

low level

TEX

conditionals

Contents

1	Preamble	1
2	T _E X primitives	6
3	ε -T _E X primitives	13
4	LuaT _E X primitives	17
5	LuaMetaT _E X primitives	21
6	For the brave	33
7	Relaxing	35

1 Preamble

1.1 Introduction

You seldom need the low level conditionals because there are quite some so called support macros available in ConT_EXt. For instance, when you want to compare two values (or more accurate: sequences of tokens), you can do this:

```
\doifelse {foo} {bar} {
  the same
} {
  different
}
```

But if you look in the ConT_EXt code, you will see that often we use primitives that start with `\if` in low level macros. There are good reasons for this. First of all, it looks familiar when you also code in other languages. Another reason is performance but that is only true in cases where the snippet of code is expanded very often, because T_EX is already pretty fast. Using low level T_EX can also be more verbose, which is not always nice in a document source. But, the most important reason (for me) is the layout of the code. I often let the look and feel of code determine the kind of coding. This also relates to the syntax highlighting that I am using, which is consistent for T_EX, MetaPost, Lua, etc. and evolved over decades. If code looks bad, it probably is bad. Of course this doesn't mean all my code looks good; you're warned. In general we can say that I often use `\if...` when coding core macros, and `\doifelse...` macros in (document) styles and modules.

In the sections below I will discuss the low level conditions in T_EX. For the often more convenient ConT_EXt wrappers you can consult the source of the system and support modules, the wiki and/or manuals.

Some of the primitives shown here are only available in Lua \TeX , and some only in Lua-Meta \TeX . We could do without them for decades but they were added to these engines because of convenience and, more important, because then made for nicer code. Of course there's also the fun aspect. This manual is not an invitation to use these very low level primitives in your document source. The ones that probably make most sense are `\ifnum`, `\ifdim` and `\ifcase`. The others are often wrapped into support macros that are more convenient.

1.2 Number and dimensions

Numbers and dimensions are basic data types in \TeX . When you enter one, a number is just that but a dimension gets a unit. Compare:

```
1234
1234pt
```

If you also use MetaPost, you need to be aware of the fact that in that language there are not really dimensions. The `post` part of the name implies that eventually a number becomes a PostScript unit which represents a base point (`bp`) in \TeX . When in MetaPost you entry `1234pt` you actually multiply 1234 by the variable `pt`. In \TeX on the other hand, a unit like `pt` is one of the keywords that gets parsed. Internally dimensions are also numbers and the unit (keyword) tells the scanner what multiplier to use. When that multiplier is one, we're talking of scaled points, with the unit `sp`.

```
\the\dimexpr 12.34pt \relax
\the\dimexpr 12.34sp \relax
\the\dimexpr 12.99sp \relax
\the\dimexpr 1234sp \relax
\the\numexpr 1234 \relax
```

```
12.34pt
0.00018pt
0.00018pt
0.01883pt
1234
```

When we serialize a dimension it always shows the dimension in points, unless we serialize it as number.

```
\scratchdimen1234sp
\number\scratchdimen
\the\scratchdimen
```

1234
0.01883pt

When a number is scanned, the first thing that is taken care of is the sign. In many cases, when $\text{T}_{\text{E}}\text{X}$ scans for something specific it will ignore spaces. It will happily accept multiple signs:

```
\number +123
\number +++123
\number + + + 123
\number +--+123
\number --123
\number ---123
```

123
123
123
123
123
-123

Watch how the negation accumulates. The scanner can handle decimal, hexadecimal and octal numbers:

```
\number -123
\number -"123
\number -'123
```

-123
-291
-83

A dimension is scanned like a number but this time the scanner checks for upto three parts: an either or not signed number, a period and a fraction. Here no number means zero, so the next is valid:

```
\the\dimexpr . pt \relax
\the\dimexpr 1. pt \relax
\the\dimexpr .1pt \relax
\the\dimexpr 1.1pt \relax
```

0.0pt
1.0pt

0.1pt

1.1pt

Again we can use hexadecimal and octal numbers but when these are entered, there can be no fractional part.

```
\the\dimexpr 16 pt \relax
\the\dimexpr "10 pt \relax
\the\dimexpr '20 pt \relax
```

16.0pt

16.0pt

16.0pt

The reason for discussing numbers and dimensions here is that there are cases where when \TeX expects a number it will also accept a dimension. It is good to know that for instance a macro defined with `\chardef` or `\mathchardef` also is treated as a number. Even normal characters can be numbers, when prefixed by a ``` (backtick).

The maximum number in \TeX is 2147483647 so we can do this:

```
\scratchcounter2147483647
```

but not this

```
\scratchcounter2147483648
```

as it will trigger an error. A dimension can be positive and negative so there we can do at most:

```
\scratchdimen 1073741823sp
```

```
\scratchdimen1073741823sp
```

```
\number\scratchdimen
```

```
\the\scratchdimen
```

```
\scratchdimen16383.99998pt
```

```
\number\scratchdimen
```

```
\the\scratchdimen
```

1073741823

16383.99998pt

1073741823

16383.99998pt

We can also do this:

```
\scratchdimen16383.99999pt
\number\scratchdimen
\the\scratchdimen

1073741823
16383.99998pt
```

but the next one will fail:

```
\scratchdimen16383.9999999pt
```

Just keep in mind that T_EX scans both parts as number so the error comes from checking if those numbers combine well.

```
\ifdim 16383.99999 pt = 16383.99998 pt the same \else different \fi
\ifdim 16383.999979 pt = 16383.999980 pt the same \else different \fi
\ifdim 16383.999987 pt = 16383.999991 pt the same \else different \fi
```

Watch the difference in dividing, the / rounds, while the : truncates.

```
the same
the same
the same
```

You need to be aware of border cases, although in practice they never really are a problem:

```
\ifdim \dimexpr16383.99997 pt/2\relax = \dimexpr 16383.99998 pt/2\relax
the same \else different
\fi
\ifdim \dimexpr16383.99997 pt:2\relax = \dimexpr 16383.99998 pt:2\relax
the same \else different
\fi
```

```
different
the same
```

```
\ifdim \dimexpr1.99997 pt/2\relax = \dimexpr 1.99998 pt/2\relax
the same \else different
\fi
\ifdim \dimexpr1.99997 pt:2\relax = \dimexpr 1.99998 pt:2\relax
the same \else different
```

`\fi`

different
the same

```
\ifdim \dimexpr1.999999 pt/2\relax = \dimexpr 1.9999995 pt/2\relax
  the same \else different
```

`\fi`

```
\ifdim \dimexpr1.999999 pt:2\relax = \dimexpr 1.9999995 pt:2\relax
  the same \else different
```

`\fi`

the same
the same

This last case demonstrates that at some point the digits get dropped (still assuming that the fraction is within the maximum permitted) so these numbers then are the same. Anyway, this is not different in other programming languages and just something you need to be aware of.

2 T_EX primitives

2.1 `\if`

I seldom use this one. Internally T_EX stores (and thinks) in terms of tokens. If you see for instance `\def` or `\dimen` or `\hbox` these all become tokens. But characters like A or @ also become tokens. In this test primitive all non-characters are considered to be the same. In the next examples this is demonstrated.

```
[\if AB yes\else nop\fi]
[\if AA yes\else nop\fi]
[\if CDyes\else nop\fi]
[\if CCyes\else nop\fi]
[\if\dimen\font yes\else nop\fi]
[\if\dimen\font yes\else nop\fi]
```

Watch how spaces after the two characters are kept: [nop] [yes] [nop] [yes] [yes] [yes]. This primitive looks at the next two tokens but when doing so it expands. Just look at the following:

```
\def\AA{AA}%
```

```
\def\AB{AB}%
[\if\AA yes\else nop\fi]
[\if\AB yes\else nop\fi]
```

We get: [yes] [nop].

2.2 \ifcat

In T_EX characters (in the input) get interpreted according to their so called catcodes. The most common are letters (alphabetic) and other (symbols) but for instance the backslash has the property that it starts a command, the dollar signs trigger math mode, while the curly braced deal with grouping. If for instance either or not the ampersand is special (for instance as column separator in tables) depends on the macro package.

```
[\ifcat AB yes\else nop\fi]
[\ifcat AA yes\else nop\fi]
[\ifcat CDyes\else nop\fi]
[\ifcat CCyes\else nop\fi]
[\ifcat Clyes\else nop\fi]
[\ifcat\dimen\font yes\else nop\fi]
[\ifcat\dimen\font yes\else nop\fi]
```

This time we also compare a letter with a number: [yes] [yes] [yes] [yes] [nop] [yes] [yes]. In that case the category codes differ (letter vs other) but in this test comparing the letters result in a match. This is a test that is used only once in ConT_EXt and even that occasion is dubious and will go away.

You can use \noexpand to prevent expansion:

```
\def\A{A}%
\let\B B%
\def\C{D}%
\let\D D%
[\ifcat\noexpand\A Ayes\else nop\fi]
[\ifcat\noexpand\B Byes\else nop\fi]
[\ifcat\noexpand\C Cyes\else nop\fi]
[\ifcat\noexpand\C Dyes\else nop\fi]
[\ifcat\noexpand\D Dyes\else nop\fi]
```

We get: [nop] [yes] [nop] [nop] [yes], so who still thinks that T_EX is easy to understand for a novice user?

2.3 `\ifnum`

This condition compares its argument with another one, separated by an `<`, `=` or `>` character.

```
\ifnum\scratchcounter<0
  less than
\else\ifnum\scratchcounter>0
  more than
\else
  equal to
\fi zero
```

This is one of these situations where a dimension can be used instead. In that case the dimension is in scaled points.

```
\ifnum\scratchdimen<0
  less than
\else\ifnum\scratchdimen>0
  more than
\else
  equal to
\fi zero
```

Of course this equal treatment of a dimension and number is only true when the dimension is a register or box property.

2.4 `\ifdim`

This condition compares one dimension with another one, separated by an `<`, `=` or `>` sign.

```
\ifdim\scratchdimen<0pt
  less than
\else\ifdim\scratchdimen>0pt
  more than
\else
  equal to
\fi zero
```

While when comparing numbers a dimension is a valid quantity but here you cannot mix them: something with a unit is expected.

2.5 `\ifodd`

This one can come in handy, although in ConT_EXt it is only used in checking for an odd of even page number.

```
\scratchdimen 3sp
\scratchcounter4

\ifodd\scratchdimen very \else not so \fi odd
\ifodd\scratchcounter very \else not so \fi odd
```

As with the previously discussed `\ifnum` you can use a dimension variable too, which is then interpreted as representing scaled points. Here we get:

```
very odd
not so odd
```

2.6 `\ifvmode`

This is a rather trivial check. It takes no arguments and just is true when we're in vertical mode. Here is an example:

```
\hbox{\ifvmode\else\par\fi\ifvmode v\else h\fi mode}
```

We're always in horizontal mode and issuing a `\par` inside a horizontal box doesn't change that, so we get: `hmode`.

2.7 `\ifhmode`

As with `\ifvmode` this one has no argument and just tells if we're in vertical mode.

```
\vbox {
  \noindent \ifhmode h\else v\fi mode
  \par
  \ifhmode h\else \noindent v\fi mode
}
```

You can use it for instance to trigger injection of code, or prevent that some content (or command) is done more than once:

```
hmode
vmode
```

2.8 `\ifmmode`

Math is something very \TeX so naturally you can check if you're in math mode. here is an example of using this test:

```
\def\enforcemath#1{\ifmmode#1\else$ #1 $\fi}
```

Of course in reality macros that do such things are more advanced than this one.

2.9 `\ifinner`

```
\def\ShowMode
  {\ifhmode      \ifinner inner \fi hmode
  \else\ifvmode \ifinner inner \fi vmode
  \else\ifmmode \ifinner inner \fi mmode
  \else         \ifinner inner \fi unset
  \fi\fi\fi}
```

```
\ShowMode \ShowMode
```

```
\vbox{\ShowMode}
```

```
\hbox{\ShowMode}
```

```
$_ShowMode$
```

```
$$\ShowMode$$
```

The first line has two tests, where the first one changes the mode to horizontal simply because a text has been typeset. Watch how display math is not inner.

```
vmode hmode
inner vmode
inner hmode
innermmode
innermmode
```

By the way, moving the `\ifinner` test outside the branches (to the top of the macro) won't work because once the word `inner` is typeset we're no longer in vertical mode, if we were at all.

2.10 `\ifvoid`

A box is one of the basic concepts in \TeX . In order to understand this primitive we present four cases:

```

\setbox0\hbox{}           \ifvoid0 void \else content \fi
\setbox0\hbox{123}       \ifvoid0 void \else content \fi
\setbox0\hbox{} \box0     \ifvoid0 void \else content \fi
\setbox0\hbox to 10pt{} \ifvoid0 void \else content \fi

```

In the first case, we have a box which is empty but it's not void. It helps to know that internally an hbox is actually an object with a pointer to a linked list of nodes. So, the first two can be seen as:

```

hlist -> [nothing]
hlist -> 1 -> 2 -> 3 -> [nothing]

```

but in any case there is a hlist. The third case puts something in a hlist but then flushes it. Now we have not even the hlist any more; the box register has become void. The last case is a variant on the first. It is an empty box with a given width. The outcome of the four lines (with a box flushed in between) is:

```

content
content

```

```

void
content

```

So, when you want to test if a box is really empty, you need to test also its dimensions, which can be up to three tests, depending on your needs.

```

\setbox0\emptybox           \ifvoid0 void\else content\fi
\setbox0\emptybox          \wd0=10pt \ifvoid0 void\else content\fi
\setbox0\hbox to 10pt {}    \ifvoid0 void\else content\fi
\setbox0\hbox               {} \wd0=10pt \ifvoid0 void\else content\fi

```

Setting a dimension of a void (empty) box doesn't make it less void:

```

void
void
content
content

```

2.11 `\ifhbox`

This test takes a box number and gives true when it is an hbox.

2.12 `\ifvbox`

This test takes a box number and gives true when it is an vbox. Both a `\vbox` and `\vtop` are vboxes, the difference is in the height and depth and the baseline. In a `\vbox` the last line determines the baseline

```
vbox or vtop
```

```
vtop or vbox
```

And in a `\vtop` the first line takes control:

```
vbox or vtop
```

```
vtop or vbox
```

but, once wrapped, both internally are just vlists.

2.13 `\ifx`

This test is actually used a lot in `ConTeXt`: it compares two token(list)s:

```

\ifx a b Y\else N\fi
\ifx ab Y\else N\fi
\def\A {a}\def\B{b}\ifx \A\B Y\else N\fi
\def\A{aa}\def\B{a}\ifx \A\B Y\else N\fi
\def\A {a}\def\B{a}\ifx \A\B Y\else N\fi

```

Here the result is: “NNNNY”. It does not expand the content, if you want that you need to use an `\edef` to create two (temporary) macros that get compared, like in:

```
\edef\TempA{...}\edef\TempB{...}\ifx\TempA\TempB ...\else ...\fi
```

2.14 `\ifeof`

This test checks if a the pointer in a given input channel has reached its end. It is also true when the file is not present. The argument is a number which relates to the `\openin` primitive that is used to open files for reading.

2.15 `\iftrue`

It does what it says: always true.

2.16 `\iffalse`

It does what it says: always false.

2.17 `\ifcase`

The general layout of an `\ifcase` tests is as follows:

```
\ifcase<number>
  when zero
\or
  when one
\or
  when two
\or
  ...
\else
  when something else
\fi
```

As in other places a number is a sequence of signs followed by one or more digits

3 ε -T_EX primitives

3.1 `\ifdefined`

This primitive was introduced for checking the existence of a macro (or primitive) and with good reason. Say that you want to know if `\MyMacro` is defined? One way to do that is:

```
\ifx\MyMacro\undefined
  {\bf undefined indeed}
\fi
```

This results in: **undefined indeed**, but is this macro really undefined? When T_EX scans your source and sees a the escape character (the forward slash) it will grab the next

characters and construct a control sequence from it. Then it finds out that there is nothing with that name and it will create a hash entry for a macro with that name but with no meaning. Because `\undefined` is also not defined, these two macros have the same meaning and therefore the `\ifx` is true. Imagine that you do this many times, with different macro names, then your hash can fill up. Also, when a user defined `\undefined` you're suddenly get a different outcome.

In order to catch the last problem there is the option to test directly:

```
\ifdefined\MyOtherMacro \else
  {\bf also undefined}
\fi
```

This (or course) results in: **also undefined**, but the macro is still sort of defined (with no meaning). The next section shows how to get around this.

3.2 `\ifcename`

A macro is often defined using a ready made name, as in:

```
\def\OhYes{yes}
```

The name is made from characters with catcode letter which means that you cannot use for instance digits or underscores unless you also give these characters that catcode, which is not that handy in a document. You can however use `\cename` to define a control sequence with any character in the name, like:

```
\expandafter\def\cename Oh Yes : 1\endcename{yes}
```

Later on you can get this one with `\cename`:

```
\cename Oh Yes : 1\endcename
```

However, if you say:

```
\cename Oh Yes : 2\endcename
```

you won't get some result, nor a message about an undefined control sequence, but the name triggers a define anyway, this time not with no meaning (undefined) but as equivalent to `\relax`, which is why

```
\expandafter\ifx\cename Oh Yes : 2\endcename\relax
  {\bf relaxed indeed}
```

```
\fi
```

is the way to test its existence. As with the test in the previous section, this can deplete the hash when you do lots of such tests. The way out of this is:

```
\ifcsname Oh Yes : 2\endcsname \else
  {\bf unknown indeed}
\fi
```

This time there is no hash entry created and therefore there is not even an undefined control sequence.

In Lua \TeX there is an option to return false in case of a messy expansion during this test, and in LuaMeta \TeX that is default. This means that tests can be made quite robust as it is pretty safe to assume that names that make sense are constructed from regular characters and not boxes, font switches, etc.

3.3 `\iffontchar`

This test was also part of the ε - \TeX extensions and it can be used to see if a font has a character.

```
\iffontchar\font`A
  {\em This font has an A!}
\fi
```

And, as expected, the outcome is: “*This font has an A!*”. The test takes two arguments, the first being a font identifier and the second a character number, so the next checks are all valid:

```
\iffontchar\font`A yes\else nop\fi\par
\iffontchar\nullfont`A yes\else nop\fi\par
\iffontchar\textfont0`A yes\else nop\fi\par
```

In the perspective of LuaMeta \TeX I considered also supporting `\fontid` but it got a bit messy due to the fact that this primitive expands in a different way so this extension was rejected.

3.4 `\unless`

You can negate the results of a test by using the `\unless` prefix, so for instance you can replace:


```

\ifdim\scratchdimen=10pt
  \dosomething
\else\ifdim\scratchdimen<10pt
  \dosomething
\fi\fi

```

by:

```

\unless\ifdim\scratchdimen>10pt
  \dosomething
\fi

```

An `\unless` makes little sense when used with `\ifcase` but contrary to the other engines we don't error or it; we just give a warning. Some conditionals internally use a case so there we can actually provide a variant:

```

\ifcase 1 \relax zero \or one \or two \else else \fi = one \par
\ifcase 2 \relax zero \or one \or two \else else \fi = two \par

```

```

\unless\ifcase 1 \relax zero \or one \or two \else else \fi % warning
\unless\ifcase 2 \relax zero \or one \or two \else else \fi % warning

```

```

\ifchkdim1pt\or yes \else nop \fi = yes \par
\ifchkdim2 \or nop \else yes \fi = yes \par

```

```

\unless\ifchkdim1pt\or nop \else yes \fi = yes \par
\unless\ifchkdim2 \or yes \else nop \fi = yes \par

```

The `\ifchkdim`, `\ifchkdimension`, `\ifchknum`, `\ifchknumber` and `\ifparameter` are supported.

```

one = one
two = two
one two
yes = yes
yes = yes
yes = yes
yes = yes

```

4 Lua_TE_X primitives

4.1 `\ifincsname`

As it had no real practical usage it might get dropped in LuaMeta_TE_X, so it will not be discussed here.

4.2 `\ifprimitive`

As it had no real practical usage due to limitations, this one is not available in LuaMeta_TE_X so it will not be discussed here. If really needed you can use `\ifflags`.

4.3 `\ifabsnum`

This test is inherited from pdf_TE_X and behaves like `\ifnum` but first turns a negative number into a positive one.

4.4 `\ifabsdim`

This test is inherited from pdf_TE_X and behaves like `\ifdim` but first turns a negative dimension into a positive one.

4.5 `\ifcondition`

This is not really a test but in order to unstand that you need to know how _TE_X internally deals with tests.

```
\ifdimen\scratchdimen>10pt
  \ifdim\scratchdimen<20pt
    result a
  \else
    result b
  \fi
\else
  result c
\fi
```

When we end up in the branch of “result a” we need to skip two `\else` branches after we're done. The `\if..` commands increment a level while the `\fi` decrements a level.

The `\else` needs to be skipped here. In other cases the true branch needs to be skipped till we end up at the right `\else`. When doing this skipping, \TeX is not interested in what it encounters beyond these tokens and this skipping (therefore) goes real fast but it does see nested conditions and doesn't interpret grouping related tokens.

A side effect of this is that the next is not working as expected:

```
\def\ifmorethan{\ifdim\scratchdimen>}
\def\iflessthan{\ifdim\scratchdimen<}

\ifmorethan10pt
  \iflessthan20pt
    result a
  \else
    result b
  \fi
\else
  result c
\fi
```

The `\iflessthan` macro is not seen as an `\if...` so the nesting gets messed up. The solution is to fool the scanner in thinking that it is. Say we have:

```
\scratchdimen=25pt

\def\ifmorethan{\ifdim\scratchdimen>}
\def\iflessthan{\ifdim\scratchdimen<}
```

and:

```
\ifcondition\ifmorethan10pt
  \ifcondition\iflessthan20pt
    result a
  \else
    result b
  \fi
\else
  result c
\fi
```

When we expand this snippet we get: “result b” and no error concerning a failure in locating the right `\fi`'s. So, when scanning the `\ifcondition` is seen as a valid

`\if...` but when the condition is really expanded it gets ignored and the `\ifmorethan` has better come up with a match or not.

In this perspective it is also worth mentioning that nesting problems can be avoided this way:

```
\def\WhenTrue {something \iftrue ...}
\def\WhenFalse{something \iffalse ...}

\ifnum\scratchcounter>123
  \let\next\WhenTrue
\else
  \let\next\WhenFalse
\fi
\next
```

This trick is mentioned in The \TeX book and can also be found in the plain \TeX format. A variant is this:

```
\ifnum\scratchcounter>123
  \expandafter\WhenTrue
\else
  \expandafter\WhenFalse
\fi
```

but using `\expandafter` can be quite intimidating especially when there are multiple in a row. It can also be confusing. Take this: an `\ifcondition` expects the code that follows to produce a test. So:

```
\def\ifwhatever#1%
  {\ifdim#1>10pt
   \expandafter\iftrue
  \else
   \expandafter\iffalse
  \fi}

\ifcondition\ifwhatever{10pt}
  result a
\else
  result b
\fi
```

This will not work! The reason is in the already mentioned fact that when we end up in the greater than 10pt case, the scanner will happily push the `\iftrue` after the `\fi`, which is okay, but when skipping over the `\else` it sees a nested condition without matching `\fi`, which makes it fail. I will spare you a solution with lots of nasty tricks, so here is the clean solution using `\ifcondition`:

```
\def\truecondition {\iftrue}
\def\falsecondition{\iffalse}

\def\ifwhatever#1%
  {\ifdim#1>10pt
   \expandafter\truecondition
  \else
   \expandafter\falsecondition
  \fi}

\ifcondition\ifwhatever{10pt}
  result a
\else
  result b
\fi
```

It will be no surprise that the two macros at the top are predefined in `ConTeXt`. It might be more of a surprise that at the time of this writing the usage in `ConTeXt` of this `\ifcondition` primitive is rather minimal. But that might change.

As a further teaser I'll show another simple one,

```
\def\HowOdd#1{\unless\ifnum\numexpr ((#1):2)*2\relax=\numexpr#1\relax}

\ifcondition\HowOdd{1}very \else not so \fi odd
\ifcondition\HowOdd{2}very \else not so \fi odd
\ifcondition\HowOdd{3}very \else not so \fi odd
```

This renders:

```
very odd
not so odd
very odd
```

The code demonstrates several tricks. First of all we use `\numexpr` which permits more complex arguments, like:

```
\ifcondition\HowOdd{4+1}very \else not so \fi odd
```

```
\ifcondition\HowOdd{2\scratchcounter+9}very \else not so \fi odd
```

Another trick is that we use an integer division (the `:`) which is an operator supported by LuaMetaTeX.

5 LuaMetaTeX primitives

5.1 `\ifnum` and `ifdim`

These have been extended with a few more operators. For instance, we can use a negation:

```
\ifnum 10 > 5 Y\else N\fi
\ifnum 10 !> 5 Y\else N\fi
```

Results in: YN. A bitwise comparison is possible too:

```
\ifnum "02 & 2 Y\else N\fi
\ifnum "02 & 4 Y\else N\fi
\ifnum "02 !& 8 Y\else N\fi
```

yields: YNY. You can also use the Unicode variants `€`, `ℳ`, `≠`, `≤`, `≥`, `≠`, and `≠`.

5.2 `\iffloat`

This is a test for a float, much like a test for a dimen without unit.

5.3 `\ifabsfloat`

This is a test for a float, much like a test for a dimen without unit.

5.4 `\ifintervalnum`

This is a test for equality of two numbers within an interval, as in:

```
\ifintervalnum 1 2 1 Y\else N\fi
\ifintervalnum 1 3 1 Y\else N\fi
\ifintervalnum 100 102 1 Y\else N\fi
\ifintervalnum 100 102 3 Y\else N\fi
```

which results in: YNNY.

5.5 `\ifintervaldim`

This is a test for equality of two dimensions within an interval, as in:

```
\ifintervaldim 1pt 2pt 1pt Y\else N\fi
\ifintervaldim 1pt 3pt 1pt Y\else N\fi
\ifintervaldim 100pt 102pt 1pt Y\else N\fi
\ifintervaldim 100pt 102pt 3pt Y\else N\fi
```

We get: YNNY.

5.6 `\ifintervalfloat`

This is a test for a float, much like a test for a `dimen` without unit.

5.7 `\ifdimexpression`

This is a boolean checker so the comparison is done as part of the expression, as in:

```
\ifdimexpression{10pt > (4pt + 8pt)}Y\else N\fi
```

5.8 `\ifnumexpression`

This is a boolean checker so the comparison is done as part of the expression, as in:

```
\ifnumexpression{10 > (4 + 8)}Y\else N\fi
```

5.9 `\ifcmpnum`

This one is part of a set of three tests that all are a variant of a `\ifcase` test. A simple example of the first test is this:

```
\ifcmpnum 123 345 less \or equal \else more \fi
```

The test scans for two numbers, which of course can be registers or expressions, and sets the case value to 0, 1 or 2, which means that you then use the normal `\or` and `\else` primitives for follow up on the test.

5.10 `\ifchknum`

This test scans a number and when it's okay sets the case value to 1, and otherwise to 2. So you can do the next:

```
\ifchknum 123\or good \else bad \fi
\ifchknum bad\or good \else bad \fi
```

An error message is suppressed and the first `\or` can be seen as a sort of recovery token, although in fact we just use the fast scanner mode that comes with the `\ifcase`: because the result is 1 or 2, we never see invalid tokens.

In order to avoid another scan the a valid result it is made available in `\lastchknumber`.

5.11 `\ifchknumber`

This one is a more rigorous variant of `\ifchknum` and doesn't like trailing non numeric crap.

5.12 `\ifchknumexpr`

This test goes a bit further and accepts an expression.

```
\ifchknumexpr 123 + 45\or good \else bad \fi
```

As with the other checkers, if there is a valid result it is available in `\lastchknumber`.

5.13 `\ifnumval`

A sort of combination of the previous two is `\ifnumval` which checks a number but also if it's less, equal or more than zero:

```
\ifnumval 123\or less \or equal \or more \else error \fi
\ifnumval bad\or less \or equal \or more \else error \fi
```

You can decide to ignore the bad number or do something that makes more sense. Often the to be checked value will be the content of a macro or an argument like `#1`.

5.14 `\ifcmpdim`

This test is like `\ifcmpnum` but for dimensions.

5.15 `\ifchkdim`

This test is like `\ifchknum` but for dimensions. The last checked value is available as `\lastchknumber`.

5.16 `\ifchkdimension`

This one is a more rigorous variant of `\ifchkdim` and doesn't like trailing rubbish.

5.17 `\ifchkdimexpr`

This test is like `\ifchknumexpr` but for dimensions. The last checked value is available as `\lastchkdimension`.

5.18 `\ifdimval`

This test is like `\ifnumval` but for dimensions. The last checked value is available as `\lastchkdim`

5.19 `\iftok`

Although this test is still experimental it can be used. What happens is that two to be compared ‘things’ get scanned for. For each we first gobble spaces and `\relax` tokens. Then we can have several cases:

1. When we see a left brace, a list of tokens is scanned up to the matching right brace.
2. When a reference to a token register is seen, that register is taken as value.
3. When a reference to an internal token register is seen, that register is taken as value.
4. When a macro is seen, its definition becomes the to be compared value.
5. When a number is seen, the value of the corresponding register is taken

An example of the first case is:

```
\iftok {abc} {def}%
...
\else
...
\fi
```

The second case goes like this:

```
\iftok\scratchtoksone\scratchtokstwo
...
\else
...
\fi
```

Case one and four mixed:

```
\iftok{123}\TempX
...
\else
...
\fi
```

The last case is more a catch: it will issue an error when no number is given. Eventually that might become a bit more clever (depending on our needs.)

5.20 \ifzeronum, \ifzerodim, \ifzerofloat

The names of these three tells what they do: checking for a zero value.

```
(\ifzerodim 10pt\norelax A\orelse\ifzerodim 0pt\norelax B\else C\fi)
(\ifzeronum 10 \norelax A\orelse\ifzeronum 0 \norelax B\else C\fi)
(\ifzerofloat 10.0\norelax A\orelse\ifzerofloat 0.0\norelax B\else C\fi)
```

Here we use the `\norelax` to get rid of trailing spaces: (B) (B) (B).

5.21 \ifhaschar, \ifhastok, \ifhastoks, \ifhasxtoks

These checkers can be used to identify a (sequence) of token(s) in a given token list. Their working can best be shown with a few examples:

```
\ifhaschar c {abcd}Y\else N\fi
\ifhastok c {abcd}Y\else N\fi
\ifhastoks {c}{abcd}Y\else N\fi
\ifhasxtoks {c}{abcd}Y\else N\fi

\def\abcd{abcd}

\ifhaschar c {\abcd}Y\else N\fi
\ifhastok c {\abcd}Y\else N\fi
\ifhastoks {c}{\abcd}Y\else N\fi
\ifhasxtoks {c}{\abcd}Y\else N\fi

\ifhaschar c {a{bc}d}Y\else N\fi
\ifhastok c {a{bc}d}Y\else N\fi
\ifhastoks {c}{a{bc}d}Y\else N\fi
\ifhasxtoks {c}{a{bc}d}Y\else N\fi
```

```
\def\abcd{a{bc}d}
```

```
\ifhaschar c {\abcd}Y\else N\fi
```

```
\ifhastok c {\abcd}Y\else N\fi
```

```
\ifhastoks {c}{\abcd}Y\else N\fi
```

```
\ifhasxtoks {c}{\abcd}Y\else N\fi
```

YYYY

NNNY

NYYY

NNNY

The `\ifhaschar` test will not descend into a braced sublist. The `x` variants expand the list before comparison.

5.22 `\ifcstok`

There is a subtle difference between this one and `\iftok`: spaces and `\relax` tokens are skipped but nothing gets expanded. So, when we arrive at the to be compared ‘things’ we look at what is there, as-is.

5.23 `\iffrozen`

This is an experimental test. Commands can be defined with the `\frozen` prefix and this test can be used to check if that has been the case.

5.24 `\ifprotected`

Commands can be defined with the `\protected` prefix (or in `ConTeXt`, for historic reasons, with `\unexpanded`) and this test can be used to check if that has been the case.

5.25 `\ifarguments`

This conditional can be used to check how many arguments were matched. It only makes sense when used with macros defined with the `\tolerant` prefix and/or when the sentinel `\ignorearguments` after the arguments is used. More details can be found in the lowlevel macros manual.

5.26 `\ifrelax`

The following tests all return the same: YYY; it is a shortcut for `\ifx ... \relax` that looks nicer in code.

```

\ifrelax\relax           Y\else N\fi
\ifrelax\norelax        Y\else N\fi
\expandafter\ifrelax\c
sname ReLaX\endcsname Y\else N\fi

```

5.27 `\ifempty`

This is again a shortcut, this time for `\ifx ... \empty` assuming that `\empty` is defined as being nothing. Instead of a token you can also pass a list, so here we get YNY.

```

\ifempty{}              Y\else N\fi
\ifempty{!}            Y\else N\fi
\ifempty\empty         Y\else N\fi

```

5.28 `\iflastnamedcs`

This test is part of the `\cscname` repertoire and uses the last valid result from such a command.

```

\def\Hello{upper}
\def\hello{lower}
\ifcscname Hello\endcsname
  \iflastnamedcs\hello
    world
  \orelse\iflastnamedcs\Hello
    World
\fi
\fi

```

Here the ‘Hello’ test result in ‘World’. It is an example of a follow up test, most likely used in user interfacing.

5.29 `\ifboolean`

Another new one is the following: it tests a number for being zero or not. As with any primitive that scans for a number, it accepts a braced expression too.

```
(\ifboolean 0 T\else F\fi)
(\ifboolean 1 T\else F\fi)
(\ifboolean {(2 * 4) < 5} T\else F\fi)
(\ifboolean \dimexpression{(1em > 20pt) or (1ex > 15pt)} T\else F\fi)
(\ifboolean \dimexpression{(1em > 3pt) and (1ex < 3pt)} T\else F\fi)
```

We get: (F) (T) (F) (F) (F).

5.30 \iflist

The `\ifvoid` test doesn't really test for a box being empty, which is why we have an additional primitive. Compare the following:

```
\setbox0\hbox{}
\setbox2\hbox{!}
\setbox4\emptybox % \box\voidbox
\setbox8\box6

\wd0 10pt \wd2 10pt \wd4 10pt \wd6 10pt

[\ifvoid0 Y\else N\fi \iflist0 Y\else N\fi \the\wd0] % empty hbox
[\ifvoid2 Y\else N\fi \iflist2 Y\else N\fi \the\wd2] % hbox with content
[\ifvoid4 Y\else N\fi \iflist4 Y\else N\fi \the\wd4] % no box
[\ifvoid6 Y\else N\fi \iflist6 Y\else N\fi \the\wd6] % no box
```

The result demonstrates that we check if there is any content at all, independent of dimensions or the presence of a wrapping list node.

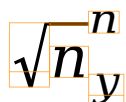
```
[NN10.0pt] [NY10.0pt] [YN0.0pt] [YN0.0pt]
```

5.31 \ifcramped

This test relates to math and in particular to four of the eight states:

```
\im {
  \sqrt
    {\ifcramped\mathstyle y\else n\fi}
  ^ {\ifcramped\mathstyle y\else n\fi}
  _ {\ifcramped\mathstyle y\else n\fi}
}
```

Because a math formula is first read and then processed in several passes you need to be aware of this state not always being easily predictable because there can be a delay between that read and successive treatments.



5.32 `\ifmathparameter`

The next example demonstrates what this test provides:

```
\ifmathparameter\Umathextrasubspace \displaystyle zero\or set\else
unset\fi]
```

```
\ifmathparameter\Umathaccentbaseheight\displaystyle zero\or set\else
unset\fi]
```

```
\ifmathparameter\Umathaccentbasedepth \displaystyle zero\or set\else
unset\fi]
```

There are three possible outcomes; here we get: [zero] [set] [set]. In LuaMetaT_EX we have more math parameters than in LuaT_EX, and some are set in font specific so called ‘goodie’ files.

5.33 `\ifmathstyle`

Here you need to keep in mind that you test the style that is set when T_EX scans for formula. Processing happens afterwards and then styles can change.

```
{\ifmathstyle D\or D'\or T\or T'\or S\or S'\or SS\or SS'\else ?\fi}
\im{\ifmathstyle D\or D'\or T\or T'\or S\or S'\or SS\or SS'\else ?\fi}
\dm{\ifmathstyle D\or D'\or T\or T'\or S\or S'\or SS\or SS'\else ?\fi}
```

We get: ? T D. The odd values are cramped.

5.34 `\iffinalignment`

This test is an experimental one:

```
\halign \bgroup
\aligncontent
\aligntab
\aligncontent
```

```

\cr
one \aligntab \ifalignment two\else three\fi \cr
\noalign{\ifalignment yes\else no\fi}
one \aligntab \hbox{\ifalignment two\else three\fi} \cr
\egroup

\hbox{\ifalignment two\else three\fi}

```

We get:

```

one two
yes
one two
three

```

5.35 \ifinsert

This primitive checks if an insert box has content. Usage depends on the macro package so for instance in ConT_EXt, after `\footnote{A note.}` you can actually check it with:

```

\setupheadertexts[\ifinsert\namedinsertionnumber{footnote} Y\else N\fi]

```

You pass the number of a insert class and in this example the content, set by the page builder, hasn't yet been flushed.

5.36 \ifflags

This one related to interfacing. When a macro is defined, one can apply several prefixes to that macro. Some of these prefixes result in a specific kind of macro, for instance a protected, tolerant, tolerant protected, or regular macro. When a macro is defined global, its (internal) level value indicates that. In addition macros, or actually any control sequence, also the built-in ones, can have a set of flags. Some, have consequences in the engine, so for instance an untraced macro will present itself as a primitive, without details that clutter a log. Other flags get meaning when the overload protection mechanisms are enabled.

Testing flags can give some insight but in ConT_EXt there is little reason to use this test other than for illustrative purposes. Take this definition

```

\global\protected\def\Foo{Foo}

```

This macro is internally represented as follows; here we used `\meaning` is:

```
\global \protected \def \Foo {Foo}
```

When we use `\meaning` we get:

```
protected macro:Foo
```

With `\meaningfull` we get:

```
global protected macro:Foo
```

Here is how you can test what properties and flags are set.

```
\ifflags\Foo\global    global    \fi
\ifflags\Foo\protected protected \fi
\ifflags\Foo\tolerant  tolerant  \fi
```

We only show a few tests here:

```
global protected
```

Instead of a prefix you can also pass a number:

```
\ifflags\relax\primitiveflagcode primitive \fi
\ifflags\relax\permanentflagcode permanent \fi
```

```
primitive
```

In `ConTEXt` many macros are defined as permanent which in terms of overload protection has the same impact. Relevant flag values are available in `tex.getflagvalues()` but in `ConTEXt` we prefer predefined constants:

```
\aliasedflagcode, \conditionalflagcode, \constantflagcode, \deferredflagcode,
\frozenflagcode, \globalflagcode, \immediateflagcode, \immutableflagcode,
\inheritedflagcode, \instanceflagcode, \mutableflagcode, \noalignedflagcode,
\overloadedflagcode, \permanentflagcode, \primitiveflagcode, \protectedflagcode,
\semiprotectedflagcode, \tolerantflagcode, \untracedflagcode, \valueflagcode
```

5.37 `\ifparameters`

This is an `\ifcase` where the number is the number of parameters passed to the current macro. Of course, when used in a macro one should be aware of the fact that another macro call will change this number.

5.38 `\ifparameter`

This test checks if a parameter has been set, and it's used as follows:

```
\ifparameter#4\or set\else unset\fi
```

because `#4` is actually a reference it refers to the parameter in the current macro and is not influenced by nested macro calls which makes it more reliable than a `\ifparameters` test.

5.39 `\orelse`

This is not really a test primitive but it does act that way. Say that we have this:

```
\ifdim\scratchdimen>10pt
  case 1
\else\ifdim\scratchdimen<20pt
  case 2
\else\ifcount\scratchcounter>10
  case 3
\else\ifcount\scratchcounter<20
  case 4
\fi\fi\fi\fi
```

A bit nicer looks this:

```
\ifdim\scratchdimen>10pt
  case 1
\orelse\ifdim\scratchdimen<20pt
  case 2
\orelse\ifcount\scratchcounter>10
  case 3
\orelse\ifcount\scratchcounter<20
  case 4
\fi
```

We stay at the same level. Sometimes a more flat test tree had advantages but if you think that it gives better performance then you will be disappointed. The fact that we stay at the same level is compensated by a bit more parsing, so unless you have millions such cases (or expansions) it might make a bit of a difference. As mentioned, I'm a bit sensitive for how code looks so that was the main motivation for introducing it. There is a companion `\orunless` continuation primitive.

A rather neat trick is the definition of `\quitcondition`:

```
\def\quitcondition{\orelse\iffalse}
```

This permits:

```
\ifdim\scratchdimen>10pt  
  case 1a  
  \quitcondition  
  case 4b  
\fi
```

where, of course, the quitting normally is the result of some intermediate extra test. But let me play safe here: beware of side effects.

5.40 `\orunless`

This is the negated variant of `\orelse`.

6 For the brave

6.1 Full expansion

If you don't understand the following code, don't worry. There is seldom much reason to go this complex but obscure T_EX code attracts some users so ...

When you have a macro that has for instance assignments, and when you expand that macro inside an `\edef`, these assignments are not actually expanded but tokenized. In LuaMetaT_EX there is a way to apply these assignments without side effects and that feature can be used to write a fully expandable user test. For instance:

```
\def\truecondition {\iftrue}  
\def>falsecondition{\iffalse}  
  
\def\fontwithidhaschar#1#2%  
  {\beginlocalcontrol  
    \scratchcounter\numexpr\fontid\font\relax  
    \setfontid\numexpr#1\relax  
    \endlocalcontrol  
    \iffontchar\font\numexpr#2\relax  
    \beginlocalcontrol
```

```

\setfontid\scratchcounter
\endlocalcontrol
\expandafter\truecondition
\else
\expandafter\falsecondition
\fi}

```

The `\iffontchar` test doesn't handle numeric font id, simply because at the time it was added to ε -TeX, there was no access to these id's. Now we can do:

```

\edef\foo{\fontwithidhaschar{1} {75}yes\else nop\fi} \meaning\foo
\edef\foo{\fontwithidhaschar{1}{999}yes\else nop\fi} \meaning\foo

[\ifcondition\fontwithidhaschar{1} {75}yes\else nop\fi]
[\ifcondition\fontwithidhaschar{1}{999}yes\else nop\fi]

```

These result in:

```

macro:yes
macro:nop

```

```

[yes]
[nop]

```

If you remove the `\immediateassignment` in the definition above then the typeset results are still the same but the meanings of `\foo` look different: they contain the assignments and the test for the character is actually done when constructing the content of the `\edef`, but for the current font. So, basically that test is now useless.

6.2 User defined if's

There is a `\newif` macro that defines three other macros:

```

\newif\ifOnMyOwnTerms

```

After this, not only `\ifOnMyOwnTerms` is defined, but also:

```

\OnMyOwnTermstrue
\OnMyOwnTermsfalse

```

These two actually are macros that redefine `\ifOnMyOwnTerms` to be either equivalent to `\iftrue` and `\iffalse`. The (often derived from plain TeX) definition of `\newif` is a

bit if a challenge as it has to deal with removing the `if` in order to create the two extra macros and also make sure that it doesn't get mixed up in a catcode jungle.

In ConTEXt we have a variant:

```
\newconditional\MyConditional
```

that can be used with:

```
\settrue\MyConditional
\setfalse\MyConditional
```

and tested like:

```
\ifconditional\MyConditional
...
\else
...
\fi
```

This one is cheaper on the hash and doesn't need the two extra macros per test. The price is the use of `\ifconditional`, which is *not* to confused with `\ifcondition` (it has bitten me already a few times).

7 Relaxing

When TEX scans for a number or dimension it has to check tokens one by one. On the case of a number, the scanning stops when there is no digit, in the case of a dimension the unit determine the end of scanning. In the case of a number, when a token is not a digit that token gets pushed back. When digits are scanned a trailing space or `\relax` is pushed back. Instead of a number of dimension made from digits, periods and units, the scanner also accepts registers, both the direct accessors like `\count` and `\dimen` and those represented by one token. Take these definitions:

```
\newdimen\MyDimenA \MyDimenA=1pt \dimen0=\MyDimenA
\newdimen\MyDimenB \MyDimenB=2pt \dimen2=\MyDimenB
```

I will use these to illustrate the side effects of scanning. Watch the spaces in the result.

First I show what effect we want to avoid. When second argument contains a number (digits) the zero will become part of it so we actually check `\dimen00` here.

```
\def\whatever#1#2%
```

```
{\ifdim#1=#2\else1\fi}
```

```
\whatever{1pt}{2pt}          [macro:1]
\whatever{1pt}{1pt}          [macro:0]
\whatever{\dimen 0}{\dimen 2} [macro:1]
\whatever{\dimen 0}{\dimen 0} [macro:]
\whatever\MyDimenA\MyDimenB  [macro:1]
\whatever\MyDimenA\MyDimenB  [macro:1]
```

The solution is to add a space but watch how that one can end up in the result:

```
\def\whatever#1#2%
  {\ifdim#1=#2 \relax\else1\fi}
```

```
\whatever{1pt}{2pt}          [macro:1]
\whatever{1pt}{1pt}          [macro:0]
\whatever{\dimen 0}{\dimen 2} [macro:1]
\whatever{\dimen 0}{\dimen 0} [macro:0]
\whatever\MyDimenA\MyDimenB  [macro:1]
\whatever\MyDimenA\MyDimenB  [macro:1]
```

A variant is using `\relax` and this time we get this token retained in the output.

```
\def\whatever#1#2%
  {\ifdim#1=#2\relax\else1\fi}
```

```
\whatever{1pt}{2pt}          [macro:1]
\whatever{1pt}{1pt}          [macro:\relax 0]
\whatever{\dimen 0}{\dimen 2} [macro:1]
\whatever{\dimen 0}{\dimen 0} [macro:\relax 0]
\whatever\MyDimenA\MyDimenB  [macro:1]
\whatever\MyDimenA\MyDimenB  [macro:1]
```

A solution that doesn't have side effects of forcing the end of a number (using a space or `\relax` is one where we use expressions. The added overhead of scanning expressions is taken for granted because the effect is what we like:

```
\def\whatever#1#2%
  {\ifdim\dimexpr#1\relax=\dimexpr#2\relax\else1\fi}
```

```
\whatever{1pt}{2pt}          [macro:1]
\whatever{1pt}{1pt}          [macro:0]
\whatever{\dimen 0}{\dimen 2} [macro:1]
```

```

\whatever{\dimen 0}{\dimen 0} [macro:0]
\whatever\MyDimenA\MyDimenB [macro:1]
\whatever\MyDimenA\MyDimenB [macro:1]

```

Just for completeness we show a more obscure trick: this one hides assignments to temporary variables. Although performance is okay, it is the least efficient one so far.

```

\def\whatever#1#2%
  {\beginlocalcontrol
   \MyDimenA#1\relax
   \MyDimenB#2\relax
  \endlocalcontrol
  \ifdim\MyDimenA=\MyDimenB0\else1\fi}

\whatever{1pt}{2pt} [macro:1]
\whatever{1pt}{1pt} [macro:0]
\whatever{\dimen 0}{\dimen 2} [macro:1]
\whatever{\dimen 0}{\dimen 0} [macro:0]
\whatever\MyDimenA\MyDimenB [macro:1]
\whatever\MyDimenA\MyDimenB [macro:1]

```

It is kind of a game to come up with alternatives but for sure those involve dirty tricks and more tokens (and runtime). The next can be considered a dirty trick too: we use a special variant of `\relax`. When a number is scanned it acts as `\relax`, but otherwise it just is ignored and disappears.

```

\def\whatever#1#2%
  {\ifdim#1=#2\norelax0\else1\fi}

\whatever{1pt}{2pt} [macro:1]
\whatever{1pt}{1pt} [macro:0]
\whatever{\dimen 0}{\dimen 2} [macro:1]
\whatever{\dimen 0}{\dimen 0} [macro:0]
\whatever\MyDimenA\MyDimenB [macro:1]
\whatever\MyDimenA\MyDimenB [macro:1]

```

7 Colofon

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