\endcase{\ifboolexpr{#1#2}{\bex@after_endswitch{#3}}}
89
90 \long\def\bex@after_endswitch#1#2\endswitch{#1}
91 \long\def\bex@otherwise#1\otherwise#2\endswitch{#1}
```

bex_ifsinglechar From etextools[3]:

```
92 \ifdefined\pdfmatch
93 \long\def\bex_ifsinglechar#1#2{\csname @%
94    \ifnum\pdfmatch{\detokenize{^[#1]$}}{\detokenize{#2}}=1 first\else second\fi
95    oftwo\endcsname}
96 \else
97 \long\gdef\bex_ifsinglechar#1#2{\csname @%
98    \bex__ifnotblank#2$${%
99    \if\expandafter\@car\detokenize{#2}\relax\@nil\expandafter\@car\detokenize{#1}\string\
100      \expandafter\expandafter\expandafter\ifx
101      \expandafter\expandafter\expandafter\\\expandafter\@cdr\detokenize{#2}\@nil\\%
102            first%
103      \else second%
104      \fi
105   \else second%
106   \fi}{second}$$oftwo\endcsname}
107 \fi

108 \bex@AtEnd\let\bex@AtEnd\@undefined
109 ⟨/package⟩
```

2.8 Future developments : to do

boolexpr should work either with ε-TEX or ε-TEX-LATEX...

May be build a "real" \NOT operator.

3 History

[2009/09/03 v3.0 – ε-TEX- and XeTEX- stable]

- Many bug fixed in \switch. Tested on LATEX, pdfLATEX and XeLATEX.
- Optimization of test macros (hopefully no best solution exists...)
- Revision of this pdf documentation.

[2009/08/31 v2.9]

- Added \value in the "list of exceptions" (\bex@test_Eval) Enhancement of \switch with the optional first argument (refer to the examples).

[2009/08/13 v2.2]

- Small optimisation in \bex@OR

3. etextools: CTAN:macros/latex/contrib/etextools

[2009/08/12 v2.1]

- Added the `\switch` syntax
- Small bug (`\numexpr` forgotten in the "list of exceptions" (`\bex@test_Eval`)
- Redesigned tests for better compilation

[2009/07/22 v1.0]

- First version.

4 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; numbers in roman refer to the code lines where the entry is used.