new primitives

in luametatex

Introduction

Here I will discuss some of the new primitives in LuaTEX and LuaMetaTEX, the later being a successor that permits the ConTEXt folks to experiment with new features. The order is arbitrary. When you compare LuaTEX with pdfTEX, there are actually quite some differences. Some primitives that pdfTEX introduced have been dropped in LuaTEX because they can be done better in Lua. Others have been promoted to core primitives that no longer have a `pdf` prefix. Then there are lots of new primitives, some introduce new concepts, some are a side effect of for instance new math font technologies, and then there are those that are handy extensions to the macro language. The LuaMetaTEX engine drops quite some primitives, like those related to pdfTEX specific f(r)ont or backend features. It also adds some new primitives, mostly concerning the macro language.

We also discuss the primitives that fit into the macro programming scope that are present in traditional TEX and ε-TEX but there are for sure better of explanations out there already. Primitives that relate to typesetting, like those controlling math, fonts, boxes, attributes, directions, catcodes, Lua (functions) etc are not discussed or discussed in less detail here.

There are for instance primitives to create aliases to low level registers like counters and dimensions, as well as other (semi-numeric) quantities like characters, but normally these are wrapped into high level macros so that definitions can't clash too much. Numbers, dimensions etc can be advanced, multiplied and divided and there is a simple expression mechanism to deal with them. We don't go into these details here: it's mostly an overview of what the engine provides. If you are new to TEX, you need to play a while with its mixed bag of typesetting and programming features in order to understand the difference between this macro language and other languages you might be familiar with.

In this document the section titles that discuss the original TEX and ε-TEX primitives have a different color those explaining the LuaTEX and LuaMetaTEX primitives.

Primitives that extend typesetting related functionality, provide control over subsystems (like math), allocate additional data types and resources, deal with fonts and languages, manipulate boxes and glyphs, etc. are hardly discussed here, only mentioned. Math for instance is a topic of its own. In this document we concentrate on the programming aspects.

Most of the new primitives are discussed in specific manuals and often also original primitives are covered there but the best explanations of the traditional primitives can be found in The TEXbook by Donald Knuth and TEX by Topic from Victor Eijkhout. I see no need to try to improve on those.

Primitives

1 \<space>

This original TEX primitive is equivalent to the more verbose `\explicitspace`.

2 \-

This original TEX primitive is equivalent to the more verbose `\explicitdiscretionary`.

3 \/

This original TEX primitive is equivalent to the more verbose `\explicititaliccorrection`.

4 \above

This is a variant of `\over` that doesn't put a rule in between.

5 \abovedisplayshortskip

The glue injected before a display formula when the line above it is not overlapping with the formula. Watch out for interference with `\baselineskip`. It can be controlled by `\displayskipmode`.

6 \abovedisplayskip

The glue injected before a display formula. Watch out for interference with `\baselineskip`. It can be controlled by `\displayskipmode`.

7 \abovewithdelims

This is a variant of `\atop` but with delimiters. It has a more advanced upgrade in `\Uabovewithdelims`.

8 \accent

This primitive is kind of obsolete in wide engines and takes two arguments: the indexes of an accent and a base character.

9 \additionalpageskip

This quantity will be added to the current page goal, stretch and shrink after which it will be set to zero.

10 \adjdemerits

When TEX considers to lines to be incompatible it will add this penalty to its verdict when considering this breakpoint.

11 \adjustspacing

This parameter controls expansion (hz). A value 2 expands glyphs and font kerns and a value of 3 only glyphs. Expansion of kerns can have side effects when they are used for positioning by OpenType features.

12 \adjustspacingshrink

When set to a non zero value this overloads the shrink maximum in a font when expansion is applied. This is then the case for all fonts.

13 \adjustspacingstep

When set to a non zero value this overloads the expansion step in a font when expansion is applied. This is then the case for all fonts.

14 \adjustspacingstretch

When set to a non zero value this overloads the stretch maximum in a font when expansion is applied. This is then the case for all fonts.

15 \advance

Advances the given register by an also given value:

```
\advance\scratchdimen      10pt
\advance\scratchdimen      by 3pt
\advance\scratchcounterone \zerocount
\advance\scratchcounterone \scratchcountertwo
```

The by keyword is optional.

16 \advanceby

This is slightly more efficient variant of \advance that doesn't look for by and therefore, if one is missing, doesn't need to push back the last seen token. Using \advance with by is nearly as efficient but takes more tokens.

17 \afterassigned

The \afterassignment primitive stores a token to be injected (and thereby expanded) after an assignment has happened. Unlike \aftergroup, multiple calls are not accumulated, and changing that would be too incompatible. This is why we have \afterassigned, which can be used to inject a bunch of tokens. But in order to be consistent this one is also not accumulative.

```
\afterassigned{done}%
\afterassigned{{\bf done}}%
\scratchcounter=123
```

results in: **done** being typeset.

18 \afterassignment

The token following \afterassignment, a traditional TEX primitive, is saved and gets injected (and then expanded) after a following assignment took place.

```
\afterassignment !\def\MyMacro {}\quad
\afterassignment !\let\MyMacro ?\quad
\afterassignment !\scratchcounter 123\quad
\afterassignment !%
\afterassignment ?\advance\scratchcounter by 1
```

The \afterassignments are not accumulated, the last one wins:

```
! ! ! ?
```

19 \aftergroup

The traditional TEX \aftergroup primitive stores the next token and expands that after the group has been closed.

Multiple \aftergroups are combined:

```
before{ ! \aftergroup a\aftergroup f\aftergroup t\aftergroup e\aftergroup r}
```

before ! after

20 \aftergrouped

The in itself powerful \aftergroup primitives works quite well, even if you need to do more than one thing: you can either use it multiple times, or you can define a macro that does multiple things and apply that after the group. However, you can avoid that by using this primitive which takes a list of tokens.

```
regular
\bgroup
\aftergrouped{regular}%
\bf bold
\egroup
```

Because it happens after the group, we're no longer typesetting in bold.

regular **bold** regular

21 \aliased

This primitive is part of the overload protection subsystem where control sequences can be tagged.

```
\permanent\def\foo{FOO}
          \let\ofo\foo
\aliased  \let\oof\foo

\meaningasis\foo
\meaningasis\ofo
\meaningasis\oof
```

gives:

```
\permanent \def \foo {FOO}
\def \ofo {FOO}
\permanent \def \oof {FOO}
```

When a something is \let the 'permanent', 'primitive' and 'immutable' flags are removed but the \aliased prefix retains them.

```
\let\relaxed\relax

\meaningasis\relax
\meaningasis\relaxed
```

So in this example the \relaxed alias is not flagged as primitive:

```
\primitive \relax
\relax
```

22 \aligncontent

This is equivalent to a hash in an alignment preamble. Contrary to \alignmark there is no need to duplicate inside a macro definition.

23 \alignmark

When you have the # not set up as macro parameter character cq. align mark, you can use this primitive instead. The same rules apply with respect to multiple such tokens in (nested) macros and alignments.

24 \alignmentcellsource

This sets the source id (a box property) of the current alignment cell.

25 \alignmentwrapsource

This sets the source id (a box property) of the current alignment row (in a \halign) or column (in a \valign).

26 \aligntab

When you have the & not set up as align tab, you can use this primitive instead. The same rules apply with respect to multiple such tokens in (nested) macros and alignments.

27 \allcrampedstyles

A symbolic representation of \crampeddisplaystyle, \crampedtextstyle, \crampedscriptstyle and \crampedscriptscriptstyle; integer representation: 17.

28 \alldisplaystyles

A symbolic representation of \displaystyle and \crampeddisplaystyle; integer representation: 8.

29 \allmainstyles

A symbolic representation of \displaystyle, \crampeddisplaystyle, \textstyle and \crampedtextstyle; integer representation: 13.

30 \allmathstyles

A symbolic representation of \displaystyle, \crampeddisplaystyle, \textstyle, \crampedtextstyle, \scriptstyle, \crampedscriptstyle, \scriptscriptstyle and \crampedscriptscriptstyle; integer representation: 12.

31 \allscriptscriptstyles

A symbolic representation of \scriptscriptstyle and \crampedscriptscriptstyle; integer representation: 11.

32 \allscriptstyles

A symbolic representation of \scriptstyle and \crampedscriptstyle; integer representation: 10.

33 \allsplitstyles

A symbolic representation of `\displaystyle` and `\textstyle` but not `\scriptstyle` and `\scriptscriptstyle`: set versus reset; integer representation: 14.

34 \alltextstyles

A symbolic representation of `\textstyle` and `\crampedtextstyle`; integer representation: 9.

35 \alluncrampedstyles

A symbolic representation of `\displaystyle`, `\textstyle`, `\scriptstyle` and `\scriptscriptstyle`; integer representation: 16.

36 \allunsplitstyles

A symbolic representation of `\scriptstyle` and `\scriptscriptstyle`; integer representation: 15.

37 \amcode

38 \associateunit

The TEX engine comes with some build in units, like `pt` (fixed) and `em` (adaptive). On top of that a macro package can add additional units, which is what we do in ConTEXt. In figure 1 we show the current repertoire.

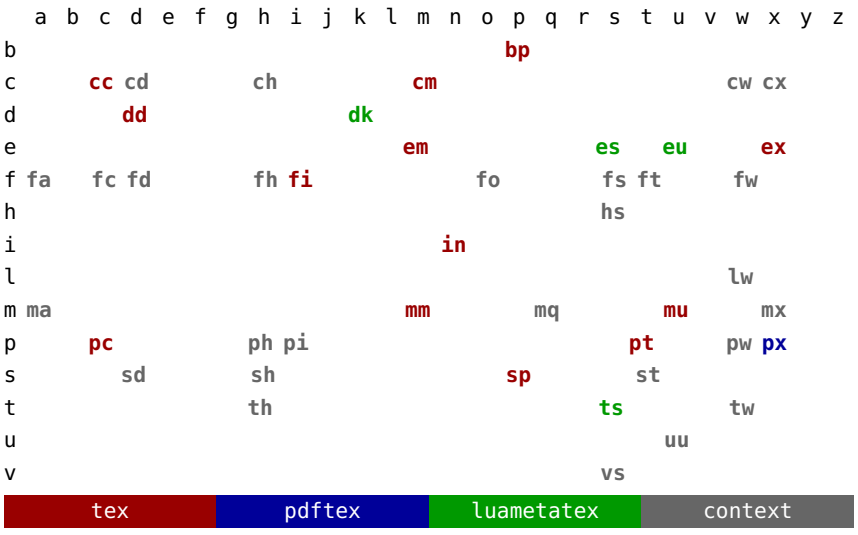


Figure 1 Available units

When this primitive is used in a context where a number is expected it returns the origin of the unit (in the color legend running from 1 upto 4). A new unit is defined as:

```
\newdimen\MyDimenZA  \MyDimenZA=10pt

\protected\def\MyDimenAB{\dimexpr\hsize/2\relax}
```

```
\associateunit za \MyDimenZA
\associateunit zb \MyMacroZB
```

Possible associations are: macros that expand to a dimension, internal dimension registers, register dimensions (`\dimendef`, direct dimensions (`\dimensiondef`) and Lua functions that return a dimension.

One can run into scanning ahead issues where TEX expects a unit and a user unit gets expanded. This is why for instance in ConTEXt we define the `ma` unit as:

```
\protected\def\mathaxisunit{\scaledmathaxis\mathstyle\norelax}

\associateunit ma \mathaxisunit % or \newuserunit \mathaxisunit ma
```

So that it can be used in rule specifications that themselves look ahead for keywords and therefore are normally terminated by a `\relax`. Adding the extra `\norelax` will make the scanner see one that doesn't get fed back into the input. Of course a macro package has to manage extra units in order to avoid conflicts.

39 \atendoffile

The `\everyeof` primitive is kind of useless because you don't know if a file (which can be a tokenlist processed as pseudo file) itself includes a file, which then results in nested application of this token register. One way around this is:

```
\atendoffile\SomeCommand
```

This acts on files the same way as `\atendofgroup` does. Multiple calls will be accumulated and are bound to the current file.

40 \atendoffiled

This is the multi token variant of `\atendoffile`. Multiple invocations are accumulated and by default prepended to the existing list. As with grouping this permits proper nesting. You can force an append by the optional keyword reverse.

41 \atendofgroup

The token provided will be injected just before the group ends. Because these tokens are collected, you need to be aware of possible interference between them. However, normally this is managed by the macro package.

```
\bgroup
\atendofgroup\unskip
\atendofgroup )%
(but it works okay
\egroup
```

Of course these effects can also be achieved by combining (extra) grouping with `\aftergroup` calls, so this is more a convenience primitives than a real necessity: (but it works okay), as proven here.

42 \atendofgrouped

This is the multi token variant of \atendofgroup. Of course the next example is somewhat naive when it comes to spacing and so, but it shows the purpose.

```
\bgroup
\atendofgrouped{\bf QED}%
\atendofgrouped{ (indeed)}%
This sometimes looks nicer.
\egroup
```

Multiple invocations are accumulated: This sometimes looks nicer. **QED (indeed)**.

43 \atop

This one stack two math elements on top of each other, like a fraction but with no rule. It has a more advanced upgrade in \Uatop.

44 \atopwithdelims

This is a variant of \atop but with delimiters. It has a more advanced upgrade in \Uatopwithdelims.

45 \attribute

The following sets an attribute(register) value:

```
\attribute 999 = 123
```

An attribute is unset by assigning -2147483647 to it. A user needs to be aware of attributes being used now and in the future of a macro package and setting them this way is very likely going to interfere.

46 \attributedef

This primitive can be used to relate a control sequence to an attribute register and can be used to implement a mechanism for defining unique ones that won't interfere. As with other registers: leave management to the macro package in order to avoid unwanted side effects!

47 \automaticdiscretionary

This is an alias for the automatic hyphen trigger -.

48 \automatichyphenpenalty

The penalty injected after an automatic discretionary -, when \hyphenationmode enables this.

49 \automigrationmode

This bitset determines what will bubble up to an outer level:

`0x01` mark
`0x02` insert
`0x04` adjust
`0x08` pre
`0x10` post

The current value is `0xFFFF`.

50 \autoparagraphmode

A paragraph can be triggered by an empty line, a `\par` token or an equivalent of it. This parameter controls how **`\par`** is interpreted in different scenarios:

`0x01` text
`0x02` macro
`0x04` continue

The current value is `0x1` and setting it to a non-zero value can have consequences for mechanisms that expect otherwise. The text option uses the same code as an empty line. The macro option checks a token in a macro preamble against the frozen `\`

token. The last option ignores the par token.

51 \badness

This one returns the last encountered badness value.

52 \baselineskip

This is the maximum glue put between lines. The depth of the previous and height of the next line are substracted.

53 \batchmode

This command disables (error) messages which can safe some runtime in situations where TEX's character-by-character log output impacts runtime. It only makes sense in automated workflows where one doesn't look at the log anyway.

54 \begincsname

The next code creates a control sequence token from the given serialized tokens:

```
\csname mymacro\endcsname
```

When `\mymacro` is not defined a control sequence will be created with the meaning `\relax`. A side effect is that a test for its existence might fail because it now exists. The next sequence will *not* create an controil sequence:

```
\begincsname mymacro\endcsname
```

This actually is kind of equivalent to:

```
\ifcsname mymacro\endcsname
    \csname mymacro\endcsname
\fi
```

55 \begingroup

This primitive starts a group and has to be ended with `\endgroup`. See `\beginsimplegroup` for more info.

56 \beginlocalcontrol

Once TEX is initialized it will enter the main loop. In there certain commands trigger a function that itself can trigger further scanning and functions. In LuaMetaTEX we can have local main loops and we can either enter it from the Lua end (which we don't discuss here) or at the TEX end using this primitive.

```
\scratchcounter100

\edef\whatever{
    a
    \beginlocalcontrol
        \advance\scratchcounter 10
        b
    \endlocalcontrol
    \beginlocalcontrol
        c
    \endlocalcontrol
    d
    \advance\scratchcounter 10
}

\the\scratchcounter
\whatever
\the\scratchcounter
```

A bit of close reading probably gives an impression of what happens here:

b c

110 a d 120

The local loop can actually result in material being injected in the current node list. However, where normally assignments are not taking place in an `\edef`, here they are applied just fine. Basically we have a local TEX job, be it that it shares all variables with the parent loop.

57 \beginmathgroup

In math mode grouping with `\begingroup` and `\endgroup` in some cases works as expected, but because the math input is converted in a list that gets processed later some settings can become persistent, like changes in style or family. The engine therefore provides the alternatives `\beginmathgroup` and `\endmathgroup` that restore some properties.

58 \beginsimplegroup

The original TEX engine distinguishes two kind of grouping that at the user end show up as:

```
\begingroup \endgroup
\bgroup \egroup { }
```

where the last two pairs are equivalent unless the scanner explicitly wants to see a left and/or right brace and not an equivalent. For the sake of simplify we use the aliases here. It is not possible to mix these pairs, so:

```
\bgroup xxx\endgroup
\begingroup xxx\egroup
```

will in both cases issue an error. This can make it somewhat hard to write generic grouping macros without somewhat dirty trickery. The way out is to use the generic group opener `\beginsimplegroup`.

Internally LuaMetaTEX is aware of what group it currently is dealing with and there we distinguish:

simple group	`\bgroup`	`\egroup`
semi simple group	`\begingroup`	`\endgroup` `\endsimplegroup`
also simple group	`\beginsimplegroup`	`\egroup` `\endgroup` `\endsimplegroup`
math simple group	`\beginmathgroup`	`\endmathgroup`

This means that you can say:

```
\beginsimplegroup xxx\endsimplegroup
\beginsimplegroup xxx\endgroup
\beginsimplegroup xxx\egroup
```

So a group started with `\beginsimplegroup` can be finished in three ways which means that the user (or calling macro) doesn't have take into account what kind of grouping was used to start with. Normally usage of this primitive is hidden in macros and not something the user has to be aware of.

59 \belowdisplayshortskip

The glue injected aftter a display formula when the line above it is not overlapping with the formula (TEX can't look ahead). Watch out for interference with `\baselineskip`. It can be controlled by `\displayskipmode`.

60 \belowdisplayskip

The glue injected after a display formula. Watch out for interference with `\baselineskip`. It can be controlled by `\displayskipmode`.

61 \binoppenalty

This internal quantity is a compatibility feature because normally we will use the inter atom spacing variables.

62 \botmark

This is a reference to the last mark on the current page, it gives back tokens.

63 \botmarks

This is a reference to the last mark with the given id (a number) on the current page, it gives back tokens.

64 \boundary

Boundaries are signals added to he current list. This primitive injects a user boundary with the given (integer) value. Such a boundary can be consulted at the Lua end or with `\lastboundary`.

65 \box

This is the box register accessor. While other registers have one property a box has many, like `\wd`, `\ht` and `\dp`. This primitive returns the box and resets the register.

66 \boxadapt

Adapting will recalculate the dimensions with a scale factor for the glue:

```
\setbox 0 \hbox       {test test test}
\setbox 2 \hbox {\red  test test test} \boxadapt 0  200
\setbox 4 \hbox {\blue test test test} \boxadapt 0 -200
\ruledhbox{\box0} \vskip-\lineheight
\ruledhbox{\box0} \vskip-\lineheight
\ruledhbox{\box0}
```

Like `\boxfreeze` and `\boxrepack` this primitive has been introduced for experimental usage, although we do use some in production code.
test test test

67 \boxanchor

This feature is part of an (experimental) mechanism that relates boxes. The engine just tags a box and it is up to the macro package to deal with it.

```
\setbox0\hbox anchor "01010202 {test}\tohexadecimal\boxanchor0
```

This gives: 1010202. Of course this feature is very macro specific and should not be used across macro packages without coordination. An anchor has two parts each not exceeding `0x0FFF`.

68 \boxanchors

This feature is part of an (experimental) mechanism that relates boxes. The engine just tags a box and it is up to the macro package to deal with it.

```
\setbox0\hbox anchors "0101 "0202 {test}\tohexadecimal\boxanchors0
```

This gives: 1010202. Of course this feature is very macro specific and should not be used across macro packages without coordination. An anchor has two parts each not exceeding `0x0FFF`.

69 \boxattribute

Every node, and therefore also every box gets the attributes set that are active at the moment of creation. Additional attributes can be set too:

```
\darkred
\setbox0\hbox attr 9999 1 {whatever}
\the\boxattribute 0 \colorattribute
\the\boxattribute 0 9998
\the\boxattribute 0 9999
```

A macro package should make provide a way define attributes that don't clash the ones it needs itself, like, in ConTEXt, the ones that can set a color

```
4
-2147483647
1
```

The number -2147483647 (-7FFFFFFF) indicates an unset attribute.

70 \boxdirection

The direction of a box defaults to `l2r` but can be explicitly set:

```
\setbox0\hbox direction 1 {this is a test}\textdirection1
\setbox2\hbox direction 0 {this is a test}\textdirection0
\the\boxdirection0: \box0
\the\boxdirection2: \box2
```

The `\textdirection` does not influence the box direction:

1: tset a si siht
0: this is a test

71 \boxfinalize

This is special version of `\boxfreeze` which we demonstrate with an example:

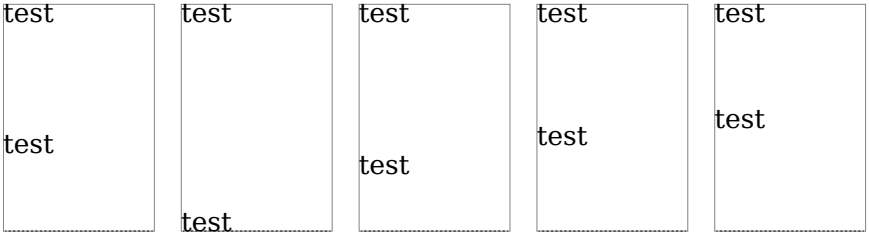
```
\boxlimitate 0 0   % don't recurse
\boxfreeze   2 0   % don't recurse
\boxfinalize 4 500 % scale glue multiplier by .50
\boxfinalize 6 250 % scale glue multiplier by .25
\boxfinalize 8 100 % scale glue multiplier by .10

\hpack\bgroup
    \copy0\quad\copy2\quad\copy4\quad\copy6\quad\copy8
```

```
\egroup
```

where the boxes are populated with:

```
\setbox0\ruledvbox to 3cm{\hsize 2cm test\vskip10pt plus 10pt test}
\setbox2\copy0\setbox4\copy0\setbox6\copy0\setbox8\copy0
```

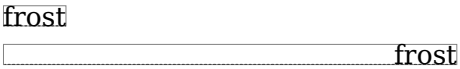


72 \boxfreeze

Glue in a box has a fixed component that will always be used and stretch and shrink that kicks in when needed. The effective value (width) of the glue is driven by some box parameters that are set by the packaging routine. This is why we can unbox: the original value is kept. It is the backend that calculates the effective value. Te `\boxfreeze` primitive can do the same: turn the flexible glue into a fixed one.

```
\setbox    0 \hbox to 6cm {\hss frost}
\setbox    2 \hbox to 6cm {\hss frost}
\boxfreeze 2 0
\ruledhbox{\unhbox 0}
\ruledhbox{\unhbox 2}
```

The second parameter to `\boxfreeze` determines recursion. We don't recurse here so just freeze the outer level:



73 \boxgeometry

A box can have an orientation, offsets and/or anchors. These are stored independently but for efficiency reasons we register if one or more of these properties is set. This primitive accesses this state; it is a bitset:

```
0x01  offset
0x02  orientation
0x04  anchor
```

74 \boxlimit

This primitive will freeze the glue in a box but only when there is glue marked with the limit option.

75 \boxlimitate

This primitive will freeze the glue in a box. It takes two arguments, a box number and an number that when set to non-zero will recurse into nested lists.

76 \boxlimitmode

This variable controls if boxes with glue marked 'limit' will be checked and frozen.

77 \boxmaxdepth

You can limit the depth of boxes being constructed. It's one of these parameters that should be used with care because when that box is filled nested boxes can be influenced.

78 \boxorientation

The orientation field can take quite some values and is discussed in one of the low level ConTEXt manuals. Some properties are dealt with in the TEX engine because they influence dimensions but in the end it is the backend that does the work.

79 \boxrepack

When a box of to wide or tight we can tweak it a bit with this primitive. The primitive expects a box register and a dimension, where a positive number adds and a negatie subtracts from the current box with.

```
\setbox 0 \hbox        {test test test}
\setbox 2 \hbox {\red   test test test} \boxrepack0 +.2em
\setbox 4 \hbox {\green test test test} \boxrepack0 -.2em
\ruledhbox{\box0} \vskip-\lineheight
\ruledhbox{\box0} \vskip-\lineheight
\ruledhbox{\box0}
```

test test test

We can also use this primitive to check the natural dimensions of a box:

```
\setbox 0 \hbox spread 10pt {test test test}
\ruledhbox{\box0} (\the\boxrepack0,\the\wd0)
```

In this context only one argument is expected.
test test test

(0.0pt,0.0pt)

80 \boxshift

Returns or sets how much the box is shifted: up or down in horizontally mode, left or right in vertical mode.

81 \boxshrink

Returns the amount of shrink found (applied) in a box:

```
\setbox0\hbox to 4em {m m m m}
```

```
\the\boxshrink0
```

gives: 3.17871pt

82 \boxsource

This feature is part of an (experimental) mechanism that relates boxes. The engine just tags a box and it is up to the macro package to deal with it.

```
\setbox0\hbox source 123 {m m m m}
\the\boxsource0
```

This gives: 123. Of course this feature is very macro specific and should not be used across macro packages without coordination.

83 \boxstretch

Returns the amount of stretch found (applied) in a box:

```
\setbox0\hbox to 6em {m m m m}
\the\boxstretch0
```

gives: 4.76807pt

84 \boxtarget

This feature is part of an (experimental) mechanism that relates boxes. The engine just tags a box and it is up to the macro package to deal with it.

```
\setbox0\hbox source 123 {m m m m}
\the\boxsource0
```

This gives: 123. Of course this feature is very macro specific and should not be used across macro packages without coordination.

85 \boxtotal

Returns the total of height and depth of the given box.

86 \boxvadjust

When used as query this returns a bitset indicating the associated adjust and migration (marks and inserts) data:

`0x1` pre adjusted
`0x2` post adjusted
`0x4` pre migrated
`0x8` post migrated

When used as a setter it directly adds adjust data to the box and it accepts the same keywords as `\vadjust`.

87 \boxxmove

This will set the vertical offset and adapt the dimensions accordingly.

88 \boxxoffset

Returns or sets the horizontal offset of the given box.

89 \boxymove

This will set the vertical offset and adapt the dimensions accordingly.

90 \boxyoffset

Returns or sets the vertical offset of the given box.

91 \brokenpenalties

Together with `\widowpenalties` and `\clubpenalties` this one permits discriminating left- and right page (doublesided) penalties. For this one needs to also specify `\options 4` and provide penalty pairs. Where the others accept multiple pairs, this primitives expects a count value one.

92 \brokenpenalty

This penalty is added after a line that ends with a hyphen; it can help to discourage a page break (or split in a box).

93 \catcode

Every character can be put in a category, but this is typically something that the macro package manages because changes can affect behavior. Also, once passed as an argument, the catcode of a character is frozen. There are 16 different values:

`\escapecatcode`	0	`\begingroupcatcode`	1
`\endgroupcatcode`	2	`\mathshiftcatcode`	3
`\alignmentcatcode`	4	`\endoflinecatcode`	5
`\parametercatcode`	6	`\superscriptcatcode`	7
`\subscriptcatcode`	8	`\ignorecatcode`	9
`\spacecatcode`	10	`\lettercatcode`	11
`\othercatcode`	12	`\activecatcode`	13
`\commentcatcode`	14	`\invalidcatcode`	15

The first column shows the constant that ConTEXt provides and the name indicates the purpose. Here are two examples:

```
\catcode123=\begingroupcatcode
\catcode125=\endgroupcatcode
```

94 \catcodetable

The catcode table with the given index will become active.

95 \cdef

This primitive is like \edef but in some usage scenarios is slightly more efficient because (delayed) expansion is ignored which in turn saves building a temporary token list.

```
\edef\FooA{this is foo} \meaningfull\FooA\crlf
\cdef\FooB{this is foo} \meaningfull\FooB\par
```

```
macro:this is foo
constant macro:this is foo
```

96 \cdefcsname

This primitive is like \edefcsame but in some usage scenarios is slightly more efficient because (delayed) expansion is ignored which in turn saves building a temporary token list.

```
\edefcsname FooA\endcsname{this is foo} \meaningasis\FooA\crlf
\cdefcsname FooB\endcsname{this is foo} \meaningasis\FooB\par
```

```
\def \FooA {this is foo}
\constant \def \FooB {this is foo}
```

97 \cfcode

This primitive is a companion to \efcode and sets the compression factor. It takes three values: font, character code, and factor.

98 \char

This appends a character with the given index in the current font.

99 \chardef

The following definition relates a control sequence to a specific character:

```
\chardef\copyrightsign"A9
```

However, because in a context where a number is expected, such a \chardef is seen as valid number, there was a time when this primitive was used to define constants without overflowing the by then limited pool of count registers. In ε-TEX aware engines this was less needed, and in LuaMetaTEX we have \integerdef as a more natural candidate.

100 \cleaders

See \gleaders for an explanation.

101 \clearmarks

This primitive is an addition to the multiple marks mechanism that originates in ε-TEX and reset the mark registers of the given category (a number).

102 \clubpenalties

This is an array of penalty put before the first lines in a paragraph. High values discourage (or even prevent) a lone line at the end of a page. This command expects a count value indicating the number of entries that will follow. The first entry is ends up after the first line.

103 \clubpenalty

This is the penalty put before a club line in a paragraph. High values discourage (or even prevent) a lone line at the end of a next page.

104 \constant

This prefix tags a macro (without arguments) as being constant. The main consequence is that in some cases expansion gets delayed which gives a little performance boost and less (temporary) memory usage, for instance in **\csname** like scenarios.

105 \constrained

See previous section about \retained.

106 \copy

This is the box register accessor that returns a copy of the box.

107 \copymathatomrule

This copies the rule bitset from the parent class (second argument) to the target class (first argument). The bitset controls the features that apply to atoms.

108 \copymathparent

This binds the given class (first argument) to another class (second argument) so that one doesn't need to define all properties.

109 \copymathspacing

This copies an class spacing specification to another one, so in

```
\copymathspacing 34 2
```

class 34 (a user one) get the spacing from class 2 (binary).

110 \count

This accesses a count register by index. This is kind of 'not done' unless you do it local and make sure that it doesn't influence macros that you call.

```
\count4023=10
```

In standard TEX the first 10 counters are special because they get reported to the console, and `\count0` is then assumed to be the page counter.

111 \countdef

This primitive relates a control sequence to a count register. Compare this to the example in the previous section.

```
\countdef\MyCounter4023
\MyCounter=10
```

However, this is also 'not done'. Instead one should use the allocator that the macro package provides.

```
\newcount\MyCounter
\MyCounter=10
```

In LuaMetaTEX we also have integers that don't rely on registers. These are assigned by the primitive `\integerdef`:

```
\integerdef\MyCounterA 10
```

Or better `\newinteger`.

```
\newinteger\MyCounterB
\MyCounterN10
```

There is a lowlevel manual on registers.

112 \cr

This ends a row in an alignment. It also ends an alignment preamble.

113 \crampeddisplaystyle

A less spacy alternative of `\displaystyle`; integer representation: 4.

114 \crampedscriptscriptstyle

A less spacy alternative of `\scriptscriptstyle`; integer representation: 6.

115 \crampedscriptstyle

A less spacy alternative of \scriptstyle; integer representation: 4.

116 \crampedtextstyle

A less spacy alternative of \textstyle; integer representation: 2.

117 \crcr

This ends a row in an alignment when it hasn't ended yet.

118 \csactive

Because LuaTEX (and LuaMetaTEX) are Unicode engines active characters are implemented a bit differently. They don't occupy a eight bit range of characters but are stored as control sequence with a special prefix U+FFFF which never shows up in documents. The \csstring primitive injects the name of a control sequence without leading escape character, the \csactive injects the internal name of the following (either of not active) character. As we cannot display the prefix: **\csactive**~ will inject the utf sequences for U+FFFF and U+007E, so here we get the bytes EFBFBF7E. Basically the next token is preceded by \string, so when you don't provide a character you are in for a surprise.

119 \csname

This original TEX primitive starts the construction of a control sequence reference. It does a lookup and when no sequence with than name is found, it will create a hash entry and defaults its meaning to \relax.

```
\csname letters and other characters\endcsname
```

120 \csstring

This primitive returns the name of the control sequence given without the leading escape character (normally a backslash). Of course you could strip that character with a simple helper but this is more natural.

```
\csstring\mymacro
```

We get the name, not the meaning: mymacro.

121 \currentgrouplevel

The next example gives: [1] [2] [3] [2] [1].

```
[\the\currentgrouplevel] \bgroup
    [\the\currentgrouplevel] \bgroup
        [\the\currentgrouplevel]
    \egroup [\the\currentgrouplevel]
\egroup [\the\currentgrouplevel]
```

122 \currentgrouptype

The next example gives: [22] [1] [22] [1] [1] [23] [1] [1].

```
[\the\currentgrouptype] \bgroup
    [\the\currentgrouptype] \begingroup
        [\the\currentgrouptype]
    \endgroup [\the\currentgrouptype]
    [\the\currentgrouptype] \beginmathgroup
        [\the\currentgrouptype]
    \endmathgroup [\the\currentgrouptype]
[\the\currentgrouptype] \egroup
```

The possible values depend in the engine and for LuaMetaTEX they are:

0	bottomlevel	9	output	18	mathoperator	27	mathnumber
1	simple	10	mathsubformula	19	mathradical	28	localbox
2	hbox	11	mathstack	20	mathchoice	29	splitoff
3	adjustedhbox	12	mathcomponent	21	alsosimple	30	splitkeep
4	vbox	13	discretionary	22	semisimple	31	preamble
5	vtop	14	insert	23	mathsimple	32	alignset
6	dbox	15	vadjust	24	mathfence	33	finishrow
7	align	16	vcenter	25	mathinline	34	lua
8	noalign	17	mathfraction	26	mathdisplay		

123 \currentifbranch

The next example gives: [0] [1] [-1] [1] [0].

```
[\the\currentifbranch] \iftrue
    [\the\currentifbranch] \iffalse
        [\the\currentifbranch]
    \else
        [\the\currentifbranch]
    \fi [\the\currentifbranch]
\fi [\the\currentifbranch]
```

So when in the ‘then’ branch we get plus one and when in the ‘else’ branch we end up with a minus one.

124 \currentiflevel

The next example gives: [0] [1][2] [3] [2] [1] [0].

```
[\the\currentiflevel] \iftrue
    [\the\currentiflevel]\iftrue
        [\the\currentiflevel] \iftrue
            [\the\currentiflevel]
        \fi [\the\currentiflevel]
```

```
    \fi [\the\currentiflevel]
\fi [\the\currentiflevel]
```

125 \currentiftype

The next example gives: [-1] [25][25] [25] [25] [25] [-1].

```
[\the\currentiftype] \iftrue
    [\the\currentiftype]\iftrue
        [\the\currentiftype] \iftrue
            [\the\currentiftype]
        \fi [\the\currentiftype]
    \fi [\the\currentiftype]
\fi [\the\currentiftype]
```

The values are engine dependent:

0	char	7	absfloat	14	odd	21	vbox	28	chknunber
1	cat	8	zerofloat	15	vmode	22	tok	29	numval
2	num	9	intervalfloat	16	hmode	23	cstoken	30	cmpnum
3	absnum	10	dim	17	mmode	24	x	31	chkdim
4	zeronum	11	absdim	18	inner	25	true	32	chkdimension
5	intervalnum	12	zerodim	19	void	26	false	33	dimval
6	float	13	intervaldim	20	hbox	27	chknum	34	cmpdim

126 \currentloopiterator

Here we show the different expanded loop variants:

```
\edef\testA{\expandedloop  1 10 1{!}}
\edef\testB{\expandedrepeat  10  {!}}
\edef\testC{\expandedendless     {\ifnum\currentloopiterator>10 \quitloop\else !\fi}}
\edef\testD{\expandedendless     {\ifnum#I>10 \quitloop\else !\fi}}
```

All these give the same result:

```
\def \testA {!!!!!!!!!!}
\def \testB {!!!!!!!!!!}
\def \testC {!!!!!!!!!!}
\def \testD {!!!!!!!!!!}
```

The #I is a shortcut to the current loop iterator; other shortcuts are #P for the parent iterator value and #G for the grand parent.

127 \currentloopnesting

This integer reports how many nested loops are currently active. Of course in practice the value only has meaning when you know at what outer level your nested loop started.

128 \currentmarks

Marks only get updated when a page is split off or part of a box using `\vsplit` gets wrapped up. This primitive gives access to the current value of a mark and takes the number of a mark class.

129 \currentstacksize

This is more diagnostic feature than a useful one but we show it anyway. There is some basic overhead when we enter a group:

```
\bgroup [\the\currentstacksize]
    \bgroup [\the\currentstacksize]
        \bgroup [\the\currentstacksize]
        [\the\currentstacksize] \egroup
    [\the\currentstacksize] \egroup
[\the\currentstacksize] \egroup
```

[62] [63] [64] [64] [63] [62]

As soon as we define something or change a value, the stack gets populated by information needed for recovery after the group ends.

```
\bgroup [\the\currentstacksize]
    \scratchcounter 1
    \bgroup [\the\currentstacksize]
        \scratchdimen 1pt
        \scratchdimen 2pt
        \bgroup [\the\currentstacksize]
            \scratchcounter 2
            \scratchcounter 3
        [\the\currentstacksize] \egroup
    [\the\currentstacksize] \egroup
[\the\currentstacksize] \egroup
```

[62] [64] [66] [67] [65] [63]

The stack also keeps some state information, for instance when a box is being built. In LuaMetaTEX that is is quite a bit more than in other engines but it is compensated by more efficient save stack handling elsewhere.

```
\hbox \bgroup [\the\currentstacksize]
    \hbox \bgroup [\the\currentstacksize]
        \hbox \bgroup [\the\currentstacksize]
        [\the\currentstacksize] \egroup
    [\the\currentstacksize] \egroup
[\the\currentstacksize] \egroup
```

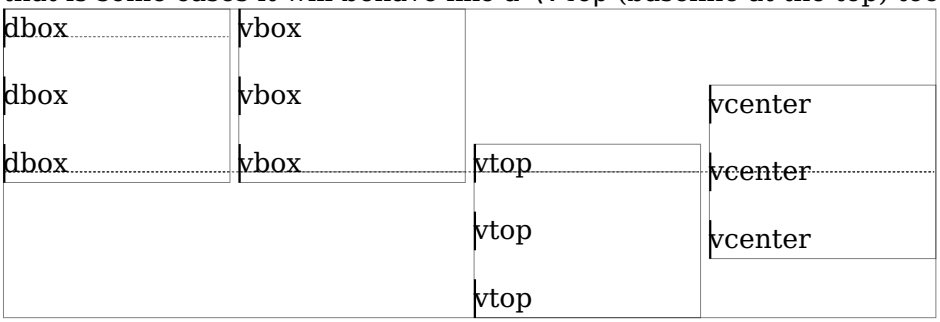
[70] [79] [88] [88] [79] [70]

130 \day

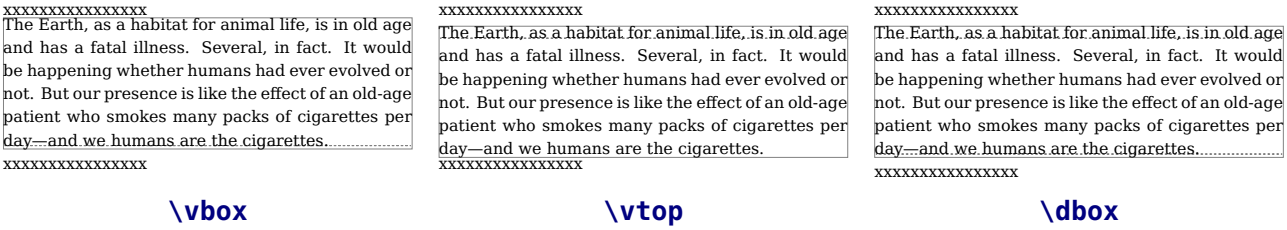
This internal number starts out with the day that the job started.

131 \dbox

A \dbox is just a \vbox (baseline at the bottom) but it has the property 'dual baseline' which means that is some cases it will behave like a \vtop (baseline at the top) too. Like:



A **\dbox** behaves like a **\vtop** when it's appended to a vertical list which means that the height of the first box or rule determines the (base)line correction that gets applied.



132 \deadcycles

This counter is incremented every time the output routine is entered. When \maxdeadcycles is reached TEX will issue an error message, so you'd better reset its value when a page is done.

133 \def

This is the main definition command, as in:

```
\def\foo{l me}
```

with companions like \gdef, \edef, \xdef, etc. and variants like:

```
\def\foo#1{... #1...}
```

where the hash is used in the preamble and for referencing. More about that can be found in the low level manual about macros.

134 \defaulthyphenchar

When a font is loaded its hyphen character is set to this value. It can be changed afterwards. However, in LuaMetaTEX font loading is under Lua control so these properties can be set otherwise.

135 \defaultskewchar

When a font is loaded its skew character is set to this value. It can be changed afterwards. However, in LuaMetaTEX font loading is under Lua control so these properties can be set otherwise. Also, OpenType math fonts have top anchor instead.

136 \defcsname

We now get a series of log clutter avoidance primitives. It's fine if you argue that they are not really needed, just don't use them.

```
\expandafter\def\csname MyMacro:1\endcsname{...}
            \defcsname MyMacro:1\endcsname{...}
```

The fact that TEX has three (expanded and global) companions can be seen as a signal that less verbosity makes sense. It's just that macro packages use plenty of `\csname`'s.

137 \deferred

This is mostly a compatibility prefix and it can be checked at the Lua end when there is a Lua based assignment going on. It is the counterpart of `\immediate`. In the traditional engines a `\write` is normally deferred (turned into a node) and can be handled `\immediate`, while a `\special` does the opposite.

138 \delcode

This assigns delimiter properties to an eight bit character so it has little use in an OpenType math setup. WHen the assigned value is hex encoded, the first byte denotes the small family, then we have two bytes for the small index, followed by three similar bytes for the large variant.

139 \delimiter

This command inserts a delimiter with the given specification. In OpenType math we use a different command so it is unlikely that this primitive is used in LuaMetaTEX. It takes a number that can best be coded hexadecimal: one byte for the class, one for the small family, two for the small index, one for the large family and two for the large index. This demonstrates that it can't handle wide fonts. Also, in OpenType math fonts the larger sizes and extensible come from the same font as the small symbol. On top of that, in LuaMetaTEX we have more classes than fit in a byte.

140 \delimiterfactor

This is one of the parameters that determines the size of a delimiter: at least this factor times the formula height divided by 1000. In OpenType math different properties and strategies are used.

141 \delimitershortfall

This is one of the parameters that determines the size of a delimiter: at least the formula height minus this parameter. In OpenType math different properties and strategies are used.

142 \detokened

The following token will be serialized into characters with category ‘other’.

```
\toks0{123}
\def\foo{let's be \relax'd}
```

```
\def\oof#1{let's see #1}
\detokened\toks0
\detokened\foo
\detokened\oof
\detokened\setbox
\detokened X
```

Gives:

```
123
let's be \relax 'd
\oof
\setbox
X
```

Macros with arguments are not shown.

143 \detokenize

This ε-TEX primitive turns the content of the provides list will become characters, kind of verbatim.

```
\expandafter\let\expandafter\temp\detokenize{1} \meaning\temp
\expandafter\let\expandafter\temp\detokenize{A} \meaning\temp
```

```
the character U+0031 1
the character U+0041 A
```

144 \detokenized

The following (single) token will be serialized into characters with category ‘other’.

```
\toks0{123}
\def\foo{let's be \relax'd}
\def\oof#1{let's see #1}
\detokenized\toks0
\detokenized\foo
\detokenized\oof
\detokenized\setbox
\detokenized X
```

Gives:

```
\toks 0
\foo
\oof
\setbox
X
```

It is one of these new primitives that complement others like `\detokened` and such, and they are often mostly useful in experiments of some low level magic, which made them stay.

145 \dimen

Like \count this is a register accessor which is described in more detail in a low level manual.

```
\dimen0=10pt
```

While TEX has some assumptions with respect to the first ten count registers (as well as the one that holds the output, normally 255), all dimension registers are treated equal. However, you need to be aware of clashes with other usage. Therefore you can best use the predefined scratch registers or define dedicate ones with the \newdimen macro.

146 \dimendef

This primitive is used by the \newdimen macro when it relates a control sequence with a specific register. Only use it when you know what you're doing.

147 \dimensiondef

A variant of \integerdef is:

```
\dimensiondef\MyDimen = 1234pt
```

The properties are comparable to the ones described in the section \integerdef.

148 \dimexpr

This primitive is similar to of \numexpr but operates on dimensions instead. Integer quantities are interpreted as dimensions in scaled points.

```
\the\dimexpr (1pt + 2pt - 5pt) * 10 / 2 \relax
```

gives: -10.0pt. You can mix in symbolic integers and dimensions. This doesn't work:

because the engine scans for a dimension and only for an integer (or equivalent) after a * or /.

149 \dimexpression

This command is like \numexpression but results in a dimension instead of an integer. Where \dimexpr doesn't like `2 * 10pt` this expression primitive is quite happy with it.

150 \directlua

This is the low level interface to Lua:

Gives: “Greetings from the lua end!” as expected. In Lua we have access to all kind of internals of the engine. In LuaMetaTEX the interfaces have been polished and extended compared to LuaTEX. Although many primitives and mechanisms were added to the TEX frontend, the main extension interface remains Lua. More information can be found in documents that come with ConTEXt, in presentations and in articles.

151 \discretionary

The three snippets given with this command determine the pre, post and replace component of the injected discretionary node. The `penalty` keyword permits setting a penalty with this node. The `postword` keyword indicates that this discretionary starts a word, and `preword` ends it. With `break` the line break algorithm will prefer a pre or post component over a replace, and with `nobreak` replace will win over pre. With `class` you can set a math class that will determine spacing and such for discretionaries used in math mode.

152 \discretionaryoptions

Processing of discretionaries is controlled by this bitset:

`0x00000000`	normalword
`0x00000001`	preword
`0x00000002`	postword
`0x00000010`	preferbreak
`0x00000020`	prefernobreak
`0x00000040`	noitaliccorrection
`0x00000080`	nozeroitaliccorrection
`0x00010000`	userfirst
`0x40000000`	userlast

These can also be set on `\discretionary` using the `options` key.

153 \displayindent

The `\displaywidth`, `\displayindent` and `\predisplaysize` parameters are set by the line break routine (but can be adapted by the user), so that mid-par display formula can adapt itself to hanging indentation and par shapes. I order to calculate thee values and adapt the line break state afterwards such a display formula is assumed to occupy three lines, so basically a rather compact formula.

154 \displaylimits

By default in math display mode limits are place on top while in inline mode they are placed like scripts, after the operator. Placement can be forced with the `\limits` and `\nolimits` modifiers (after the operator). Because there can be multiple of these in a row there is `\displaylimits` that forces the default placement, so effectively it acts here as a reset modifier.

155 \displaystyle

One of the main math styles; integer representation: 0.

156 \displaywidowpenalties

This is a math specific variant of `\widowpenalties`.

157 \displaywidowpenalty

This is a math specific variant of `\widowpenalty`.

158 \displaywidth

This parameter determines the width of the formula and normally defaults to the \hsize unless we are in the middle of a paragraph in which case it is compensated for hanging indentation or the par shape.

159 \divide

The \divide operation can be applied to integers, dimensions, float, attribute and glue quantities. There are subtle rounding differences between the divisions in expressions and \divide:

```
\scratchcounter 1049 \numexpr\scratchcounter / 10\relax : 105
\scratchcounter 1049 \numexpr\scratchcounter : 10\relax : 104
\scratchcounter 1049 \divide\scratchcounter by 10       : 104
```

The : divider in \dimexpr is something that we introduced in LuaTEX.

160 \divideby

This is slightly more efficient variant of \divide that doesn't look for by. See previous section.

161 \doublehyphendemerits

This penalty will be added to the penalty assigned to a breakpoint that results in two lines ending with a hyphen.

162 \doublepenaltymode

When set to one this parameter signals the backend to use the alternative (left side) penalties of the pairs set on \widowpenalties, \clubpenalties and \brokenpenalties. For more information on this you can consult manuals (and articles) that come with ConTEXt.

163 \dp

Returns the depth of the given box.

164 \dpack

This does what \dbox does but without callback overhead.

165 \dsplit

This is the dual baseline variant of \vsplit (see \dbox for what that means).

166 \dump

This finishes an (ini) run and dumps a format (basically the current state of the engine).

167 \edef

This is the expanded version of \def.

```
\def \foo{foo}      \meaning\foo
\def \ofo{\foo\foo} \meaning\ofo
\edef\oof{\foo\foo} \meaning\oof
```

Because \foo is unprotected it will expand inside the body definition:

```
macro:foo
macro:\foo \foo
macro:foofoo
```

168 \edefcsname

This is the companion of \edef:

```
\expandafter\edef\csname MyMacro:1\endcsname{...}
            \edefcsname MyMacro:1\endcsname{...}
```

169 \edivide

When expressions were introduced the decision was made to round the divisions which is incompatible with the way \divide works. The expression scanners in LuaMetaTEX compensates that by providing a : for integer division. The \edivide does the opposite: it rounds the way expressions do.

```
\the\dimexpr .4999pt                    : 2 \relax          =.24994pt
\the\dimexpr .4999pt                    / 2 \relax          =.24995pt
\scratchdimen.4999pt \divide \scratchdimen 2 \the\scratchdimen=.24994pt
\scratchdimen.4999pt \edivide\scratchdimen 2 \the\scratchdimen=.24995pt

\the\numexpr   1001                       : 2 \relax            =500
\the\numexpr   1001                       / 2 \relax            =501
\scratchcounter1001  \divide \scratchcounter 2 \the\scratchcounter=500
\scratchcounter1001  \edivide\scratchcounter 2 \the\scratchcounter=501
```

Keep in mind that with dimensions we have a fractional part so we actually rounding applies to the fraction. For that reason we also provide \rdivide.

```
0.24994pt=.24994pt
0.24995pt=.24995pt
0.24994pt=.24994pt
0.24995pt=.24995pt

500=500
501=501
500=500
501=501
```

170 \edivideby

This the by-less variant of \edivide.

171 \efcode

This primitive originates in pdfTEX and can be used to set the expansion factor of a glyph (characters). This primitive is obsolete because the values can be set in the font specification that gets passed via Lua to TEX. Keep in mind that setting font properties at the TEX end is a global operation and can therefore influence related fonts. In LuaMetaTEX the \cf code can be used to specify the compression factor independent from the expansion factor. The primitive takes three values: font, character code, and factor.

172 \else

This traditional primitive is part of the condition testing mechanism. When a condition matches, TEX will continue till it sees an \else or \or or \orelse (to be discussed later). It will then do a fast skipping pass till it sees an \fi.

173 \emergencyextrastretch

This is one of the extended parbuilder parameters. You can you it so temporary increase the permitted stretch without knowing or messing with the normal value.

174 \emergencyleftskip

This is one of the extended parbuilder parameters (playground). It permits going ragged left in case of a too bad result.

175 \emergencyrightskip

This is one of the extended parbuilder parameters (playground). It permits going ragged right in case of a too bad result.

176 \emergencystretch

When set the par builder will run a third pass in order to fit the set criteria.

177 \end

This ends a TEX run, unless of course this primitive is redefined.

178 \endcsname

This primitive is used in combination with \csname, \ifcsname and \begincsname where its end the scanning for the to be constructed control sequence token.

179 \endgroup

This is the companion of the \begingroup primitive that opens a group. See \beginsimplegroup for more info.

180 \endinput

The engine can be in different input modes: reading from file, reading from a token list, expanding a macro, processing something that comes back from Lua, etc. This primitive quits reading from file:

```
this is seen
\endinput
here we're already quit
```

There is a catch. This is what the above gives:

this is seen

but how about this:

```
this is seen
before \endinput after
here we're already quit
```

Here we get:

this is seen before after

Because a token list is one line, the following works okay:

```
\def\quitrun{\ifsomething \endinput \fi}
```

but in a file you'd have to do this when you quit in a conditional:

```
\ifsomething
    \expandafter \endinput
\fi
```

While the one-liner works as expected:

```
\ifsomething \endinput \fi
```

181 \endlinechar

This is an internal integer register. When set to positive value the character with that code point will be appended to the line. The current value is 13. Here is an example:

```
\endlinechar\hyphenasciicode
line 1
line 2
```

line 1-line 2-

If the character is active, the property is honored and the command kicks in. The maximum value is 127 (the maximum character code a single byte utf character can carry.)

182 \endlocalcontrol

See \beginlocalcontrol.

183 \endmathgroup

This primitive is the counterpart of \beginmathgroup.

184 \endsimplegroup

This one ends a simple group, see \beginsimplegroup for an explanation about grouping primitives.

185 \enforced

The engine can be set up to prevent overloading of primitives and macros defined as \permanent or \immutable. However, a macro package might want to get around this in controlled situations, which is why we have a \enforced prefix. This prefix in interpreted differently in so called 'ini' mode when macro definitions can be dumped in the format. Internally they get an always flag as indicator that in these places an overload is possible.

```
\permanent\def\foo{original}

\def\oof         {\def\foo{fails}}
\def\oof{\enforced\def\foo{succeeds}}
```

Of course this only has an effect when overload protection is enabled.

186 \eofinput

This is a variant on \input that takes a token list as first argument. That list is expanded when the file ends. It has companion primitives \atendoffile (single token) and \atendoffiled (multiple tokens).

187 \eqno

This primitive stores the (typeset) content (presumably a number) and when the display formula is wrapped that number will end up right of the formula.

188 \errhelp

This is additional help information to \errmessage that triggers an error and shows a message.

189 \errmessage

This primitive expects a token list and shows its expansion on the console and/or in the log file, depending on how TEX is configured. After that it will enter the error state and either goes on or waits

for input, again depending on how TEX is configured. For the record: we don't use this primitive in ConTEXt.

190 \errorcontextlines

This parameter determines the number on lines shown when an error is triggered.

191 \errorstopmode

This directive stops at every opportunity to interact. In ConTEXt we overload the actions in a callback and quit the run because we can assume that a successful outcome is unlikely.

192 \escapechar

This internal integer has the code point of the character that get prepended to a control sequence when it is serialized (for instance in tracing or messages).

193 \etoks

This assigns an expanded token list to a token register:

```
\def\temp{less stuff}
\etoks\scratchtoks{a bit \temp}
```

The orginal value of the register is lost.

194 \etoksapp

A variant of `\toksapp` is the following: it expands the to be appended content.

```
\def\temp{more stuff}
\etoksapp\scratchtoks{some \temp}
```

195 \etokspre

A variant of `\tokspre` is the following: it expands the to be prepended content.

```
\def\temp{less stuff}
\etokspre\scratchtoks{a bit \temp}
```

196 \eufactor

When we introduced the `es` (2.5cm) and `ts` (2.5mm) units as metric variants of the `in` we also added the `eu` factor. One `eu` equals one tenth of a `es` times the `\eufactor`. The `ts` is a convenient offset in test files, the `es` a convenient ones for layouts and image dimensions and the `eu` permits definitions that scale nicely without the need for dimensions. They also were a prelude to what later became possible with `\associateunit`.

197 \everybeforepar

This token register is expanded before a paragraph is triggered. The reason for triggering is available in `\lastpartrigger`.

198 \everycr

This token list gets expanded when a row ends in an alignment. Normally it will use `\noalign` as wrapper

```
{\everycr{\noalign{H}}            \halign{#\cr test\cr test\cr}}
{\everycr{\noalign{V}} \hsize 4cm \valign{#\cr test\cr test\cr}}
```

Watch how the `\cr` ending the preamble also get this treatment:
H
test

H
test

H

Vtest Vtest V

199 \everydisplay

This token list gets expanded every time we enter display mode. It is a companion of `\everymath`.

200 \everyeof

The content of this token list is injected when a file ends but it can only be used reliably when one is really sure that no other file is loaded in the process. So in the end it is of no real use in a more complex macro package.

201 \everyhbox

This token list behaves similar to `\everyvbox` so look there for an explanation.

202 \everyjob

This token list register is injected at the start of a job, or more precisely, just before the main control loop starts.

203 \everymath

Often math needs to be set up independent from the running text and this token list can be used to do that. There is also `\everydisplay`.

204 \everymathatom

When a math atom is seen this tokenlist is expanded before content is processed inside the atom body.

205 \everypar

When a paragraph starts this tokenlist is expanded before content is processed.

206 \everytab

This token list gets expanded every time we start a table cell in `\halign` or `\valign`.

207 \everyvbox

This token list gets expanded every time we start a vertical box. Like `\everyhbox` this is not that useful unless you are certain that there are no nested boxes that don't need this treatment. Of course you can wipe this register in this expansion, like:

```
\everyvbox{\kern10pt\everyvbox{}}
```

208 \exceptionpenalty

In exceptions we can indicate a penalty by `[digit]` in which case a penalty is injected set by this primitive, multiplied by the digit.

209 \exhyphenchar

The character that is used as pre component of the related discretionary.

210 \exhyphenpenalty

The penalty injected after `-` or `\-` unless `\hyphenationmode` is set to force the dedisated penalties.

211 \expand

Beware, this is not a prefix but a directive to ignore the protected characters of the following macro.

```
\protected \def \testa{\the\scratchcounter}
           \edef\testb{\testa}
           \edef\testc{\expand\testa}
```

The meaning of the three macros is:

```
protected macro:\the \scratchcounter
macro:\testa
macro:123
```

212 \expandactive

This a bit of an outlier and mostly there for completeness.

```
                          \meaningasis~
\edef\foo{~}              \meaningasis\foo
\edef\foo{\expandactive~} \meaningasis\foo
```

There seems to be no difference but the real meaning of the first `\foo` is ‘active character 126’ while the second `\foo` ‘protected call ’ is.

\protected \def ~ {\nobreakspace }
\def \foo {~}
\def \foo {~}

Of course the definition of the active tilde is ConTEXt specific and situation dependent.

213 \expandafter

This original TEX primitive stores the next token, does a one level expansion of what follows it, which actually can be an not expandable token, and reinjects the stored token in the input. Like:

```
\expandafter\let\csname my weird macro name\endcsname{m w m n}
```

Without `\expandafter` the `\csname` primitive would have been let to the left brace (effectively then a begin group). Actually in this particular case the control sequence with the weird name is injected and when it didn't yet exist it will get the meaning `\relax` so we sort of have two assignments in a row then.

214 \expandafterpars

Here is another gobbler: the next token is reinjected after following spaces and par tokens have been read. So:

```
[\expandafterpars 1 2]
[\expandafterpars 3
4]
[\expandafterpars 5

6]
```

gives us: [12] [34] [56], because empty lines are like `\par` and therefore ignored.

215 \expandafterspaces

This is a gobbler: the next token is reinjected after following spaces have been read. Here is a simple example:

```
[\expandafterspaces 1 2]
[\expandafterspaces 3
4]
[\expandafterspaces 5

6]
```

We get this typeset: [12] [34] [5

6], because a newline normally is configured to be a space (and leading spaces in a line are normally being ingored anyway).

216 \expandcstoken

The rationale behind this primitive is that when we \let a single token like a character it is hard to compare that with something similar, stored in a macro. This primitive pushes back a single token alias created by \let into the input.

```
\let\tempA + \meaning\tempA

\let\tempB X \meaning\tempB \crlf
\let\tempC $ \meaning\tempC \par

\edef\temp         {\tempA} \doifelse{\temp}{+}{Y}{N} \meaning\temp \crlf
\edef\temp         {\tempB} \doifelse{\temp}{X}{Y}{N} \meaning\temp \crlf
\edef\temp         {\tempC} \doifelse{\temp}{X}{Y}{N} \meaning\temp \par

\edef\temp{\expandcstoken\tempA} \doifelse{\temp}{+}{Y}{N} \meaning\temp \crlf
\edef\temp{\expandcstoken\tempB} \doifelse{\temp}{X}{Y}{N} \meaning\temp \crlf
\edef\temp{\expandcstoken\tempC} \doifelse{\temp}{$}{Y}{N} \meaning\temp \par

\doifelse{\expandcstoken\tempA}{+}{Y}{N}
\doifelse{\expandcstoken\tempB}{X}{Y}{N}
\doifelse{\expandcstoken\tempC}{$}{Y}{N} \par
```

The meaning of the \let macros shows that we have a shortcut to a character with (in this case) catcode letter, other (here ‘other character’ gets abbreviated to ‘character’), math shift etc.

```
the character U+002B 'plus sign'

the letter U+0058 X
math shift character U+0024 'dollar sign'

N macro:\tempA
N macro:\tempB
N macro:\tempC

Y macro:+
Y macro:X
Y macro:$

Y Y Y
```

Here we use the ConTEXt macro **\doifelse** which can be implemented in different ways, but the only property relevant to the user is that the expanded content of the two arguments is compared.

217 \expanded

This primitive complements the two expansion related primitives mentioned in the previous two sections. This time the content will be expanded and then pushed back into the input. Protected macros will not be expanded, so you can use this primitive to expand the arguments in a call. In ConTEXt you

need to use **\normalexpanded** because we already had a macro with that name. We give some examples:

```
\def\A{!}
          \def\B#1{\string#1}                          \B{\A}
          \def\B#1{\string#1} \normalexpanded{\noexpand\B{\A}}
\protected\def\B#1{\string#1}                          \B{\A}
```

```
\A
!
\A
```

218 \expandedafter

The following two lines are equivalent:

```
\def\foo{123}
\expandafter[\expandafter[\expandafter\secondofthreearguments\foo]]
\expandedafter{[[\secondofthreearguments}\foo]]
```

In ConTEXt MkIV the number of times that one has multiple `\expandafters` is much larger than in ConTEXt LMTX thanks to some of the new features in LuaMetaTEX, and this primitive is not really used yet in the core code.

```
[[2]]
[[2]]
```

219 \expandeddetokenize

This is a companion to `\detokenize` that expands its argument:

```
\def\foo{12#H3}
\def\oof{\foo}
\detokenize        {\foo} \detokenize        {\oof}
\expandeddetokenize{\foo} \expandeddetokenize{\oof}
\edef\ofo{\expandeddetokenize{\foo}} \meaningless\ofo
\edef\ofo{\expandeddetokenize{\oof}} \meaningless\ofo
```

This is a bit more convenient than

```
\detokenize \expandafter {\normalexpanded {\foo}}
```

kind of solutions. We get:

```
\foo  \oof
12#3 12#3
12#3
12#3
```

220 \expandedendless

This one loops forever but because the loop counter is not set you need to find a way to quit it.

221 \expandedloop

This variant of the previously introduced \localcontrolledloop doesn't enter a local branch but immediately does its work. This means that it can be used inside an expansion context like \edef.

```
\edef\whatever
  {\expandedloop 1 10 1
     {\scratchcounter=\the\currentloopiterator\relax}}

\meaningasis\whatever
```

```
\def \whatever {\scratchcounter =1\relax \scratchcounter =2\relax \scratchcounter =3\relax \scratchcounter
=4\relax \scratchcounter =5\relax \scratchcounter =6\relax \scratchcounter =7\relax \scratchcounter =8\relax
\scratchcounter =9\relax \scratchcounter =10\relax }
```

222 \expandedrepeat

This one takes one instead of three arguments which is sometimes more convenient.

223 \expandparameter

This primitive is a predecessor of \parameterdef so we stick to a simple example.

```
\def\foo#1#2%
  {\integerdef\MyIndexOne\parameterindex\plusone % 1
   \integerdef\MyIndexTwo\parameterindex\plustwo % 2
   \oof{P}\oof{Q}\oof{R}\norelax}

\def\oof#1%
  {<1:\expandparameter\MyIndexOne><1:\expandparameter\MyIndexOne>%
   #1%
   <2:\expandparameter\MyIndexTwo><2:\expandparameter\MyIndexTwo>}

\foo{A}{B}
```

In principle the whole parameter stack can be accessed but often one never knows if a specific macro is called nested. The original idea behind this primitive was tracing but it can also be used to avoid passing parameters along a chain of calls.

<1:A><1:A>P<2:B><2:B><1:A><1:A>Q<2:B><2:B><1:A><1:A>R<2:B><2:B>

224 \expandtoken

This primitive creates a token with a specific combination of catcode and character code. Because it assumes some knowledge of TEX we can show it using some \expandafter magic:

```
\expandafter\let\expandafter\temp\expandtoken 11 `X \meaning\temp
\expandafter\let\expandafter\temp\expandtoken 12 `X \meaning\temp
```

The meanings are:

```
the letter U+0058 X
```

```
the character U+0058 X
```

Using other catcodes is possible but the results of injecting them into the input directly (or here by injecting \temp) can be unexpected because of what TEX expects. You can get messages you normally won't get, for instance about unexpected alignment interference, which is a side effect of TEX using some catcode/character combinations as signals and there is no reason to change those internals. That said:

```
\xdef\tempA{\expandtoken  9 `X} \meaning\tempA
\xdef\tempB{\expandtoken 10 `X} \meaning\tempB
\xdef\tempC{\expandtoken 11 `X} \meaning\tempC
\xdef\tempD{\expandtoken 12 `X} \meaning\tempD
```

are all valid and from the meaning you cannot really deduce what's in there:

```
macro:X
macro:X
macro:X
macro:X
```

But you can be assured that:

```
[AB: \ifx\tempA\tempB Y\else N\fi]
[AC: \ifx\tempA\tempC Y\else N\fi]
[AD: \ifx\tempA\tempD Y\else N\fi]
[BC: \ifx\tempB\tempC Y\else N\fi]
[BD: \ifx\tempB\tempD Y\else N\fi]
[CD: \ifx\tempC\tempD Y\else N\fi]
```

makes clear that they're different: [AB: N] [AC: N] [AD: N] [BC: N] [BD: N] [CD: N], and in case you wonder, the characters with catcode 10 are spaces, while those with code 9 are ignored.

225 \expandtoks

This is a more efficient equivalent of \the applied to a token register, so:

```
\scratchtoks{just some tokens}
\edef\TestA{[\the       \scratchtoks]}
\edef\TestB{[\expandtoks\scratchtoks]}
[\the       \scratchtoks] [\TestA] \meaning\TestA
[\expandtoks\scratchtoks] [\TestB] \meaning\TestB
```

does the expected:

```
[just some tokens] [[just some tokens]] macro:[just some tokens]
[just some tokens] [[just some tokens]] macro:[just some tokens]
```

The \expandtoken primitive avoid a copy into the input when there is no need for it.

226 \explicitdiscretionary

This is the verbose alias for one of TEX's single character control sequences: \-.

227 \explicithyphenpenalty

The penalty injected after an automatic discretionary \-, when \hyphenationmode enables this.

228 \explicititaliccorrection

This is the verbose alias for one of TEX's single character control sequences: \/. Italic correction is a character property specific to TEX and the concept is not present in modern font technologies. There is a callback that hooks into this command so that a macro package can provide its own solution to this (or alternatively it can assign values to the italic correction field.

229 \explicitspace

This is the verbose alias for one of TEX's single character control sequences: \. A space is inserted with properties according the space related variables. There is look-back involved in order to deal with space factors.

When \nospaces is set to 1 no spaces are inserted, when its value is 2 a zero space is inserted.

230 \fam

In a numeric context it returns the current family number, otherwise it sets the given family. The number of families in a traditional engine is 16, in LuaTEX it is 256 and in LuaMetaTEX we have at most 64 families. A future version can lower that number when we need more classes.

231 \fi

This traditional primitive is part of the condition testing mechanism and ends a test. So, we have:

```
\ifsomething ... \else ... \fi
\ifsomething ... \or ... \or ... \else ... \fi
\ifsomething ... \orelse \ifsometing  ... \else ... \fi
\ifsomething ... \or ... \orelse \ifsometing  ... \else ... \fi
```

The \orelse is new in LuaMetaTEX and a continuation like we find in other programming languages (see later section).

232 \finalhyphendemerits

This penalty will be added to the penalty assigned to a breakpoint when that break results in a pre-last line ending with a hyphen.

233 \firstmark

This is a reference to the first mark on the (split off) page, it gives back tokens.

234 \firstmarks

This is a reference to the first mark with the given id (a number) on the (split off) page, it gives back tokens.

235 \firstvalidlanguage

Language id's start at zero, which makes it the first valid language. You can set this parameter to indicate the first language id that is actually a language. The current value is 1, so lower values will not trigger hyphenation.

236 \fitnessdemerits

We can have more fitness classes than traditional TEX that has 'very loose', 'loose', 'decent' and 'tight'. In ConTEXt we have 'veryloose', 'loose', 'almostloose', 'barelyloose', 'decent', 'barelytight', 'almosttight', 'tight' and 'verytight'. Although we can go up to 31 this is already more than enough. The default is the same as in regular TEX.

The `\fitnessdemerits` can be used to set the criteria and like other specification primitives (like `\parshape` and `\widowpenalties`, it expects a count. The criteria come in pairs because we can go up or down in the chain (getting better or worse). The criterium used when we go from one to another is the sum of the given values. The rationale behind this approach is explained in articles, presentations and manuals.

237 \float

In addition to integers and dimensions, which are fixed 16.16 integer floats we also have 'native' floats, based on 32 bit posit unums.

```
\float0 = 123.456           \the\float0
\float2 = 123.456           \the\float0
\advance \float0 by 123.456 \the\float0
\advance \float0 by \float2 \the\float0
\divideby\float0 3          \the\float0
```

They come with the same kind of support as the other numeric data types:

123.45600032806396484
123.45600032806396484
246.91200065612792969
370.36800384521484375
123.45600128173828125

We leave the subtle differences between floats and dimensions to the user to investigate:

```
\dimen00 = 123.456pt          \the\dimen0
\dimen02 = 123.456pt          \the\dimen0
\advance \dimen0 by 123.456pt \the\dimen0
\advance \dimen0 by \dimen2   \the\dimen0
\divideby\dimen0 3            \the\dimen0
```

The nature of posits is that they are more accurate around zero (or smaller numbers in general).

123.456pt
123.456pt
246.91199pt

370.36798pt
123.456pt

This also works:

```
\float0=123.456e4
\float2=123.456    \multiply\float2 by 10000
\the\float0
\the\float2
```

The values are (as expected) the same:

1234560
1234560

238 \floatdef

This primitive defines a symbolic (macro) alias to a float register, just like `\countdef` and friends do.

239 \floatexpr

This is the companion of `\numexpr`, `\dimexpr` etc.

```
\scratchcounter 200
\the   \floatexpr 123.456/456.123     \relax
\the   \floatexpr 1.2*\scratchcounter \relax
\the   \floatexpr \scratchcounter/3   \relax
\number\floatexpr \scratchcounter/3   \relax
```

Watch the difference between `\the` and `\number`:

0.27066383324563503265
240
66.666666984558105469
67

240 \floatingpenalty

When an insertion is split (across pages) this one is added to to accumulated `\insertpenalties`. In LuaMetaTEX this penalty can be stored per insertion class.

241 \flushmarks

This primitive is an addition to the multiple marks mechanism that originates in ε-TEX and inserts a reset signal for the mark given category that will perform a clear operation (like `\clearmarks` which operates immediately).

242 \font

This primitive is either a symbolic reference to the current font or in the perspective of an assignment is used to trigger a font definitions with a given name (`cs`) and specification. In LuaMetaTEX the

assignment will trigger a callback that then handles the definition; in addition to the filename an optional size specifier is checked (`at` or `scaled`).

In LuaMetaTEX *all* font loading is delegated to Lua, and there is no loading code built in the engine. Also, instead of `\font` in ConTEXt one uses dedicated and more advanced font definition commands.

243 \fontcharba

Fetches the bottom anchor of a character in the given font, so:

results in: 4.8025pt. However, this anchor is only available when it is set and it is not part of OpenType; it is something that ConTEXt provides for math fonts.

244 \fontchardp

Fetches the depth of a character in the given font, so:

results in: 2.22168pt.

245 \fontcharht

Fetches the width of a character in the given font, so:

results in: 5.33203pt.

246 \fontcharic

Fetches the italic correction of a character in the given font, but because it is not an OpenType property it is unlikely to return something useful. Although math fonts have such a property in ConTEXt we deal with it differently.

247 \fontcharta

Fetches the top anchor of a character in the given font, so:

results in: 4.8025pt. This is a specific property of math characters because in text mark anchoring is driven by a feature.

248 \fontcharwd

Fetches the width of a character in the given font, so:

results in: 6.40137pt.

249 \fontdimen

A traditional TEX font has a couple of font specific dimensions, we only mention the seven that come with text fonts:

1. The slant (slope) is an indication that we have an italic shape. The value divided by 65.536 is a fraction that can be compared with for instance the `slanted` operator in MetaPost. It is used for positioning accents, so actually not limited to oblique fonts (just like italic correction can be a property of any character). It is not relevant in the perspective of OpenType fonts where we have glyph specific top and bottom anchors.
2. Unless is it overloaded by `\spaceskip` this determines the space between words (or actually anything separated by a space).
3. This is the stretch component of `\fontdimen` 2(space).
4. This is the shrink component of `\fontdimen` 2(space).
5. The so called ex-height is normally the height of the 'x' and is also accessible as `em` unit.
6. The so called em-width or in TEX speak quad width is about the with of an 'M' but in many fonts just matches the font size. It is also accessible as `em` unit.
7. This is a very TEX specific property also known as extra space. It gets *added* to the regular space after punctuation when `\spacefactor` is 2000 or more. It can be overloaded by `\xspaceskip`.

This primitive expects a a number and a font identifier. Setting a font dimension is a global operation as it directly pushes the value in the font resource.

250 \fontid

Returns the (internal) number associated with the given font:

```
{\bf \xdef\MyFontA{\the\fontid\font}}
{\sl \xdef\MyFontB{\setfontid\the\fontid\font}}
```

with:

```
test {\setfontid\MyFontA test} test {\MyFontB test} test
```

gives: test **test** test *test* test.

251 \fontmathcontrol

The `\mathfontcontrol` parameter controls how the engine deals with specific font related properties and possibilities. It is set at the TEX end. It makes it possible to fine tune behavior in this mixed traditional and not perfect OpenType math font arena. One can also set this bitset when initializing (loading) the font (at the Lua end) and the value set there is available in `\fontmathcontrol`. The bits set in the font win over those in `\mathfontcontrol`. There are a few cases where we set these options in the (so called) goodie files. For instance we ignore font kerns in Libertinus, Antykwa and some more.

modern	0x0
pagella	0x0
antykwa	0x37EF3FF
libertinus	0x37EF3FF

252 \fontname

Depending on how the font subsystem is implemented this gives some information about the used font:

```
{\tf \fontname\font}
```

```
{\bf \fontname\font}
{\sl \fontname\font}
```

DejaVuSerif at 10.0pt
DejaVuSerif-Bold at 10.0pt
DejaVuSerif-Italic at 10.0pt

253 \fontspecdef

This primitive creates a reference to a specification that when triggered will change multiple parameters in one go.

```
\fontspecdef\MyFontSpec
    \fontid\font
    scale  1200
    xscale 1100
    yscale  800
    weight  200
    slant   500
\relax
```

is equivalent to:

```
\fontspecdef\MyFontSpec
    \fontid\font
    all 1200 1100 800 200 500
\relax
```

while

```
\fontspecdef\MyFontSpec
    \fontid\font
    all \glyphscale \glyphxscale \glyphyscale \glyphslant \glyphweight
\relax
```

is the same as

```
\fontspecdef\MyFontSpec
    \fontid\font
\relax
```

The engine adapts itself to these glyph parameters but when you access certain quantities you have to make sure that you use the scaled ones. The same is true at the Lua end. This is somewhat fundamental in the sense that when one uses these sort of dynamic features one also need to keep an eye on code that uses font specific dimensions.

254 \fontspecid

Internally a font reference is a number and this primitive returns the number of the font bound to the specification.

255 \fontspecifiedname

Depending on how the font subsystem is implemented this gives some information about the (original) definition of the used font:

```
{\tf \fontspecifiedname\font}
{\bf \fontspecifiedname\font}
{\sl \fontspecifiedname\font}
```

Serif sa 1
SerifBold sa 1
SerifSlanted sa 1

256 \fontspecifiedsize

Depending on how the font subsystem is implemented this gives some information about the (original) size of the used font:

```
{\tf  \the\fontspecifiedsize\font : \the\glyphscale}
{\bfa \the\fontspecifiedsize\font : \the\glyphscale}
{\slx \the\fontspecifiedsize\font : \the\glyphscale}
```

Depending on how the font system is setup, this is not the real value that is used in the text because we can use for instance `\glyphscale`. So the next lines depend on what font mode this document is typeset.

10.0pt: 1000
10.0pt: 1200
10.0pt: 800

257 \fontspecscale

This returns the scale factor of a fontspec where as usual 1000 means scaling by 1.

258 \fontspecslant

This returns the slant factor of a font specification, usually between zero and 1000 with 1000 being maximum slant.

259 \fontspecweight

This returns the weight of the font specification. Reasonable values are between zero and 500.

260 \fontspecxscale

This returns the scale factor of a font specification where as usual 1000 means scaling by 1.

261 \fontspecyscale

This returns the scale factor of a font specification where as usual 1000 means scaling by 1.

262 \fonttextcontrol

This returns the text control flags that are set on the given font, here `0x8`. Bits that can be set are:

`0x01`	collapsehyphens
`0x02`	baseligaturing
`0x04`	basekerning
`0x08`	noneprotected
`0x10`	hasitalics
`0x20`	autoitalics

263 \forcedleftcorrection

This is a callback driven left correction signal similar to italic corrections.

264 \forcedrightcorrection

This is a callback driven right correction signal similar to italic corrections.

265 \formatname

It is in the name: `cont-en`, but we cheat here by only showing the filename and not the full path, which in a ConTEXt setup can span more than a line in this paragraph.

266 \frozen

You can define a macro as being frozen:

```
\frozen\def\MyMacro{...}
```

When you redefine this macro you get an error:

```
! You can't redefine a frozen macro.
```

This is a prefix like `\global` and it can be combined with other prefixes.[1]

267 \futurecsname

In order to make the repertoire of `def`, `let` and `futurelet` primitives complete we also have:

```
\futurecsname MyMacro:1\endcsname\MyAction
```

268 \futuredef

We elaborate on the example of using `\futurelet` in the previous section. Compare that one with the next:

[1] The `\outer` and `\long` prefixes are no-ops in LuaMetaTEX and LuaTEX can be configured to ignore them.

```
\def\MySpecialToken{[}
\def\DoWhatever{\ifx\NextToken\MySpecialToken YES\else NOP\fi : }
\futurelet\NextToken\DoWhatever [A]\crlf
\futurelet\NextToken\DoWhatever (A)\par
```

This time we get:

NOP: [A]
NOP: (A)

It is for that reason that we now also have `\futuredef`:

```
\def\MySpecialToken{[}
\def\DoWhatever{\ifx\NextToken\MySpecialToken YES\else NOP\fi : }
\futuredef\NextToken\DoWhatever [A]\crlf
\futuredef\NextToken\DoWhatever (A)\par
```

So we're back to what we want:

YES: [A]
NOP: (A)

269 \futureexpand

This primitive can be used as an alternative to a `\futurelet` approach, which is where the name comes from.[2]

```
\def\variantone<#1>{(#1)}
\def\varianttwo#1{[#1]}
\futureexpand<\variantone\varianttwo<one>
\futureexpand<\variantone\varianttwo{two}
```

So, the next token determines which of the two variants is taken:

(one) [two]

Because we look ahead there is some magic involved: spaces are ignored but when we have no match they are pushed back into the input. The next variant demonstrates this:

```
\def\variantone<#1>{(#1)}
\def\varianttwo{}
\def\temp{\futureexpand<\variantone\varianttwo}
[\temp <one>]
[\temp {two}]
[\expandafter\temp\space <one>]
[\expandafter\temp\space {two}]
```

This gives us:

[(one)] [two] [(one)] [two]

[2] In the engine primitives that have similar behavior are grouped in commands that are then dealt with together, code wise.

270 \futureexpandis

We assume that the previous section is read. This variant will not push back spaces, which permits a consistent approach i.e. the user can assume that macro always gobbles the spaces.

```
\def\variantone<#1>{(#1)}
\def\varianttwo{}
\def\temp{\futureexpandis<\variantone\varianttwo}
[\temp <one>]
[\temp {two}]
[\expandafter\temp\space <one>]
[\expandafter\temp\space {two}]
```

So, here no spaces are pushed back. This `is` in the name of this primitive means 'ignore spaces', but having that added to the name would have made the primitive even more verbose (after all, we also don't have `\expandeddef` but `\edef` and no `\globalexpandeddef` but `\xdef`.

[(one)] [two] [(one)] [two]

271 \futureexpandisap

This primitive is like the one in the previous section but also ignores par tokens, so `isap` means 'ignore spaces and paragraphs'.

272 \futurelet

The original TEX primitive `\futurelet` can be used to create an alias to a next token, push it back into the input and then expand a given token.

```
\let\MySpecialTokenL[
\let\MySpecialTokenR] % nicer for checker
\def\DoWhatever{\ifx\NextToken\MySpecialTokenL YES\else NOP\fi : }
\futurelet\NextToken\DoWhatever [A]\crlf
\futurelet\NextToken\DoWhatever (A)\par
```

This is typically the kind of primitive that most users will never use because it expects a sane follow up handler (here `\DoWhatever`) and therefore is related to user interfacing.

YES: [A]
NOP: (A)

273 \gdef

The is the global companion of `\def`.

274 \gdefcsname

As with standard TEX we also define global ones:

```
\expandafter\gdef\csname MyMacro:1\endcsname{...}
```

```
\gdefcsname MyMacro:1\endcsname{...}
```

275 \givenmathstyle

This primitive expects a math style and returns it when valid or otherwise issues an error.

276 \gleaders

Leaders are glue with special property: a box, rule of (in LuaMetaTEX) glyph, like:

x MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMx
xx MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM xx

xMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMx
xx MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM xx

xMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMx
xxMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMxx

xMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMx
xx MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM xx

Leaders fill the available space. The `\leaders` command starts at the left edge and stops when there is no more space. The blobs get centered when we use `\cleaders`: excess space is distributed before and after a blob while `\xleaders` also puts space between the blobs.

When a rule is given the advance (width or height and depth) is ignored, so these are equivalent.

```
x\leaders \hrule           \hfill x
x\leaders \hrule width 1cm \hfill x
```

When a box is used one will normally have some alignment in that box.

```
x\leaders \hbox {\hss.\hss} \hfill            x
x\leaders \hbox {\hss.\hss} \hskip 6cm \relax x
```

The reference point is the left edge of the current (outer) box and the effective glue (when it has stretch or shrink) depends on that box. The `\gleaders` variant takes the page as reference. That makes it possible to 'align' across boxes.

277 \glet

This is the global companion of `\let`. The fact that it is not an original primitive is probably due to the expectation for it not it not being used (as) often (as in ConTEXt).

278 \gletcsname

Naturally LuaMetaTEX also provides a global variant:

```
\expandafter\global\expandafter\let\csname MyMacro:1\endcsname\relax
\expandafter                 \glet\csname MyMacro:1\endcsname\relax
```

```
\gletcsname MyMacro:1\endcsname\relax
```

So, here we save even more.

279 \glettonothing

This is the global companion of `\lettonothing`.

280 \global

This is one of the original prefixes that can be used when we define a macro of change some register.

```
\bgroup
       \def\MyMacroA{a}
\global\def\MyMacroB{a}
      \gdef\MyMacroC{a}
\egroup
```

The macro defined in the first line is forgotten when the groups is left. The second and third definition are both global and these definitions are retained.

281 \globaldefs

When set to a positive value, this internal integer will force all definitions to be global, and in a complex macro package that is not something a user will do unless it is very controlled.

282 \glueexpr

This is a more extensive variant of `\dimexpr` that also handles the optional stretch and shrink components.

283 \glueshrink

This returns the shrink component of a glue quantity. The result is a dimension so you need to apply `\the` when applicable.

284 \glueshrinkorder

This returns the shrink order of a glue quantity. The result is a integer so you need to apply `\the` when applicable.

285 \gluespecdef

A variant of `\integerdef` and `\dimensiondef` is:

```
\gluespecdef\MyGlue = 3pt plus 2pt minus 1pt
```

The properties are comparable to the ones described in the previous sections.

286 \gluestretch

This returns the stretch component of a glue quantity. The result is a dimension so you need to apply `\the` when applicable.

287 \gluestretchorder

This returns the stretch order of a glue quantity. The result is a integer so you need to apply `\the` when applicable.

288 \gluetomu

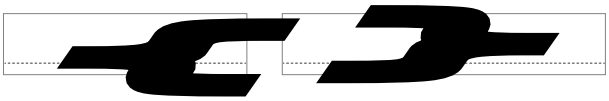
The sequence `\the\gluetomu 20pt plus 10pt minus 5pt` gives 20.0mu plus 10.0mu minus 5.0mu.

289 \glyph

This is a more extensive variant of `\char` that permits setting some properties if the injected character node.

```
\ruledhbox{\glyph
    scale 2000 xscale 9000 yscale 1200
    slant 700 weight 200
    xoffset 10pt yoffset -5pt left 10pt right 20pt
    123}
\quad
\ruledhbox{\glyph
    scale 2000 xscale 9000 yscale 1200
    slant 700 weight 200
    125}
```

In addition one can specify `font` (symbol), `id` (valid font id number), an `options` (bit set) and `raise`.



When no parameters are set, the current ones are used. More details and examples of usage can be found in the ConTEXt distribution.

290 \glyphdatafield

The value of this parameter is assigned to data field in glyph nodes that get injected. It has no meaning in itself but can be used at the Lua end.

291 \glyphoptions

The value of this parameter is assigned to the options field in glyph nodes that get injected.

`0x00000000`	normal	`0x00000002`	norightligature
`0x00000001`	noleftligature	`0x00000004`	noleftkern

0x00000008	norightkern	0x00000400	mathdiscretionary
0x00000010	noexpansion	0x00000800	mathsitalicstoo
0x00000020	noprotrusion	0x00001000	mathartifact
0x00000040	noitaliccorrection	0x00002000	weightless
0x00000080	nozeroitaliccorrection	0x00004000	spacefactoroverload
0x00000100	applyxoffset	0x00010000	userfirst
0x00000200	applyyoffset	0x40000000	userlast

292 \glyphscale

An integer parameter defining the current glyph scale, assigned to glyphs (characters) inserted into the current list.

293 \glyphscriptfield

The value of this parameter is assigned to script field in glyph nodes that get injected. It has no meaning in itself but can be used at the Lua end.

294 \glyphscriptscale

This multiplier is applied to text font and glyph dimension properties when script style is used.

295 \glyphscriptscriptscale

This multiplier is applied to text font and glyph dimension properties when script script style is used.

296 \glyphslant

An integer parameter defining the current glyph slant, assigned to glyphs (characters) inserted into the current list.

297 \glyphstatefield

The value of this parameter is assigned to script state in glyph nodes that get injected. It has no meaning in itself but can be used at the Lua end.

298 \glyphtextscale

This multiplier is applied to text font and glyph dimension properties when text style is used.

299 \glyphweight

An integer parameter defining the current glyph weight, assigned to glyphs (characters) inserted into the current list.

300 \glyphxoffset

An integer parameter defining the current glyph x offset, assigned to glyphs (characters) inserted into the current list. Normally this will only be set when one explicitly works with glyphs and defines a specific sequence.

301 \glyphxscale

An integer parameter defining the current glyph x scale, assigned to glyphs (characters) inserted into the current list.

302 \glyphxscaled

This primitive returns the given dimension scaled by the `\glyphscale` and `\glyphxscale`.

303 \glyphyoffset

An integer parameter defining the current glyph x offset, assigned to glyphs (characters) inserted into the current list. Normally this will only be set when one explicitly works with glyphs and defines a specific sequence.

304 \glyphyscale

An integer parameter defining the current glyph y scale, assigned to glyphs (characters) inserted into the current list.

305 \glyphyscaled

This primitive returns the given dimension scaled by the `\glyphscale` and `\glyphyscale`.

306 \gtoksapp

This is the global variant of `\toksapp`.

307 \gtokspre

This is the global variant of `\tokspre`.

308 \halign

This command starts horizontally aligned material. Macro packages use this command in table mechanisms and math alignments. It starts with a preamble followed by entries (rows and columns).

309 \hangafter

This parameter tells the par builder when indentation specified with `\hangindent` starts. A negative value does the opposite and starts indenting immediately. So, a value of −2 will make the first two lines indent.

310 \hangindent

This parameter relates to \hangafter and sets the amount of indentation. When larger than zero indentation happens left, otherwise it starts at the right edge.

311 \hbadness

This sets the threshold for reporting a horizontal badness value, its current value is 0.

312 \hbox

This constructs a horizontal box. There are a lot of optional parameters so more details can be found in dedicated manuals. When the content is packed a callback can kick in that can be used to apply for instance font features.

313 \hccode

The TEX engine is good at hyphenating but traditionally that has been limited to hyphens. Some languages however use different characters. You can set up a different \hyphenchar as well as pre and post characters, but there's also a dedicated code for controlling this.

```
\hccode"2013 "2013

\hsize 50mm test\char"2013test\par
\hsize  1mm test\char"2013test\par

\hccode"2013 `!

\hsize 50mm test\char"2013test\par
\hsize  1mm test\char"2013test\par
```

This example shows that we can mark a character as hyphen-like but also can remap it to something else:

test–test
test–
test
test–test
test!
test

314 \hfil

This is a shortcut for `\hskip plus 1 fil` (first order filler).

315 \hfill

This is a shortcut for `\hskip plus 1 fill` (second order filler).

316 \hfilneg

This is a shortcut for `\hskip plus - 1 fil` so it can compensate `\hfil`.

317 \hfuzz

This dimension sets the threshold for reporting horizontal boxes that are under- or overfull. The current value is 0.1pt.

318 \hjcode

The so called lowercase code determines if a character is part of a to-be-hyphenated word. In LuaTEX we introduced the 'hyphenation justification' code as replacement. When a language is saved and no `\hjcode` is set the `\lccode` is used instead. This code serves a second purpose. When the assigned value is greater than 0 but less than 32 it indicated the to be used length when checking for left- and righthyphenmin. For instance it make sense to set the code to 2 for characters like œ.

319 \hkern

This primitive is like `\kern` but will force the engine into horizontal mode if it isn't yet.

320 \hmcode

The `hm` stands for 'hyphenation math'. When bit 1 is set the characters will be repeated on the next line after a break. The second bit concerns italic correction but is of little relevance now that we moved to a different model in ConTEXt. Here are some examples, we also show an example of `\mathdiscretionary` because that is what this code triggers:

```
test $ \dorecurse {50} {
    a \discretionary class 2 {$\darkred +$}{$\darkgreen +$}{$\darkblue +$}
} b$

test $ a \mathdiscretionary class 1 {-}{-}{-} b$

\bgroup
    \hmcode"002B=1 % +
    \hmcode"002D=1 % -
    \hmcode"2212=1 % -
    test $ \dorecurse{50}{a + b - } c$
\egroup
```

test $a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a +$
$+ a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + a + b$

test $a - b$

test $a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b -$
$- a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a +$
$+ b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b -$
$- a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - a + b - c$

321 \holdinginserts

When set to a positive value inserts will be kept in the stream and not moved to the insert registers.

322 \holdingmigrations

When set to a positive value marks (and adjusts) will be kept in the stream and not moved to the outer level or related registers.

323 \hpack

This primitive is like `\hbox` but without the callback overhead.

324 \hpenalty

This primitive is like `\penalty` but will force the engine into horizontal mode if it isn't yet.

325 \hrule

This creates a horizontal rule. Unless the width is set it will stretch to fix the available width. In addition to the traditional `width`, `height` and `depth` specifiers some more are accepted. These are discussed in other manuals. To give an idea:

```
h\hrule width 10mm height 2mm depth 1mm \relax rule
h\hrule width 10mm height 2mm depth 1mm xoffset 30mm yoffset -10mm \relax rule
v\vrule width 10mm height 2mm depth 1mm \relax rule
v\vrule width 10mm height 2mm depth 1mm xoffset 30mm yoffset  10mm \relax rule
```

The `\relax` stops scanning and because we have more keywords we get a different error report than in traditional TEX when a lookahead confuses the engine. On separate lines we get the following.

h
rule
h
rule
v rule
v rule

326 \hsize

This sets (or gets) the current horizontal size.

```
\hsize 40pt \setbox0\vbox{x} hsize: \the\wd0
\setbox0\vbox{\hsize 40pt x} hsize: \the\wd0
```

In both cases we get the same size reported but the first one will also influence the current paragraph when used ungrouped.

hsize: 40.0pt
hsize: 40.0pt

327 \hskip

The given glue is injected in the horizontal list. If possible horizontal mode is entered.

328 \hss

In traditional TEX glue specifiers are shared. This makes a lot of sense when memory has to be saved. For instance spaces in a paragraph of text are often the same and a glue specification has at least an amount, stretch, shrink, stretch order and shrink order field plus a leader pointer; in LuaMetaTEX we have even more fields. In LuaTEX these shared (and therefore referenced) glue spec nodes became just copies.

```
x\hbox to 0pt{\hskip 0pt plus 1 fil minus 1 fil\relax test}x
x\hbox to 0pt{\hss test}x
x\hbox to 0pt{test\hskip 0pt plus 1 fil minus 1 fil\relax}x
x\hbox to 0pt{test\hss}x
```

The \hss primitives injects a glue node with one order stretch and one order shrink. In traditional TEX this is a reference to a shared specification, and in LuaTEX just a copy of a predefined specifier. The only gain is now in tokens because one could just be explicit or use a glue register with that value because we have plenty glue registers.

```
testx
testx
   xtest
   xtest
```

We could have this:

```
\permanent\protected\untraced\def\hss
  {\hskip0pt plus 1 fil minus 1 fil\relax}
```

or this:

```
\gluespecdef\hssglue 0pt plus 1 fil minus 1 fil

\permanent\protected\untraced\def\hss
  {\hskip\hssglue}
```

but we just keep the originals around.

329 \ht

Returns the height of the given box.

330 \hyphenation

The list passed to this primitive contains hyphenation exceptions that get bound to the current language. In LuaMetaTEX this can be managed at the Lua end. Exceptions are not stored in the format file.

331 \hyphenationmin

This property (that also gets bond to the current language) sets the minimum length of a word that gets hyphenated.

332 \hyphenchar

This is one of the font related primitives: it returns the number of the hyphen set in the given font.

333 \hyphenpenalty

Discretionary nodes have a related default penalty. The `\hyphenpenalty` is injected after a regular discretionary, and `\exhyphenpenalty` after `\-` or `-`. The later case is called an automatic discretionary. In LuaMetaTEX we have two extra penalties: `\explicithyphenpenalty` and `\automatichyphenpenalty` and these are used when the related bits are set in `\hyphenationmode`.

334 \if

This traditional TEX conditional checks if two character codes are the same. In order to understand unexpanded results it is good to know that internally TEX groups primitives in a way that serves the implementation. Each primitive has a command code and a character code, but only for real characters the name character code makes sense. This condition only really tests for character codes when we have a character, in all other cases, the result is true.

```
\def\A{A}\def\B{B} \chardef\C=`C \chardef\D=`D \def\AA{AA}

[\if AA   YES \else NOP \fi] [\if AB   YES \else NOP \fi]
[\if \A\B YES \else NOP \fi] [\if \A\A YES \else NOP \fi]
[\if \C\D YES \else NOP \fi] [\if \C\C YES \else NOP \fi]
[\if \count\dimen YES \else NOP \fi] [\if \AA\A YES \else NOP \fi]
```

The last example demonstrates that the tokens get expanded, which is why we get the extra A:

[YES] [NOP] [NOP] [YES] [YES] [YES] [YES] [AYES]

335 \ifabsdim

This test will negate negative dimensions before comparison, as in:

```
\def\TestA#1{\ifdim   #1<2pt too small\orelse\ifdim   #1>4pt too large\else okay\fi}
\def\TestB#1{\ifabsdim#1<2pt too small\orelse\ifabsdim#1>4pt too large\else okay\fi}

\TestA {1pt}\quad\TestA {3pt}\quad\TestA {5pt}\crlf
\TestB {1pt}\quad\TestB {3pt}\quad\TestB {5pt}\crlf
\TestB{-1pt}\quad\TestB{-3pt}\quad\TestB{-5pt}\par
```

So we get this:

too small okay too large
too small okay too large
too small okay too large

336 \ifabsfloat

This test will negate negative floats before comparison, as in:

```
\def\TestA#1{\iffloat   #1<2.46 small\orelse\iffloat   #1>4.68 large\else medium\fi}
\def\TestB#1{\ifabsfloat#1<2.46 small\orelse\ifabsfloat#1>4.68 large\else medium\fi}

\TestA {1.23}\quad\TestA {3.45}\quad\TestA {5.67}\crlf
\TestB {1.23}\quad\TestB {3.45}\quad\TestB {5.67}\crlf
\TestB{-1.23}\quad\TestB{-3.45}\quad\TestB{-5.67}\par
```

So we get this:

small medium large
small medium large
small medium large

337 \ifabsnum

This test will negate negative numbers before comparison, as in:

```
\def\TestA#1{\ifnum   #1<100 too small\orelse\ifnum   #1>200 too large\else okay\fi}
\def\TestB#1{\ifabsnum#1<100 too small\orelse\ifabsnum#1>200 too large\else okay\fi}

\TestA {10}\quad\TestA {150}\quad\TestA {210}\crlf
\TestB {10}\quad\TestB {150}\quad\TestB {210}\crlf
\TestB{-10}\quad\TestB{-150}\quad\TestB{-210}\par
```

Here we get the same result each time:

too small okay too large
too small okay too large
too small okay too large

338 \ifarguments

This is a variant of `\ifcase` were the selector is the number of arguments picked up. For example:

```
\def\MyMacro#1#2#3{\ifarguments\0\or1\or2\or3\else ?\fi} \MyMacro{A}{B}{C}
\def\MyMacro#1#0#3{\ifarguments\0\or1\or2\or3\else ?\fi} \MyMacro{A}{B}{C}
\def\MyMacro#1#-#2{\ifarguments\0\or1\or2\or3\else ?\fi} \MyMacro{A}{B}{C}\par
```

Watch the non counted, ignored, argument in the last case. Normally this test will be used in combination with `\ignorearguments`.

3 3 2

339 \ifboolean

This tests a number (register or equivalent) and any nonzero value represents `true`, which is nicer than using an **`\unless\ifcase`**.

340 \ifcase

This numeric TEX conditional takes a counter (literal, register, shortcut to a character, internal quantity) and goes to the branch that matches.

```
\ifcase 3 zero\or one\or two\or three\or four\else five or more\fi
```

Indeed: three equals three. In later sections we will see some LuaMetaTEX primitives that behave like an \ifcase.

341 \ifcat

Another traditional TEX primitive: what happens with what gets read in depends on the catcode of a character, think of characters marked to start math mode, or alphabetic characters (letters) versus other characters (like punctuation).

```
\def\A{A}\def\B{,} \chardef\C=`C \chardef\D=`, \def\AA{AA}

[\ifcat $!   YES \else NOP \fi] [\ifcat ()   YES \else NOP \fi]
[\ifcat AA   YES \else NOP \fi] [\ifcat AB   YES \else NOP \fi]
[\ifcat \A\B YES \else NOP \fi] [\ifcat \A\A YES \else NOP \fi]
[\ifcat \C\D YES \else NOP \fi] [\ifcat \C\C YES \else NOP \fi]
[\ifcat \count\dimen YES \else NOP \fi] [\ifcat \AA\A YES \else NOP \fi]
```

Close reading is needed here:

[NOP] [YES] [YES] [YES] [NOP] [YES] [YES] [YES] [YES] [AYES]

This traditional TEX condition as a well as the one in the previous section are hardly used in ConTEXt, if only because they expand what follows and we seldom need to compare characters.

342 \ifchkdim

A variant on the checker in the previous section is a dimension checker:

```
\ifchkdim oeps        \or okay\else error\fi\quad
\ifchkdim 12          \or okay\else error\fi\quad
\ifchkdim 12pt        \or okay\else error\fi\quad
\ifchkdim 12pt or more\or okay\else error\fi
```

We get:

error error okay okay

343 \ifchkdimension

COntrary to \ifchkdim this test doesn't accept trailing crap:

```
\ifchkdimension oeps        \or okay\else error\fi\quad
\ifchkdimension 12          \or okay\else error\fi\quad
\ifchkdimension 12pt        \or okay\else error\fi\quad
\ifchkdimension 12pt or more\or okay\else error\fi
```

reports:

error error okay error

344 \ifchknum

In ConTEXt there are quite some cases where a variable can have a number or a keyword indicating a symbolic name of a number or maybe even some special treatment. Checking if a valid number is given is possible to some extend, but a native checker makes much sense too. So here is one:

```
\ifchknum oeps         \or okay\else error\fi\quad
\ifchknum 12           \or okay\else error\fi\quad
\ifchknum 12pt         \or okay\else error\fi\quad
\ifchknum 12pt or more\or okay\else error\fi
```

The result is as expected:

error okay okay okay

345 \ifchknumber

This check is more restrictive than `\ifchknum` discussed in the previous section:

```
\ifchknumber oeps         \or okay\else error\fi\quad
\ifchknumber 12           \or okay\else error\fi\quad
\ifchknumber 12pt         \or okay\else error\fi\quad
\ifchknumber 12pt or more\or okay\else error\fi
```

Here we get:

error okay error error

346 \ifcmpdim

This conditional compares two dimensions and the resulting `\ifcase` reflects their relation:

```
[1pt 2pt : \ifcmpdim 1pt 2pt less\or equal\or more\fi]\quad
[1pt 1pt : \ifcmpdim 1pt 1pt less\or equal\or more\fi]\quad
[2pt 1pt : \ifcmpdim 2pt 1pt less\or equal\or more\fi]
```

This gives:

[1pt 2pt : less] [1pt 1pt : equal] [2pt 1pt : more]

347 \ifcmpnum

This conditional compares two numbers and the resulting `\ifcase` reflects their relation:

```
[1 2 : \ifcmpnum 1 2 less\or equal\or more\fi]\quad
[1 1 : \ifcmpnum 1 1 less\or equal\or more\fi]\quad
[2 1 : \ifcmpnum 2 1 less\or equal\or more\fi]
```

This gives:

[1 2 : less] [1 1 : equal] [2 1 : more]

348 \ifcondition

The conditionals in TEX are hard coded as primitives and although it might look like `\newif` creates one, it actually just defined three macros.

```
\newif\ifMyTest
\meaning\MyTesttrue  \crlf
\meaning\MyTestfalse \crlf
\meaning\ifMyTest    \crlf \MyTesttrue
\meaning\ifMyTest    \par
```

```
protected macro:\always \let \ifMyTest \iftrue
protected macro:\always \let \ifMyTest \iffalse
\iffalse
\iftrue
```

This means that when you say:

```
\ifMytest ... \else ... \fi
```

You actually have one of:

```
\iftrue  ... \else ... \fi
\iffalse ... \else ... \fi
```

and because these are proper conditions nesting them like:

```
\ifnum\scratchcounter > 0 \ifMyTest A\else B\fi \fi
```

will work out well too. This is not true for macros, so for instance:

```
\scratchcounter = 1
\unexpanded\def\ifMyTest{\iftrue}
\ifnum\scratchcounter > 0 \ifMyTest A\else B\fi \fi
```

will make a run fail with an error (or simply loop forever, depending on your code). This is where `\ifcondition` enters the picture:

```
\def\MyTest{\iftrue} \scratchcounter0
\ifnum\scratchcounter > 0
    \ifcondition\MyTest A\else B\fi
\else
    x
\fi
```

This primitive is seen as a proper condition when TEX is in “fast skipping unused branches” mode but when it is expanding a branch, it checks if the next expanded token is a proper tests and if so, it deals with that test, otherwise it fails. The main condition here is that the `\MyTest` macro expands to a proper true or false test, so, a definition like:

```
\def\MyTest{\ifnum\scratchcounter<10 }
```

is also okay. Now, is that neat or not?

349 \ifcramped

Depending on the given math style this returns true of false:

```
\ifcramped\mathstyle        no  \fi
\ifcramped\crampedtextstyle yes \fi
\ifcramped\textstyle        no  \fi
\ifcramped\displaystyle     yes \fi
```

gives: yes.

350 \ifcsname

This is an ε-TEX conditional that complements the one on the previous section:

```
\expandafter\ifx\csname MyMacro\endcsname\relax ... \else ... \fi
           \ifcsname   MyMacro\endcsname       ... \else ... \fi
```

Here the first one has the side effect of defining the macro and defaulting it to `\relax`, while the second one doesn't do that. Just think of checking a few million different names: the first one will deplete the hash table and probably string space too.

In LuaMetaTEX the construction stops when there is no letter or other character seen (TEX expands on the go so expandable macros are dealt with). Instead of an error message, the match is simply false and all tokens till the `\endcsname` are gobbled.

351 \ifcstok

A variant on the primitive mentioned in the previous section is one that operates on lists and macros:

```
\def\a{a} \def\b{b} \def\c{a}
```

This:

```
\ifcstok\a\b   Y\else N\fi\space
\ifcstok\a\c   Y\else N\fi\space
\ifcstok{\a}\c Y\else N\fi\space
\ifcstok{a}\c  Y\else N\fi
```

will give us: N Y Y Y.

352 \ifdefined

In traditional TEX checking for a macro to exist was a bit tricky and therefore ε-TEX introduced a convenient conditional. We can do this:

```
\ifx\MyMacro\undefined ... \else ... \fi
```

but that assumes that \undefined is indeed undefined. Another test often seen was this:

```
\expandafter\ifx\csname MyMacro\endcsname\relax ... \else ... \fi
```

Instead of comparing with \undefined we need to check with \relax because the control sequence is defined when not yet present and defaults to \relax. This is not pretty.

353 \ifdim

Dimensions can be compared with this traditional TEX primitive.

```
\scratchdimen=1pt \scratchcounter=65536

\ifdim\scratchdimen=\scratchcounter sp YES \else NOP\fi
\ifdim\scratchdimen=1               pt YES \else NOP\fi
```

The units are mandate:

YES YES

354 \ifdimexpression

The companion of the previous primitive is:

This matches when the result is non zero, and you can mix calculations and tests as with normal expressions. Contrary to the number variant units can be used and precision kicks in.

355 \ifdimval

This conditional is a variant on \ifchkdim and provides some more detailed information about the value:

```
[-12pt : \ifdimval-12pt\or negative\or zero\or positive\else error\fi]\quad
[0pt   : \ifdimval  0pt\or negative\or zero\or positive\else error\fi]\quad
[12pt  : \ifdimval 12pt\or negative\or zero\or positive\else error\fi]\quad
[oeps  : \ifdimval oeps\or negative\or zero\or positive\else error\fi]
```

This gives:

[-12pt : negative] [0pt : zero] [12pt : positive] [oeps : error]

356 \ifempty

This conditional checks if a control sequence is empty:

```
is \ifempty\MyMacro \else not \fi empty
```

It is basically a shortcut of:

```
is \ifx\MyMacro\empty \else not \fi empty
```

with:

```
\def\empty{}
```

Of course this is not empty at all:

```
\def\notempty#1{}
```

357 \iffalse

Here we have a traditional TEX conditional that is always false (therefore the same is true for any macro that is `\let` to this primitive).

358 \ifflags

This test primitive relates to the various flags that one can set on a control sequence in the perspective of overload protection and classification.

```
\protected\untraced\tolerant\def\foo[#1]{...#1...}
\permanent\constant          \def\oof{okay}
```

flag	\foo	\oof	flag	\foo	\oof
frozen	N	N	permanent	N	Y
immutable	N	N	mutable	N	N
noaligned	N	N	instance	N	N
untraced	Y	N	global	N	N
tolerant	Y	N	constant	N	Y
protected	Y	N	semiprotected	N	N

Instead of checking against a prefix you can test against a bitset made from:

0x1	frozen	0x2	permanent	0x4	immutable	0x8	primitive
0x10	mutable	0x20	noaligned	0x40	instance	0x80	untraced
0x100	global	0x200	tolerant	0x400	protected	0x800	overloaded
0x1000	aliased	0x2000	immediate	0x4000	conditional	0x8000	value
0x10000	semiprotected	0x20000	inherited	0x40000	constant	0x80000	deferred

359 \iffloat

This test does for floats what `\ifnum`, `\ifdim` do for numbers and dimensions: comparing two of them.

360 \iffontchar

This is an ε-TEX conditional. It takes a font identifier and a character number. In modern fonts simply checking could not be enough because complex font features can swap in other ones and their index can be anything. Also, a font mechanism can provide fallback fonts and characters, so don't rely on this one too much. It just reports true when the font passed to the frontend has a slot filled.

361 \ifhaschar

This one is a simplified variant of the above:

```
\ifhaschar !{this ! works} yes \else no \fi
```

and indeed we get: yes! Of course the spaces in this this example code are normally not present in such a test.

362 \ifhastok

This conditional looks for occurrences in token lists where each argument has to be a proper list.

```
\def\scratchtoks{x}

\ifhastoks{yz}         {xyz} Y\else N\fi\quad
\ifhastoks\scratchtoks {xyz} Y\else N\fi
```

We get:

Y Y

363 \ifhastoks

This test compares two token lists. When a macro is passed it's meaning gets used.

```
\def\x  {x}
\def\xyz{xyz}

(\ifhastoks  {x}  {xyz}Y\else N\fi)\quad
(\ifhastoks {\x}  {xyz}Y\else N\fi)\quad
(\ifhastoks  \x   {xyz}Y\else N\fi)\quad
(\ifhastoks  {y}  {xyz}Y\else N\fi)\quad
(\ifhastoks {yz}  {xyz}Y\else N\fi)\quad
(\ifhastoks {yz} {\xyz}Y\else N\fi)
```

(Y) (N) (Y) (Y) (Y) (N)

364 \ifhasxtoks

This primitive is like the one in the previous section but this time the given lists are expanded.

```
\def\x  {x}
\def\xyz{\x yz}

(\ifhasxtoks  {x}  {xyz}Y\else N\fi)\quad
(\ifhasxtoks {\x}  {xyz}Y\else N\fi)\quad
(\ifhastoks   \x   {xyz}Y\else N\fi)\quad
(\ifhasxtoks  {y}  {xyz}Y\else N\fi)\quad
(\ifhasxtoks {yz}  {xyz}Y\else N\fi)\quad
(\ifhasxtoks {yz} {\xyz}Y\else N\fi)
```

(Y) (Y) (Y) (Y) (Y) (Y)

This primitive has some special properties.

```
\edef\+{\expandtoken 9 `+}

\ifhasxtoks {xy}   {xyz}Y\else N\fi\quad
\ifhasxtoks {x\+y} {xyz}Y\else N\fi
```

Here the first argument has a token that has category code ‘ignore’ which means that such a character will be skipped when seen. So the result is:

Y Y

This permits checks like these:

```
\edef\,{\expandtoken 9 `,}

\ifhasxtoks{\,x\,} {,x,y,z,}Y\else N\fi\quad
\ifhasxtoks{\,y\,} {,x,y,z,}Y\else N\fi\quad
\ifhasxtoks{\,z\,} {,x,y,z,}Y\else N\fi\quad
\ifhasxtoks{\,x\,}  {,xy,z,}Y\else N\fi
```

I admit that it needs a bit of a twisted mind to come up with this, but it works ok:

Y Y Y N

365 \ifhbox

This traditional conditional checks if a given box register or internal box variable represents a horizontal box,

366 \ifhmode

This traditional conditional checks we are in (restricted) horizontal mode.

367 \ifinalignment

As the name indicates, this primitive tests for being in an alignment. Roughly spoken, the engine is either in a state of align, handling text or dealing with math.

368 \ifincsname

This conditional is sort of obsolete and can be used to check if we're inside a `\csname` or `\ifcsname` construction. It's not used in ConTEXt.

369 \ifinner

This traditional one can be confusing. It is true when we are in restricted horizontal mode (a box), internal vertical mode (a box), or inline math mode.

```
test \ifhmode \ifinner INNER\fi HMODE\fi\crlf
\hbox{test \ifhmode \ifinner INNER \fi HMODE\fi} \par

\ifvmode \ifinner INNER\fi VMODE \fi\crlf
```

```
\vbox{\ifvmode \ifinner INNER \fi VMODE\fi} \crlf
\vbox{\ifinner INNER \ifvmode VMODE \fi \fi} \par
```

Watch the last line: because we typeset `INNER` we enter horizontal mode:

test HMODE
test INNER HMODE

VMODE
INNER VMODE
INNER

370 \ifinsert

This is the equivalent of `\ifvoid` for a given insert class.

371 \ifintervaldim

This conditional is true when the intervals around the values of two dimensions overlap. The first dimension determines the interval.

```
[\ifintervaldim1pt 20pt 21pt \else no \fi overlap]
[\ifintervaldim1pt 18pt 20pt \else no \fi overlap]
```

So here: [overlap] [no overlap]

372 \ifintervalfloat

This one does with floats what we described under `\ifintervaldim`.

373 \ifintervalnum

This one does with integers what we described under `\ifintervaldim`.

374 \iflastnamedcs

When a `\csname` is constructed and succeeds the last one is remembered and can be accessed with `\lastnamedcs`. It can however be an undefined one. That state can be checked with this primitive. Of course it also works with the `\ifcsname` and `\begincsname` variants.

375 \ifmathparameter

This is an `\ifcase` where the value depends on if the given math parameter is zero, (`0`), set (`1`), or unset (`2`).

```
\ifmathparameter\Umathpunctclosespacing\displaystyle
    zero    \or
    nonzero \or
    unset   \fi
```

376 \ifmathstyle

This is a variant of \ifcase were the number is one of the seven possible styles: display, text, cramped text, script, cramped script, script script, cramped script script.

```
\ifmathstyle
  display
\or
  text
\or
  cramped text
\else
  normally smaller than text
\fi
```

377 \ifmmode

This traditional conditional checks we are in (inline or display) math mode mode.

378 \ifnum

This is a frequently used conditional: it compares two numbers where a number is anything that can be seen as such.

```
\scratchcounter=65 \chardef\A=65

\ifnum65=`A               YES \else NOP\fi
\ifnum\scratchcounter=65 YES \else NOP\fi
\ifnum\scratchcounter=\A YES \else NOP\fi
```

Unless a number is an unexpandable token it ends with a space or \relax, so when you end up in the true branch, you'd better check if TEX could determine where the number ends.

YES YES YES

On top of these ascii combinations, the engine also accepts some Unicode characters. This brings the full repertoire to:

character			operation
0x003C	<		less
0x003D	=		equal
0x003E	>		more
0x2208	∈		element of
0x2209	∉		not element of
0x2260	≠	!=	not equal
0x2264	≤	!>	less equal
0x2265	≥	!<	greater equal
0x2270	≰		not less equal
0x2271	≱		not greater equal

This also applied to \ifdim although in the case of element we discard the fractional part (read: divide the numeric representation by 65536).

379 \ifnumexpression

Here is an example of a conditional using expressions:

This matches when the result is non zero, and you can mix calculations and tests as with normal expressions.

380 \ifnumval

This conditional is a variant on \ifchknum. This time we get some more detail about the value:

```
[-12  : \ifnumval  -12\or negative\or zero\or positive\else error\fi]\quad
[0    : \ifnumval    0\or negative\or zero\or positive\else error\fi]\quad
[12   : \ifnumval   12\or negative\or zero\or positive\else error\fi]\quad
[oeps : \ifnumval oeps\or negative\or zero\or positive\else error\fi]
```

This gives:

[-12 : negative] [0 : zero] [12 : positive] [oeps : error]

381 \ifodd

One reason for this condition to be around is that in a double sided layout we need test for being on an odd or even page. It scans for a number the same was as other primitives,

```
\ifodd65 YES \else NO\fi &
\ifodd`B YES \else NO\fi .
```

So: YES & NO.

382 \ifparameter

In a macro body #1 is a reference to a parameter. You can check if one is set using a dedicated parameter condition:

```
\tolerant\def\foo[#1]#*[#2]%
  {\ifparameter#1\or one\else no one\fi\enspace
   \ifparameter#2\or two\else no two\fi\emspace}

\foo
\foo[1]
\foo[1][2]
```

We get:

no one no two one no two one two

383 \ifparameters

This is equivalent to an \ifcase with as value the number of parameters passed to the current macro.

384 \ifrelax

This is a convenient shortcut for **\ifx\relax** and the motivation for adding this one is (as with some others) to get less tracing.

385 \iftok

When you want to compare two arguments, the usual way to do this is the following:

```
\edef\tempA{#1}
\edef\tempb{#2}
\ifx\tempA\tempB
    the same
\else
    different
\fi
```

This works quite well but the fact that we need to define two macros can be considered a bit of a nuisance. It also makes macros that use this method to be not so called 'fully expandable'. The next one avoids both issues:

```
\iftok{#1}{#2}
    the same
\else
    different
\fi
```

Instead of direct list you can also pass registers, so given:

```
\scratchtoks{a}%
\toks0{a}%
```

This:

```
\iftok 0 \scratchtoks          Y\else N\fi\space
\iftok{a}\scratchtoks          Y\else N\fi\space
\iftok\scratchtoks\scratchtoks Y\else N\fi
```

gives: Y Y Y.

386 \iftrue

Here we have a traditional TEX conditional that is always true (therefore the same is true for any macro that is \let to this primitive).

387 \ifvbox

This traditional conditional checks if a given box register or internal box variable represents a vertical box,

388 \ifvmode

This traditional conditional checks we are in (internal) vertical mode.

389 \ifvoid

This traditional conditional checks if a given box register or internal box variable has any content.

390 \ifx

We use this traditional TEX conditional a lot in ConTEXt. Contrary to `\if` the two tokens that are compared are not expanded. This makes it possible to compare the meaning of two macros. Depending on the need, these macros can have their content expanded or not. A different number of parameters results in false.

Control sequences are identical when they have the same command code and character code. Because a `\let` macro is just a reference, both let macros are the same and equal to `\relax`:

```
\let\one\relax \let\two\relax
```

The same is true for other definitions that result in the same (primitive) or meaning encoded in the character field (think of `\chardefs` and so).

391 \ifzerodim

This tests for a dimen (dimension) being zero so we have:

```
\ifdim<dimension>=0pt
\ifzerodim<dimension>
\ifcase<dimension register>
```

392 \ifzerofloat

As the name indicated, this tests for a zero float value.

```
[\scratchfloat\zerofloat \ifzerofloat\scratchfloat \else not \fi zero]
[\scratchfloat\plusone   \ifzerofloat\scratchfloat \else not \fi zero]
[\scratchfloat 0.01      \ifzerofloat\scratchfloat \else not \fi zero]
[\scratchfloat 0.0e0     \ifzerofloat\scratchfloat \else not \fi zero]
[\scratchfloat \zeropoint\ifzerofloat\scratchfloat \else not \fi zero]
```

So: [zero] [not zero] [not zero] [zero] [zero]

393 \ifzeronum

This tests for a number (integer) being zero so we have these variants now:

```
\ifnum<integer or equivalent>=0
\ifzeronum<integer or equivalent>
\ifcase<integer or equivalent>
```

394 \ignorearguments

This primitive will quit argument scanning and start expansion of the body of a macro. The number of grabbed arguments can be tested as follows:

```
\def\MyMacro[#1][#2][#3]%
 {\ifarguments zero\or one\or two\or three \else hm\fi}

\MyMacro          \ignorearguments \quad
\MyMacro       [1]\ignorearguments \quad
\MyMacro    [1][2]\ignorearguments \quad
\MyMacro [1][2][3]\ignorearguments \par
```

zero one two three

Todo: explain optional delimiters.

395 \ignoredepthcriterion

When setting the `\prevdepth` (either by TEX or by the current user) of the current vertical list the value 1000pt is a signal for special treatment of the skip between 'lines'. There is an article on that in the distribution. It also demonstrates that `\ignoredepthcriterion` can be used to change this special signal, just in case it is needed.

396 \ignorenestedupto

This primitive gobbles following tokens and can deal with nested 'environments', for example:

```
\def\startfoo{\ignorenestedupto\startfoo\stopfoo}

(before
\startfoo
    test \startfoo test \stopfoo
   {test \startfoo test \stopfoo}
\stopfoo
after)
```

delivers:

(before after)

397 \ignorepars

This is a variant of `\ignorespaces`: following spaces *and* **\par** equivalent tokens are ignored, so for instance:

```
one + \ignorepars
```

```
two = \ignorepars \par
three
```

renders as: one + two = three. Traditionally TEX has been sensitive to \par tokens in some of its building blocks. This has to do with the fact that it could indicate a runaway argument which in the times of slower machines and terminals was best to catch early. In LuaMetaTEX we no longer have long macros and the mechanisms that are sensitive can be told to accept \par tokens (and ConTEXt set them such that this is the case).

398 \ignorerest

An example shows what this primitive does:

```
\tolerant\def\foo[#1]#*[#2]%
  {1234
   \ifparameter#1\or\else
     \expandafter\ignorerest
   \fi
   /#1/
   \ifparameter#2\or\else
     \expandafter\ignorerest
   \fi
   /#2/ }

\foo test \foo[456] test \foo[456][789] test
```

As this likely makes most sense in conditionals you need to make sure the current state is properly finished. Because \expandafter bumps the input state, here we actually quit two levels; this is because so called 'backed up text' is intercepted by this primitive.

1234 test 1234 /456/ test 1234 /456/ /789/ test

399 \ignorespaces

This traditional TEX primitive signals the scanner to ignore the following spaces, if any. We mention it because we show a companion in the next section.

400 \ignoreupto

This ignores everything upto the given token, so

```
\ignoreupto \foo not this but\foo only this
```

will give: only this.

401 \immediate

This one has no effect unless you intercept it at the Lua end and act upon it. In original TEX immediate is used in combination with read from and write to file operations. So, this is an old primitive with a new meaning.

402 \immutable

This prefix flags what follows as being frozen and is usually applied to for instance `\integerdef`'d control sequences. In that respect is is like `\permanent` but it makes it possible to distinguish quantities from macros.

403 \indent

In engines other than LuaMetaTEX a paragraph starts with an indentation box. The width of that (empty) box is determined by `\parindent`. In LuaMetaTEX we can use a dedicated indentation skip instead (as part of paragraph normalization). An indentation can be zero'd with `\undent`.

404 \indexedsubprescript

This primitive (or `____`) puts a flag on the script but renders the same:

```
$
    x \indexedsuperprescript{2} \subprescript       {2} +
    x \superprescript       {2} \indexedsubprescript{2} +
    x \superprescript       {2} ____                {2} =
    x \superprescript       {2} \subprescript       {2}
$
```

Gives: ${}^{2}_{2}x + {}^{2}_{2}x + {}^{2}_{2}x = {}^{2}_{2}x$.

405 \indexedsubscript

This primitive (or `__`) puts a flag on the script but renders the same:

```
$
    x \indexedsuperscript{2} \subscript       {2} +
    x \superscript       {2} \indexedsubscript{2} +
    x \superscript       {2} __                {2} =
    x \superscript       {2} \subscript       {2}
$
```

Gives: $x^{2}_{2} + x^{2}_{2} + x^{2}_{2} = x^{2}_{2}$.

406 \indexedsuperprescript

This primitive (or `^^^^`) puts a flag on the script but renders the same:

```
$
    x \indexedsuperprescript{2} \subprescript       {2} +
    x ^^^^                  {2} \subprescript       {2} +
    x \superprescript       {2} \indexedsubprescript{2} =
    x \superprescript       {2} \subprescript       {2}
$
```

Gives: ${}^{2}_{2}x + {}^{2}_{2}x + {}^{2}_{2}x = {}^{2}_{2}x$.

407 \indexedsuperscript

This primitive (or ^^) puts a flag on the script but renders the same:

```
$
    x \indexedsuperscript{2} \subscript       {2} +
    x ^^                 {2} \subscript       {2} +
    x \superscript       {2} \indexedsubscript{2} =
    x \superscript       {2} \subscript       {2}
$
```

Gives: $x_2^2 + x_2^2 + x_2^2 = x_2^2$.

408 \indexofcharacter

This primitive is more versatile variant of the backward quote operator, so instead of:

```
\number`|
\number`~
\number`\a
\number`\q
```

you can say:

```
\the\indexofcharacter |
\the\indexofcharacter ~
\the\indexofcharacter \a
\the\indexofcharacter \q
```

In both cases active characters and unknown single character control sequences are valid. In addition this also works:

```
\chardef    \foo 128
\mathchardef\oof 130

\the\indexofcharacter \foo
\the\indexofcharacter \oof
```

An important difference is that `\indexofcharacter` returns an integer and not a serialized number. A negative value indicates no valid character.

409 \indexofregister

You can use this instead of `\number` for determining the index of a register but it also returns a number when a register value is seen. The result is an integer, not a serialized number.

410 \inherited

When this prefix is used in a definition using `\let` the target will inherit all the properties of the source.

411 \initcatcodetable

This initializes the catcode table with the given index.

412 \initialpageskip

When a page starts the value of this register are used to initialize `\pagetotal`, `\pagestretch` and `\pageshrink`. This make nicer code than using a `\topskip` with weird values.

413 \initialtopskip

When set this one will be used instead of `\topskip`. The rationale is that the `\topskip` is often also used for side effects and compensation.

414 \input

There are several ways to use this primitive:

```
\input  test
\input {test}
\input "test"
\input 'test'
```

When no suffix is given, TEX will assume the suffix is `.tex`. The second one is normally used.

415 \inputlineno

This integer holds the current linenumber but it is not always reliable.

416 \insert

This stores content in the insert container with the given index. In LuaMetaTEX inserts bubble up to outer boxes so we don't have the ‘deeply buried insert issue’.

417 \insertbox

This is the accessor for the box (with results) of an insert with the given index. This is equivalent to the `\box` in the traditional method.

418 \insertcopy

This is the accessor for the box (with results) of an insert with the given index. It makes a copy so the original is kept. This is equivalent to a `\copy` in the traditional method.

419 \insertdepth

This is the (current) depth of the inserted material with the given index. It is comparable to the `\dp` in the traditional method.

420 \insertdistance

This is the space before the inserted material with the given index. This is equivalent to `\glue` in the traditional method.

421 \insertheight

This is the (current) depth of the inserted material with the given index. It is comparable to the `\ht` in the traditional method.

422 \insertheights

This is the combined height of the inserted material.

423 \insertlimit

This is the maximum height that the inserted material with the given index can get. This is equivalent to `\dimen` in the traditional method.

424 \insertmaxdepth

This is the maximum depth that the inserted material with the given index can get.

425 \insertmode

In traditional TEX inserts are controlled by a `\box`, `\dimen`, `\glue` and `\count` register with the same index. The allocators have to take this into account. When this primitive is set to one a different model is followed with its own namespace. There are more abstract accessors to interface to this.[3]

426 \insertmultiplier

This is the height (contribution) multiplier for the inserted material with the given index. This is equivalent to `\count` in the traditional method.

427 \insertpenalties

This dual purpose internal counter holds the sum of penalties for insertions that got split. When we're the output routine in reports the number of insertions that is kept in store.

428 \insertpenalty

This is the insert penalty associated with the inserted material with the given index.

429 \insertprogress

This returns the current accumulated insert height of the insert with the given index.

[3] The old model might be removed at some point.

430 \insertstorage

The value passed will enable (one) or disable (zero) the insert with the given index.

431 \insertstoring

The value passed will enable (one) or disable (zero) inserts.

432 \insertunbox

This is the accessor for the box (with results) of an insert with the given index. It makes a copy so the original is kept. The content is unpacked and injected. This is equivalent to an \unvbox in the traditional method.

433 \insertuncopy

This is the accessor for the box (with results) of an insert with the given index. It makes a copy so the original is kept. The content is unpacked and injected. This is equivalent to the \unvcopy in the traditional method.

434 \insertwidth

This is the (current) width of the inserted material with the given index. It is comparable to the \wd in the traditional method.

435 \instance

This prefix flags a macro as an instance which is mostly relevant when a macro package want to categorize macros.

436 \integerdef

You can alias to a count (integer) register with \countdef:

```
\countdef\MyCount134
```

Afterwards the next two are equivalent:

```
\MyCount   = 99
\count1234 = 99
```

where \MyCount can be a bit more efficient because no index needs to be scanned. However, in terms of storage the value (here 99) is always in the register so \MyCount has to get there. This indirectness has the benefit that directly setting the value is reflected in the indirect accessor.

```
\integerdef\MyCount = 99
```

This primitive also defines a numeric equivalent but this time the number is stored with the equivalent. This means that:

```
\let\MyCopyOfCount = \MyCount
```

will store the *current* value of `\MyCount` in `\MyCopyOfCount` and changing either of them is not reflected in the other.

The usual `\advance`, `\multiply` and `\divide` can be used with these integers and they behave like any number. But compared to registers they are actually more a constant.

437 \interactionmode

This internal integer can be used to set or query the current interaction mode:

\batchmode	0	omits all stops and terminal output
\nonstopmode	1	omits all stops
\scrollmode	2	omits error stops
\errorstopmode	3	stops at every opportunity to interact

438 \interlinepenalties

This is a more granular variant of `\interlinepenalty`: an array of penalties to be put between successive line from the start of a paragraph. The list starts with the number of penalties that gets passed.

439 \interlinepenalty

This is the penalty that is put between lines.

440 \jobname

This gives the current job name without suffix: `primitives`.

441 \kern

A kern is injected with the given dimension. For variants that switch to a mode we have `\hkern` and `\vkern`.

442 \language

Sets (or returns) the current language, a number. In LuaTEX and LuaMetaTEX the current language is stored in the glyph nodes.

443 \lastarguments

```
\def\MyMacro    #1{\the\lastarguments (#1) }          \MyMacro{1}       \crlf
\def\MyMacro  #1#2{\the\lastarguments (#1) (#2)}     \MyMacro{1}{2}    \crlf
\def\MyMacro#1#2#3{\the\lastarguments (#1) (#2) (#3)} \MyMacro{1}{2}{3} \par

\def\MyMacro    #1{(#1)           \the\lastarguments} \MyMacro{1}       \crlf
\def\MyMacro  #1#2{(#1) (#2)      \the\lastarguments} \MyMacro{1}{2}    \crlf
```

```
\def\MyMacro#1#2#3{(#1) (#2) (#3) \the\lastarguments} \MyMacro{1}{2}{3} \par
```

The value of `\lastarguments` can only be trusted in the expansion until another macro is seen and expanded. For instance in these examples, as soon as a character (like the left parenthesis) is seen, horizontal mode is entered and `\everypar` is expanded which in turn can involve macros. You can see that in the second block (that is: unless we changed `\everypar` in the meantime).

1(1)
2(1) (2)
3(1) (2) (3)

(1) 0
(1) (2) 2
(1) (2) (3) 3

444 \lastatomclass

This returns the class number of the last atom seen in the math input parser.

445 \lastboundary

This primitive looks back in the list for a user boundary injected with `\boundary` and when seen it returns that value or otherwise zero.

446 \lastbox

When issued this primitive will, if possible, pull the last box from the current list.

447 \lastchkdimension

When the last check for a dimension with `\ifchkdimension` was successful this primitive returns the value.

448 \lastchknumber

When the last check for an integer with `\ifchknumber` was successful this primitive returns the value.

449 \lastkern

This returns the last kern seen in the list (if possible).

450 \lastleftclass

This variable registers the first applied math class in a formula.

451 \lastlinefit

The ε-TEX manuals explains this parameter in detail but in practice it is enough to know that when set to 1000 spaces in the last line might match those in the previous line. Basically it counters the strong push of a `\parfillskip`.

452 \lastloopiterator

In addition to \currentloopiterator we have a variant that stores the value in case an unexpanded loop is used:

```
\localcontrolledrepeat 8 { [\the\currentloopiterator\eq\the\lastloopiterator] }
\expandedrepeat        8 { [\the\currentloopiterator\eq\the\lastloopiterator] }
\unexpandedrepeat      8 { [\the\currentloopiterator\ne\the\lastloopiterator] }
```

```
[1=1] [2=2] [3=3] [4=4] [5=5] [6=6] [7=7] [8=8]
[1=1] [2=2] [3=3] [4=4] [5=5] [6=6] [7=7] [8=8]
[0≠1] [0≠2] [0≠3] [0≠4] [0≠5] [0≠6] [0≠7] [0≠8]
```

453 \lastnamedcs

The example code in the previous section has some redundancy, in the sense that there to be looked up control sequence name mymacro is assembled twice. This is no big deal in a traditional eight bit TEX but in a Unicode engine multi-byte sequences demand some more processing (although it is unlikely that control sequences have many multi-byte utf8 characters).

```
\ifcsname mymacro\endcsname
    \csname mymacro\endcsname
\fi
```

Instead we can say:

```
\ifcsname mymacro\endcsname
    \lastnamedcs
\fi
```

Although there can be some performance benefits another advantage is that it uses less tokens and parsing. It might even look nicer.

454 \lastnodesubtype

When possible this returns the subtype of the last node in the current node list. Possible values can be queried (for each node type) via Lua helpers.

455 \lastnodetype

When possible this returns the type of the last node in the current node list. Possible values can be queried via Lua helpers.

456 \lastpageextra

This reports the last applied (permitted) overshoot.

457 \lastparcontext

When a paragraph is wrapped up the reason is reported by this state variable. Possible values are:

0x00	normal	0x04	dbox	0x08	output	0x0C	math
0x01	vmode	0x05	vcenter	0x09	align	0x0D	lua
0x02	vbox	0x06	vadjust	0x0A	noalign	0x0E	reset
0x03	vtop	0x07	insert	0x0B	span		

458 \lastpartrigger

There are several reasons for entering a paragraphs and some are automatic and triggered by other commands that force TEX into horizontal mode.

0x00	normal	0x04	mathchar	0x08	math	0x0C	valign
0x01	force	0x05	char	0x09	kern	0x0D	vrule
0x02	indent	0x06	boundary	0x0A	hskip		
0x03	noindent	0x07	space	0x0B	unhbox		

459 \lastpenalty

This returns the last penalty seen in the list (if possible).

460 \lastrightclass

This variable registers the last applied math class in a formula.

461 \lastskip

This returns the last glue seen in the list (if possible).

462 \lccode

When the `\lowercase` operation is applied the lowercase code of a character is used for the replacement. This primitive is used to set that code, so it expects two character number. The code is also used to determine what characters make a word suitable for hyphenation, although in LuaTEX we introduced the `\hj` code for that.

463 \leaders

See `\gleaders` for an explanation.

464 \left

Inserts the given delimiter as left fence in a math formula.

465 \lefthyphenmin

This is the minimum number of characters after the last hyphen in a hyphenated word.

466 \leftmarginkern

The dimension returned is the protrusion kern that has been added (if at all) to the left of the content in the given box.

467 \leftskip

This skip will be inserted at the left of every line.

468 \leqno

This primitive stores the (typeset) content (presumably a number) and when the display formula is wrapped that number will end up left of the formula.

469 \let

Where a `\def` creates a new macro, either or not with argument, a `\let` creates an alias. You are not limited to aliasing macros, basically everything can be aliased.

470 \letcharcode

Assigning a meaning to an active character can sometimes be a bit cumbersome; think of using some documented uppercase magic that one tends to forget as it's used only a few times and then never looked at again. So we have this:

```
{\letcharcode 65 1 \catcode 65 13 A : \meaning A}\crlf
{\letcharcode 65 2 \catcode 65 13 A : \meaning A}\par
```

here we define `A` as an active charcter with meaning `1` in the first line and `2` in the second.

```
1 : the character U+0031 1
2 : the character U+0032 2
```

Normally one will assign a control sequence:

```
{\letcharcode 66 \bf \catcode 66 13 {B   bold}: \meaning B}\crlf
{\letcharcode 73 \it \catcode 73 13 {I italic}: \meaning I}\par
```

Of course `\bf` and `\it` are ConTEXt specific commands:

```
bold: protected macro:\ifmmode \expandafter \mathbf \else \expandafter \normalbf \fi
italic: protected macro:\ifmmode \expandafter \mathit \else \expandafter \normalit \fi
```

471 \letcsname

It is easy to see that we save two tokens when we use this primitive. As with the `..defcs..` variants it also saves a push back of the composed macro name.

```
\expandafter\let\csname MyMacro:1\endcsname\relax
            \letcsname MyMacro:1\endcsname\relax
```

472 \letfrozen

You can explicitly freeze an unfrozen macro:

```
\def\MyMacro{...}
\letfrozen\MyMacro
```

A redefinition will now give:

```
! You can't redefine a frozen macro.
```

473 \letmathatomrule

You can change the class for a specific style. This probably only makes sense for user classes. It's one of those features that we used when experimenting with more control.

```
\letmathatomrule 4 = 4 4 0 0
\letmathatomrule 5 = 5 5 0 0
```

This changes the classes 4 and 5 into class 0 in the two script styles and keeps them the same in display and text. We leave it to the reader to ponder how useful this is.

474 \letmathparent

This primitive takes five arguments: the target class, and four classes that determine the pre penalty class, post penalty class, options class and a dummy class for future use.

475 \letmathspacing

By default inter-class spacing inherits from the ordinary class but you can remap specific combinations is you want:

```
\letmathspacing \mathfunctioncode
    \mathordinarycode \mathordinarycode
    \mathordinarycode \mathordinarycode
```

The first value is the target class, and the nest four tell how it behaves in display, text, script and script script style. Here `\mathfunctioncode` is a ConTEXt specific class (26), one of the many.

476 \letprotected

Say that you have these definitions:

```
            \def  \MyMacroA{alpha}
\protected  \def  \MyMacroB{beta}
            \edef \MyMacroC{\MyMacroA\MyMacroB}
\letprotected     \MyMacroA
            \edef \MyMacroD{\MyMacroA\MyMacroB}
\meaning          \MyMacroC\crlf
\meaning          \MyMacroD\par
```

The typeset meaning in this example is:

```
macro:alpha\MyMacroB
macro:\MyMacroA \MyMacroB
```

477 \lettolastnamedcs

The \lastnamedcs primitive is somewhat special as it is a (possible) reference to a control sequence which is why we have a dedicated variant of \let.

```
\csname relax\endcsname\let                          \foo\lastnamedcs \meaning\foo
\csname relax\endcsname\expandafter\let\expandafter \oof\lastnamedcs \meaning\oof
\csname relax\endcsname\lettolastnamedcs             \ofo             \meaning\ofo
```

These give the following where the first one obviously is not doing what we want and the second one is kind of cumbersome.

\lastnamedcs
\relax
\relax

478 \lettonothing

This one let's a control sequence to nothing. Assuming that \empty is indeed empty, these two lines are equivalent.

```
\let         \foo\empty
\lettonothing\oof
```

479 \limits

This is a modifier: it flags the previous math atom to have its scripts above and below the (summation, product, integral etc.) symbol. In LuaMetaTEX this can be any atom (that is: any class). In display mode the location defaults to above and below.

Like any modifier it looks back for a math specific element. This means that the following will work well:

```
\sum \limits ^2 _3
\sum ^2 \limits _3
\sum ^2 _3 \limits
\sum ^2 _3 \limits \nolimits \limits
```

because scripts are bound to these elements so looking back just sees the element.

480 \linebreakoptional

This selects the optional text range that is to be used. Optional content is marked with optionalboundary nodes.

481 \linebreakpasses

When set to a positive value it will apply additional line break runs defined with `\parpasses` until the criteria set in there are met. When set to −1 it will signal a final pass

482 \linedirection

This sets the text direction (1 for `r2l`) to the given value but keeps preceding glue into the range.

483 \linepenalty

Every line gets this penalty attached, so normally it is a small value, like here: 10.

484 \lineskip

This is the amount of glue that gets added when the distance between lines falls below `\lineskiplimit`.

485 \lineskiplimit

When the distance between two lines becomes less than `\lineskiplimit` a `\lineskip` glue item is added.

```
\ruledvbox{
    \lineskiplimit 0pt \lineskip3pt \baselineskip0pt
    \ruledhbox{line 1}
    \ruledhbox{line 2}
    \ruledhbox{\tx line 3}
}
```

Normally the `\baselineskip` kicks in first but here we've set that to zero, so we get two times a 3pt glue injected.

486 \localcontrol

This primitive takes a single token:

```
\edef\testa{\scratchcounter123 \the\scratchcounter}
\edef\testc{\testa \the\scratchcounter}
\edef\testd{\localcontrol\testa \the\scratchcounter}
```

The three meanings are:

```
123

\testa  macro:\scratchcounter 123 123
\testc  macro:\scratchcounter 123 123123
\testd  macro:123
```

The \localcontrol makes that the following token gets expanded so we don't see the yet to be expanded assignment show up in the macro body.

487 \localcontrolled

The previously described local control feature comes with two extra helpers. The \localcontrolled primitive takes a token list and wraps this into a local control sidetrack. For example:

```
\edef\testa{\scratchcounter123 \the\scratchcounter}
\edef\testb{\localcontrolled{\scratchcounter123}\the\scratchcounter}
```

The two meanings are:

```
\testa  macro:\scratchcounter 123 123
\testb  macro:123
```

The assignment is applied immediately in the expanded definition.

488 \localcontrolledendless

As the name indicates this will loop forever. You need to explicitly quit the loop with \quitloop or \quitloopnow. The first quitter aborts the loop at the start of a next iteration, the second one tries to exit immediately, but is sensitive for interference with for instance nested conditionals.

489 \localcontrolledloop

As with more of the primitives discussed here, there is a manual in the 'lowlevel' subset that goes into more detail. So, here a simple example has to do:

```
\localcontrolledloop 1 100 1 {%
    \ifnum\currentloopiterator>6\relax
        \quitloop
    \else
        [\number\currentloopnesting:\number\currentloopiterator]
        \localcontrolledloop 1 8 1 {%
            (\number\currentloopnesting:\number\currentloopiterator)
        }\par
    \fi
}
```

Here we see the main loop primitive being used nested. The code shows how we can \quitloop and have access to the \currentloopiterator as well as the nesting depth \currentloopnesting.

[1:1] (2:1) (2:2) (2:3) (2:4) (2:5) (2:6) (2:7) (2:8)
[1:2] (2:1) (2:2) (2:3) (2:4) (2:5) (2:6) (2:7) (2:8)
[1:3] (2:1) (2:2) (2:3) (2:4) (2:5) (2:6) (2:7) (2:8)
[1:4] (2:1) (2:2) (2:3) (2:4) (2:5) (2:6) (2:7) (2:8)
[1:5] (2:1) (2:2) (2:3) (2:4) (2:5) (2:6) (2:7) (2:8)
[1:6] (2:1) (2:2) (2:3) (2:4) (2:5) (2:6) (2:7) (2:8)

Be aware of the fact that `\quitloop` will end the loop at the *next* iteration so any content after it will show up. Normally this one will be issued in a condition and we want to end that properly. Also keep in mind that because we use local control (a nested TEX expansion loop) anything you feed back can be injected out of order.

The three numbers can be separated by an equal sign which is a trick to avoid look ahead issues that can result from multiple serialized numbers without spaces that indicate the end of sequence of digits.

490 \localcontrolledrepeat

This one takes one instead three arguments which looks a bit better in simple looping.

491 \localleftbox

This sets the box that gets injected at the left of every line.

492 \localleftboxbox

This returns the box set with `\localleftbox`.

493 \localmiddlebox

This sets the box that gets injected at the left of every line but its width is ignored.

494 \localmiddleboxbox

This returns the box set with `\localmiddlebox`.

495 \localrightbox

This sets the box that gets injected at the right of every line.

496 \localrightboxbox

This returns the box set with `\localrightbox`.

497 \long

This original prefix gave the macro being defined the property that it could not have `\par` (or the often equivalent empty lines) in its arguments. It was mostly a protection against a forgotten right curly brace, resulting in a so called run-away argument. That mattered on a paper terminal or slow system where such a situation should be catched early. In LuaTEX it was already optional, and in LuaMetaTEX we dropped this feature completely (so that we could introduce others).

498 \looseness

The number fo lines in the current paragraph will be increased by given number of lines. For this to succeed there need to be enough stretch in the spacing to make that happen. There is some wishful thinking involved.

499 \lower

This primitive takes two arguments, a dimension and a box. The box is moved down. The operation only succeeds in horizontal mode.

500 \lowercase

This token processor converts character tokens to their lowercase counterparts as defined per `\lccode`. In order to permit dirty tricks active characters are also processed. We don't really use this primitive in ConTEXt, but for consistency we let it respond to `\expand`:[4]

```
\edef           \foo       {\lowercase{tex TeX \TEX}} \meaningless\foo
\lowercase{\edef\foo                  {tex TeX \TEX}} \meaningless\foo
\edef           \foo{\expand\lowercase{tex TeX \TEX}} \meaningless\foo
```

Watch how `\lowercase` is not expandable but can be forced to. Of course, as the logo macro is protected the TEX logo remains mixed case.

```
\lowercase {tex TeX \TEX }
tex tex \TEX
tex tex \TEX
```

501 \lpcode

This one can be used to set the left protrusion factor of a glyph in a font and takes three arguments: font, character code and factor. It is kind of obsolete because we can set up vectors at definition time and tweaking from TEX can have side effects because it globally adapts the font.

502 \luaboundary

This primive inserts a boundary that takes two integer values. Some mechanisms (like math constructors) can trigger a callback when preceded by such a boundary. As we go more mechanisms might do such a check but we don't want a performance hit on ConTEXt as we do so (nor unwanted interference).

503 \luabytecode

This behaves like `\luafunction` but here the number is a byte code register. These bytecodes are in the `lua.bytecode` array.

504 \luabytecodecall

This behaves like `\luafunctioncall` but here the number is a byte code register. These bytecodes are in the `lua.bytecode` array.

[4] Instead of providing **\lowercased** and **\uppercased** primitives that would clash with macros anyway.

505 \luacopyinputnodes

When set to a positive value this will ensure that when nodes are printed from Lua to TEX copies are used.

506 \luadef

This command relates a (user) command to a Lua function registered in the `lua.lualib_get_functions_table()`, so after:

```
\luadef\foo123
```

the `\foo` command will trigger the function at index 123. Of course a macro package has to make sure that these definitions are unique.[5]

This command is accompanied by `\luafunctioncall` and `\luafunction`. When we have funciton 123 defined as

```
function() tex.sprint("!") end
```

the following:

```
(\luafunctioncall  \foocode ?)
(\normalluafunction\foocode ?)
(\foo                       ?)
```

gives three times `(!?)`. But this:

```
\edef\oof{\foo                     } \meaning\oof  % protected
\edef\oof{\luafunctioncall  \foocode} \meaning\oof  % protected
\edef\oof{\normalluafunction\foocode} \meaning\oof  % expands
```

returns:

```
macro:!
macro:\luafunctioncall 1740
macro:!
```

Because the definition command is like any other

```
\permanent\protected\luadef\foo123
```

boils down to:

```
permanent protected luacall 123
```

507 \luaescapestring

This command converts the given (token) list into something that is acceptable for Lua. It is inherited from LuaTEX and not used in ConTEXt.

[5] Plain TEX established a norm for allocating registers, like `\newdimen` but there is no such convention for Lua functions.

```
\directlua { tex.print ("\luaescapestring {{\tt This is a "test".}}") }
```

Results in: `This is a "test".` (Watch the grouping.)

508 \luafunction

The integer passed to this primitive is the index in the table returned by `lua.lualib_get_functions_table()`. Of course a macro package has to provide reliable management for this. This is a so called convert command so it expands in an expansion context (like an `\edef`).

509 \luafunctioncall

The integer passed to this primitive is the index in the table returned by `lua.lualib_get_functions_table()`. Of course a macro package has to provide reliable management for this. This primitive doesn't expand in an expansion context (like an `\edef`).

510 \luatexbanner

This gives: `This is LuaMetaTeX, Version 2.11.03`.

511 \luatexrevision

This is an integer. The current value is: `11`.

512 \luatexversion

This is an integer. The current value is: `2`.

513 \mark

The given token list is stored in a node in the current list and might become content of `\topmark`, `\botmark` or `\firstmark` when a page split off, or in the case of a box split in `\splitbotmark` or `\splitfirstmark`. In LuaMetaTEX deeply burried marks bubbly up to an outer box level.

514 \marks

This command is similar to `\mark` but first expects a number of a mark register. Multiple marks were introduced in ε-TEX.

515 \mathaccent

This takes a number and a math object to put the accent on. The four byte number has a dummy class byte, a family byte and two index bytes. It is replaced by `\Umathaccent` that handles wide fonts.

516 \mathatom

This operation wraps following content in a atom with the given class. It is part of LuaMetaTEX's extended math support. There are three class related key/values: `class`, `leftclass` and `rightclass`

(or `all` for all of them). When none is given this command expects a class number before scanning the content. The `options` key expects a bitset but there are also direct option keys, like `limits`, `nolimits`, `unpack`, `unroll`, `single`, `nooverflow`, `void` and `phantom`. A `source` id can be set, one or more `attr` assigned, and for specific purposes `textfont` and `mathfont` directives are accepted. Features like this are discussed in dedicated manuals.

517 \mathatomglue

This returns the glue that will be inserted between two atoms of a given class for a specific style.

```
\the\mathatomglue \textstyle   1 1
\the\mathatomglue \textstyle   0 2
\the\mathatomglue \scriptstyle 1 1
\the\mathatomglue \scriptstyle 0 2
```

```
1.66667mu
2.22223mu plus 1.11111mu minus 1.11111mu
1.66667mu
0.55556mu minus 0.27777mu
```

518 \mathatomskip

This injects a glue with the given style and class pair specification: $x x$ $x x$ $x x$ $x x$ $x x$ $x x$.

```
$x x$
$x \mathatomskip \textstyle   1 1 x$
$x \mathatomskip \textstyle   0 2 x$
$x \mathatomskip \scriptstyle 1 1 x$
$x \mathatomskip \scriptstyle 0 2 x$
```

519 \mathbackwardpenalties

See `\mathforwardpenalties` for an explanation.

520 \mathbeginclass

This variable can be set to signal the class that starts the formula (think of an imaginary leading atom).

521 \mathbin

This operation wraps following content in a atom with class ‘binary’.

522 \mathboundary

This primitive is part of an experiment with granular penalties in math. When set nested fences will use the `\mathdisplaypenaltyfactor` or `\mathinlinepenaltyfactor` to increase nested penalties. A bit more control is possible with `\mathboundary`:

0	begin	factor 1000
1	end	factor 1000
2	begin	given factor
3	end	given factor

These will be used when the mentioned factors are zero. The last two variants expect factor to be given.

523 \mathchar

Replaced by `\Umathchar` this old one takes a four byte number: one byte for the class, one for the family an two for the index. The specified character is appended to to the list.

524 \mathcharclass

Returns the slot (in the font) of the given math character.

```
\the\mathcharclass\Umathchar 4 2 123
```

The first passed number is the class, so we get: 4.

525 \mathchardef

Replaced by `\Umathchardef` this primitive relates a control sequence with a four byte number: one byte for the class, one for the family an two for the index. The defined command will insert that character.

526 \mathcharfam

Returns the family number of the given math character.

```
\the\mathcharfam\Umathchar 4 2 123
```

The second passed number is the family, so we get: 2.

527 \mathcharslot

Returns the slot (or index in the font) of the given math character.

```
\the\mathcharslot\Umathchar 4 2 123
```

The third passed number is the slot, so we get: 123.

528 \mathcheckfencesmode

When set to a positive value there will be no warning if a right fence (`\right` or `\Uright`) is missing.

529 \mathchoice

This command expects four subformulas, for display, text, script and scriptscript and it will eventually use one of them depending on circumstances later on. Keep in mind that a formula is first scanned and when that is finished the analysis and typesetting happens.

530 \mathclass

There are build in classes and user classes. The first possible user class is 20 and the last one is 60. You can better not touch the special classes ‘all’ (61), ‘begin’ (62) and ‘end’ (63). The basic 8 classes that original TEX provides are of course also present in LuaMetaTEX. In addition we have some that relate to constructs that the engine builds.

ordinary	ord	0	the default
operator	op	1	small and large operators
binary	bin	2	
relation	rel	3	
open		4	
close		5	
punctuation	punct	6	
variable		7	adapts to the current family
active		8	character marked as such becomes active
inner		9	this class is not possible for characters
under		10	
over		11	
fraction		12	
radical		13	
middle		14	
accent		16	
fenced		17	
ghost		18	
vcenter		19	

There is no standard for user classes but ConTEXt users should be aware of quite some additional ones that are set up. The engine initialized the default properties of classes (spacing, penalties, etc.) the same as original TEX.

Normally characters have class bound to them but you can (temporarily) overload that one. The `\mathclass` primitive expects a class number and a valid character number or math character and inserts the symbol as if it were of the given class; so the original class is replaced.

```
\ruledhbox{$(x)$} and \ruledhbox{$\mathclass 1 `(x\mathclass 1 `)$}
```

Changing the class is likely to change the spacing, compare (x) and (x).

531 \mathclose

This operation wraps following content in a atom with class ‘close’.

532 \mathcode

This maps a character to one in a family: the assigned value has one byte for the class, one for the family and two for the index. It has little use in an OpenType math setup.

533 \mathdictgroup

This is an experimental feature that in due time will be explored in ConTEXt. It currently has no consequences for rendering.

534 \mathdictionary

This is an experimental feature that in due time will be explored in ConTEXt. It currently has no consequences for rendering.

535 \mathdictproperties

This is an experimental feature that in due time will be explored in ConTEXt. It currently has no consequences for rendering.

536 \mathdirection

When set to 1 this will result in `r2l` typeset math formulas but of course you then also need to set up math accordingly (which is the case in ConTEXt).

537 \mathdisplaymode

Display mode is entered with two dollars (other characters can be used but the dollars are a convention). Mid paragraph display formulas get a different treatment with respect to the width and indentation than stand alone. When `\mathdisplaymode` is larger than zero the double dollars (or equivalents) will behave as inline formulas starting out in `\displaystyle` and with `\everydisplay` expanded.

538 \mathdisplaypenaltyfactor

This one is simular to `\mathinlinepenaltyfactor` but is used when we're in display style.

539 \mathdisplayskipmode

A display formula is preceded and followed by vertical glue specified by `\abovedisplayskip` and `\belowdisplayskip` or `\abovedisplayshortskip` and `\belowdisplayshortskip`. Spacing 'above' is always inserted, even when zero, but the spacing 'below' is only inserted when it is non-zero. There's also `\baselineskip` involved. The way spacing is handled can be influenced with `\mathdisplayskipmode`, which takes the following values:

0 does the same as any TEX engine
1 idem
2 only insert spacing when it is not zero
3 never insert spacing

540 \mathdoublescriptmode

When this parameter has a negative value double scripts trigger an error, so with `\superscript`, `\nosuperscript`, `\indexedsuperscript`, `\superprescript`, `\nosuperprescript`, `\indexedsuperprescript`,

\subscript, \nosubscript, \indexedsubscript, \subprescript, \nosubprescript, \indexedsubprescript and \primescript, as well as their (multiple) _ and ^ aliases.

A value of zero does the normal and inserts a dummy atom (basically a {}) but a positive value is more interesting. Compare these:

```
{\mathdoublescriptmode 0      $x_x_x$}
{\mathdoublescriptmode"000000 $x_x_x$}
{\mathdoublescriptmode"030303 $x_x_x$}
{$x_x_x$}
```

The three pairs of bytes indicate the main class, left side class and right side class of the inserted atom, so we get this: x_{xx} x_{xx} $x_{x\,x}$ x_{xx}. The last line gives what ConTEXt is configured for.

541 \mathendclass

This variable can be set to signal the class that ends the formula (think of an imaginary trailing atom).

542 \matheqnogapstep

The display formula number placement heuristic puts the number on the same line when there is place and then separates it by a quad. In LuaTEX we decided to keep that quantity as it can be tight into the math font metrics but introduce a multiplier \matheqnogapstep that defaults to 1000.

543 \mathfontcontrol

This bitset controls how the math engine deals with fonts, and provides a way around dealing with inconsistencies in the way they are set up. The \fontmathcontrol makes it possible to bind options ot a specific math font. In practice, we just set up the general approach which ii possible because we normalize the math fonts and 'fix' issues at runtime.

0x00000001	usefontcontrol
0x00000002	overrule
0x00000004	underrule
0x00000008	radicalrule
0x00000010	fractionrule
0x00000020	accentskewhalf
0x00000040	accentskewapply
0x00000080	applyordinarykernpair
0x00000100	applyverticalitalickern
0x00000200	applyordinaryitalickern
0x00000400	applycharitalickern
0x00000800	reboxcharitalickern
0x00001000	applyboxeditalickern
0x00002000	staircasekern
0x00004000	applytextitalickern
0x00008000	checktextitalickern
0x00010000	checkspaceitalickern
0x00020000	applyscriptitalickern
0x00040000	analyzescriptnucleuschar

0x00080000 analyzescriptnucleuslist
0x00100000 analyzescriptnucleusbox
0x00200000 accenttopskewwithoffset
0x00400000 ignorekerndimensions
0x00800000 ignoreflataccents
0x01000000 extendaccents
0x02000000 extenddelimiters

544 \mathforwardpenalties

Inline math can have multiple atoms and constructs and one can configure the penalties between then bases on classes. In addition it is possible to configure additional penalties starting from the beginning or end using `\mathforwardpenalties` and `\mathbackwardpenalties`. This is one the features that we added in the perspective of breaking paragraphs heavy on math into lines. It not that easy to come up with useable values.

545 \mathgluemode

We can influence the way math glue is handled. By default stretch and shrink is applied but this variable can be used to change that. The limit option ensures that the stretch and shrink doesn't go beyond their natural values.

0x01 stretch
0x02 shrink
0x04 limit

546 \mathgroupingmode

Normally a {} or \bgroup-\egroup pair in math create a math list. However, users are accustomed to using it also for grouping and then a list being created might not be what a user wants. As an alternative to the more verbose `\begingroup-\endgroup` or even less sensitive `\beginmathgroup-\endmathgroup` you can set the math grouping mode to a non zero value which makes curly braces (and the aliases) behave as expected.

547 \mathinlinepenaltyfactor

A math formula can have nested (sub)formulas and one might want to discourage a line break inside those. If this value is non zero it becomes a mulitiplier, so a value of 1000 will make an inter class penalty of 100 into 200 when at nesting level 2 and 500 when at level 5.

548 \mathinner

This operation wraps following content in a atom with class 'inner'. In LuaMetaTEX we have more classes and this general wrapper one is therefore kind of redundant.

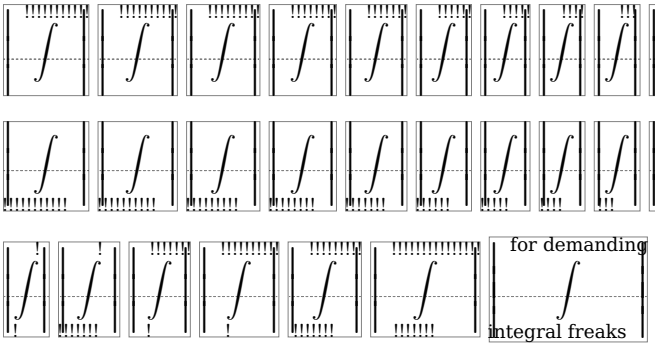
549 \mathleftclass

When set this class will be used when a formula starts.

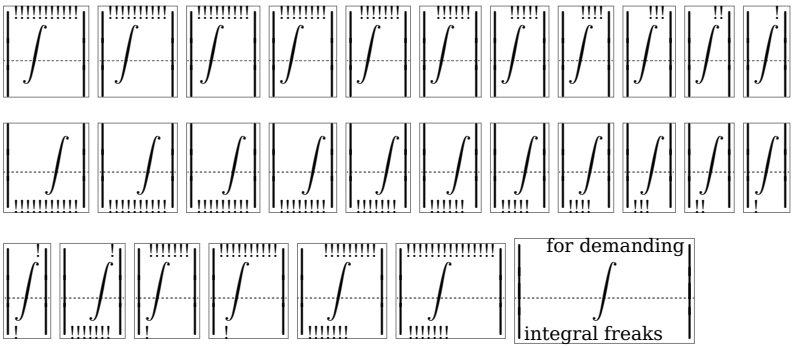
550 \mathlimitsmode

When this parameter is set to a value larger than zero real dimensions are used and longer limits will not stick out, which is a traditional TEX feature. We could have more advanced control but this will do.

Compare the zero setting:



with the positive variant:



Here we switched to Latin Modern because it's font dependent how serious this issue is. In Pagella all is fine in both modes.

551 \mathmainstyle

This inspector returns the outermost math style (contrary to `\mathstyle`), as we can see in the next examples where use these snippets:

```
\def\foo{(\the\mathmainstyle,\the\mathstyle)}
\def\oof{\sqrt[\foo]{\foo}}
\def\ofo{\frac{\foo}{\foo}}
\def\fof{\mathchoice{\foo}{\foo}{\foo}{\foo}}
```

When we use the regular math triggers we get this:

```
$\displaystyle      \foo + \oof + \ofo$
$\textstyle         \foo + \oof + \ofo$
$\displaystyle      \foo + \fof$
$\textstyle         \foo + \fof$
$\scriptstyle       \foo + \fof$
$\scriptscriptstyle\foo + \fof$
```

$(2,0) + \sqrt[(2,0)]{(2,1)} + \frac{(2,5)}{(2,5)}$

$(2, 2) + \sqrt[(2,2)]{(2, 3)} + \frac{(2,5)}{(2,5)}$
$(2, 0) + (2, 0)$
$(2, 2) + (2, 2)$
$(2,4)+(2,4)$
$(2,6)+(2,6)$

But we can also do this:

```
\Ustartmathmode \displaystyle      \foo + \oof + \ofo \Ustopmathmode
\Ustartmathmode \textstyle         \foo + \oof + \ofo \Ustopmathmode
\Ustartmathmode \displaystyle      \foo + \fof \Ustopmathmode
\Ustartmathmode \textstyle         \foo + \fof \Ustopmathmode
\Ustartmathmode \scriptstyle       \foo + \fof \Ustopmathmode
\Ustartmathmode \scriptscriptstyle\foo + \fof \Ustopmathmode
```

$(0, 0) + \sqrt[(0,0)]{(0, 1)} + \frac{(0,5)}{(0,5)}$
$(2, 2) + \sqrt[(2,2)]{(2, 3)} + \frac{(2,5)}{(2,5)}$
$(0, 0) + (0, 0)$
$(2, 2) + (2, 2)$
$(4,4)+(4,4)$
$(6,6)+(6,6)$

552 \mathnolimitsmode

This parameter influences the placement of scripts after an operator. The reason we have this lays in the fact that traditional TEX uses italic correction and OpenType math does the same but fonts are not consistent in how they set this up. Actually, in OpenType math it's the only reason that there is italic correction. Say that we have a shift δ determined by the italic correction:

mode	top	bottom
0	0	$-\delta$
1	$\delta \times f_t$	$\delta \times f_b$
2	0	0
3	0	$-\delta/2$
4	$\delta/2$	$-\delta/2$
> 15	0	$-n \times \delta/1000$

Mode 1 uses two font parameters: f_b: `\Umathnolimitsubfactor` and f_t: `\Umathnolimitsupfactor`.

553 \mathop

This operation wraps following content in a atom with class ‘operator’.

554 \mathopen

This operation wraps following content in a atom with class ‘open’.

555 \mathord

This operation wraps following content in a atom with class ‘ordinary’.

556 \mathparentstyle

This inspector returns the math style used in a construct, so is is either equivalent to `\mathmainstyle` or a nested `\mathstyle`. For instance in a nested fraction we get this (in ConTEXt) in display formulas:

$$\frac{\frac{\frac{(0,1,1)}{(0,1,1)}}{(0,1,1)}}{(0,1,1)} + (0,0,0)$$

but this in inline formulas:

$\frac{\frac{\frac{(2,5,7)}{(2,5,7)}}{(2,5,7)}}{(2,5,7)} + (2,2,2)$

where the first element in a nested fraction.

557 \mathpenaltiesmode

Normally the TEX math engine only inserts penalties when in textstyle. You can force penalties in displaystyle with this parameter. In inline math we always honor penalties, with mode 0 and mode 1 we get this:

$x \mathop{+}_{\text{MP:0}} 2x \mathop{=}_{\text{MP:500 MP:0}} 0$
$x \mathop{+}_{\text{MP:0}} 2x \mathop{=}_{\text{MP:500 MP:0}} 1$

However in ConTEXt, where all is done in inline math mode, we set this this parameter to 1, otherwise we wouldn't get these penalties, as shown next:

$$x \mathop{+}_{\text{MP:700}} 2x \mathop{=}_{\text{MP:500}} 0$$

$$x \mathop{+}_{\text{MP:700}} 2x \mathop{=}_{\text{MP:500}} 1$$

If one uses a callback it is possible to force penalties from there too.

558 \mathpretolerance

This is used instead of `\pretolerance` when a breakpoint is calculated when a math formula starts.

559 \mathpunct

This operation wraps following content in a atom with class ‘punctuation’.

560 \mathrel

This operation wraps following content in a atom with class ‘relation’.

561 \mathrightclass

When set this class will be used when a formula ends.

562 \mathrulesfam

When set, this family will be used for setting rule properties in fractions, under and over.

563 \mathrulesmode

When set to a non zero value rules (as in fractions and radicals) will be based on the font parameters in the current family.

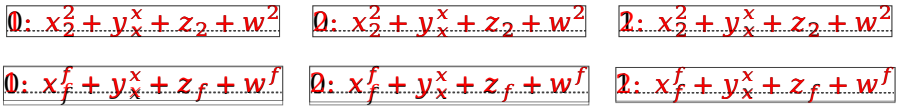
564 \mathscale

In LuaMetaTEX we can either have a family of three (text, script and scriptscript) fonts or we can use one font that we scale and where we also pass information about alternative shapes for the smaller sizes. When we use this more compact mode this primitive reflects the scale factor used.

What gets reported depends on how math is implemented, where in ConTEXt we can have either normal or compact mode: 1000 700 550 1000 700 550. In compact mode we have the same font three times so then it doesn't matter which of the three is passed.

565 \mathscriptsmode

There are situations where you don't want TEX to be clever and optimize the position of super- and subscripts by shifting. This parameter can be used to influence this.



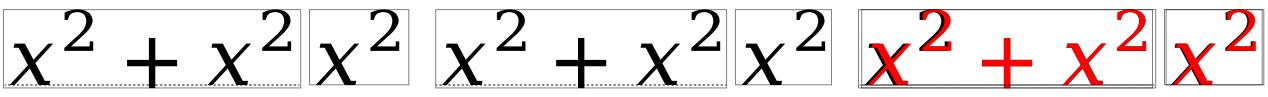
1 over 0 2 over 0 2 over 1

The next table shows what parameters kick in when:

	or (1)	**and (2)**	**otherwise**
super	sup shift up	sup shift up	sup shift up, sup bot min
sub	sub shift down	sub sup shift down	sub shift down, sub top max
both	sub shift down	sub sup shift down	sub sup shift down, sub sup vgap, sup sub bot max

566 \mathslackmode

When positive this parameter will make sure that script spacing is discarded when there is no reason to add it.



disabled (0) enabled (1) enabled over disabled

567 \mathspacingmode

Zero inter-class glue is not injected but setting this parameter to a positive value bypasses that check. This can be handy when checking (tracing) how (and what) spacing is applied. Keep in mind that glue

in math is special in the sense that it is not a valid breakpoint. Line breaks in (inline) math are driven by penalties.

568 \mathstack

There are a few commands in TEX that can behave confusing due to the way they are scanned. Compare these:

```
$ 1 \over 2 $
$ 1 + x \over 2 + x$
$ {1 + x} \over {2 + x}$
$ {{1 + x} \over {2 + x}}$
```

A single 1 is an atom as is the curly braced $1 + x$. The two arguments to `\over` eventually will get typeset in the style that this fraction constructor uses for the numerator and denominator but on might actually also like to relate that to the circumstances. It is comparable to using a `\mathchoice`. In order not to waste runtime on four variants, which itself can have side effects, for instance when counters are involved, LuaTEX introduced `\mathstack`, used like:

```
$\mathstack {1 \over 2}$
```

This `\mathstack` command will scan the next brace and opens a new math group with the correct (in this case numerator) math style. The `\mathstackstyle` primitive relates to this feature that defaults to 'smaller unless already scriptscript'.

569 \mathstackstyle

This returns the (normally) numerator style but the engine can be configured to default to another style. Although all these in the original TEX engines hard coded style values can be changed in LuaMetaTEX it is unlikely to happen. So this primitive will normally return the (current) style 'smaller unless already scriptscript'.

570 \mathstyle

This returns the current math style, so `$\the\mathstyle$` gives 2.

571 \mathstylefontid

This returns the font id (a number) of a style/family combination. What you get back depends on how a macro package implements math fonts.

```
(\the\mathstylefontid\textstyle        \fam)
(\the\mathstylefontid\scriptstyle      \fam)
(\the\mathstylefontid\scriptscriptstyle\fam)
```

In ConTEXt gives: (2) (2) (2).

572 \mathsurround

The kern injected before and after an inline math formula. In practice it will be set to zero, if only because otherwise nested math will also get that space added. We also have `\mathsurroundskip` which, when set, takes precedence. Spacing is controlled by `\mathsurroundmode`.

573 \mathsurroundmode

The possible ways to control spacing around inline math formulas in other manuals and mostly serve as playground.

574 \mathsurroundskip

When set this one wins over `\mathsurround`.

575 \maththreshold

This is a glue parameter. The amount determines what happens: when it is non zero and the inline formula is less than that value it will become a special kind of box that can stretch and/ or shrink within the given specification. The par builder will use these stretch and/ or shrink components but it is up to one of the Lua callbacks to deal with the content eventually (if at all). As this is somewhat specialized, more details can be found on ConTEXt documentation.

576 \mathtolerance

This is used instead of `\tolerance` when a breakpoint is calculated when a math formula starts.

577 \maxdeadcycles

When the output routine is called this many times and no page is shipped out an error will be triggered. You therefore need to reset its companion counter `\deadcycles` if needed. Keep in mind that LuaMetaTEX has no real `\shipout` because providing a backend is up to the macro package.

578 \maxdepth

The depth of the page is limited to this value.

579 \meaning

We start with a primitive that will be used in the following sections. The reported meaning can look a bit different than the one reported by other engines which is a side effect of additional properties and more extensive argument parsing.

```
\tolerant\permanent\protected\gdef\foo[#1]#*[#2]{(#1)(#2)} \meaning\foo
```

tolerant protected macro:[#1]#*[#2]->(#1)(#2)

580 \meaningasis

Although it is not really round trip with the original due to information being lost this primitive tries to return an equivalent definition.

```
\tolerant\permanent\protected\gdef\foo[#1]#*[#2]{(#1)(#2)} \meaningasis\foo
```

\permanent \tolerant \protected \def \foo [#1]#*[#2]{(#1)(#2)}

581 \meaningful

This one reports a bit less than `\meaningful`.

```
\tolerant\permanent\protected\gdef\foo[#1]#*[#2]{(#1)(#2)} \meaningful\foo
```

permanent tolerant protected macro

582 \meaningfull

This one reports a bit more than `\meaning`.

```
\tolerant\permanent\protected\gdef\foo[#1]#*[#2]{(#1)(#2)} \meaningfull\foo
```

permanent tolerant protected macro:[#1]#*[#2]->(#1)(#2)

583 \meaningles

This one reports a bit less than `\meaningless`.

```
\tolerant\permanent\protected\gdef\foo[#1]#*[#2]{(#1)(#2)} \meaningles\foo
```

[#1]#*[#2]

584 \meaningless

This one reports a bit less than `\meaning`.

```
\tolerant\permanent\protected\gdef\foo[#1]#*[#2]{(#1)(#2)} \meaningless\foo
```

[#1]#*[#2]->(#1)(#2)

585 \medmuskip

A predefined mu skip register that can be used in math (inter atom) spacing. The current value is `4.0mu plus 2.0mu minus 2.0mu`. In traditional TEX most inter atom spacing is hard coded using the predefined registers.

586 \message

Prints the serialization of the (tokenized) argument to the log file and/or console.

587 \middle

Inserts the given delimiter as middle fence in a math formula. In LuaMetaTEX it is a full blown fence and not (as in ε-TEX) variation of `\open`.

588 \mkern

This one injects a kern node in the current (math) list and expects a value in so called mu units.

589 \month

This internal number starts out with the month that the job started.

590 \moveleft

This primitive takes two arguments, a dimension and a box. The box is moved to the left. The operation only succeeds in vertical mode.

591 \moveright

This primitive takes two arguments, a dimension and a box. The box is moved to the right. The operation only succeeds in vertical mode.

592 \mskip

The given math glue (in `mu` units) is injected in the horizontal list. For this to succeed we need to be in math mode.

593 \muexpr

This is a companion of `\glueexpr` so it handles the optional stretch and shrink components. Here math units (`mu`) are expected.

594 \mugluespecdef

A variant of `\gluespecdef` that expects `mu` units is:

```
\mugluespecdef\MyGlue = 3mu plus 2mu minus 1mu
```

The properties are comparable to the ones described in the previous sections.

595 \multiply

The given quantity is multiplied by the given integer (that can be preceded by the keyword ‘by’, like:

```
\scratchdimen=10pt \multiply\scratchdimen by 3
```

596 \multiplyby

This is slightly more efficient variant of `\multiply` that doesn't look for `by`. See previous section.

597 \muskip

This is the accessor for an indexed muskip (muglue) register.

598 \muskipdef

This command associates a control sequence with a muskip (math skip) register (accessed by number).

599 \mutable

This prefix flags what follows can be adapted and is not subjected to overload protection.

600 \mutoglue

The sequence `\the\mutoglue 20mu plus 10mu minus 5mu` gives 20.0pt plus 10.0pt minus 5.0pt.

601 \nestedloopiterator

This is one of the accessors of loop iterators:

```
\expandedrepeat 2 {%
    \expandedrepeat 3 {%
        (n=\the\nestedloopiterator  1,
         p=\the\previousloopiterator1,
         c=\the\currentloopiterator)
    }%
}%
```

Gives:

(n=1, p=1, c=1) (n=2, p=1, c=2) (n=3, p=1, c=3) (n=1, p=2, c=1) (n=2, p=2, c=2) (n=3, p=2, c=3)

Where a nested iterator starts relative to innermost loop, the previous one is relative to the outer loop (which is less predictable because we can already be in a loop).

602 \newlinechar

When something is printed to one of the log channels the character with this code will trigger a linebreak. That also resets some counters that deal with suppressing redundant ones and possible indentation. Contrary to other engines LuaMetaTEX doesn't bother about the length of lines.

603 \noalign

The token list passed to this primitive signals that we don't enter a table row yet but for instance in a `\halign` do something between the lines: some calculation or injecting inter-row material. In LuaMetaTEX this primitive can be used nested.

604 \noaligned

The alignment mechanism is kind of special when it comes to expansion because it has to look ahead for a \noalign. This interferes with for instance protected macros, but using this prefix we get around that. Among the reasons to use protected macros inside an alignment is that they behave better inside for instance \expanded.

605 \noatomruling

Spacing in math is based on classes and this primitive inserts a signal that there is no ruling in place here. Basically we have a zero skip glue tagged as non breakable because in math mode glue is not a valid breakpoint unless we have configured inter-class penalties.

606 \noboundary

This inserts a boundary node with no specific property. It can still serve as boundary but is not interpreted in special ways, like the others.

607 \noexpand

This prefix prevents expansion in a context where expansion happens. Another way to prevent expansion is to define a macro as \protected.

```
          \def\foo{foo} \edef\oof{we expanded      \foo} \meaning\oof
          \def\foo{foo} \edef\oof{we keep \noexpand\foo} \meaning\oof
\protected\def\foo{foo} \edef\oof{we keep          \foo} \meaning\oof
```

macro:we expanded foo
macro:we keep \foo
macro:we keep \foo

608 \nohrule

This is a rule but flagged as empty which means that the dimensions kick in as for a normal rule but the backend can decide not to show it.

609 \noindent

This starts a paragraph. In LuaTEX (and LuaMetaTEX) a paragraph starts with a so called par node (see \indent on how control that. After that comes either \parindent glue or a horizontal box. The \indent makes gives them some width, while \noindent keeps that zero.

610 \nolimits

This is a modifier: it flags the previous math atom to have its scripts after the the atom (contrary to \limits. In LuaMetaTEX this can be any atom (that is: any class). In display mode the location defaults to above and below.

611 \nonscript

This prevents TEX from adding inter-atom glue at this spot in script or scriptscript mode. It actually is a special glue itself that serves as signal.

612 \nonstopmode

This directive omits all stops.

613 \norelax

The rationale for this command can be shown by a few examples:

```
\dimen0 1pt \dimen2 1pt \dimen4 2pt
\edef\testa{\ifdim\dimen0=\dimen2\norelax N\else Y\fi}
\edef\testb{\ifdim\dimen0=\dimen2\relax   N\else Y\fi}
\edef\testc{\ifdim\dimen0=\dimen4\norelax N\else Y\fi}
\edef\testd{\ifdim\dimen0=\dimen4\relax   N\else Y\fi}
\edef\teste{\norelax}
```

The five meanings are:

```
\testa  macro:N
\testb  macro:\relax N
\testc  macro:Y
\testd  macro:Y
\teste  macro:
```

So, the `\norelax` acts like `\relax` but is not pushed back as usual (in some cases).

614 \normalizelinemode

The TEX engine was not designed to be opened up, and therefore the result of the linebreak effort can differ depending on the conditions. For instance not every line gets the left- or rightskip. The first and last lines have some unique components too. When LuaTEX made it possible too get the (intermediate) result manipulating the result also involved checking what one encountered, for instance glue and its origin. In LuaMetaTEX we can normalize lines so that they have for instance balanced skips.

`0x0001`	normalizeline	`0x0040`	clipwidth
`0x0002`	parindentskip	`0x0080`	flattendiscretionaries
`0x0004`	swaphangindent	`0x0100`	discardzerotabskips
`0x0008`	swapparshape	`0x0200`	flattenhleaders
`0x0010`	breakafterdir	`0x0400`	balanceinlinemath
`0x0020`	removemarginkerns		

The order in which the skips get inserted when we normalize is as follows:

`\lefthangskip`	the hanging indentation (or zero)
`\leftskip`	the value even when zero

`\parfillleftskip`	only on the last line
`\parinitleftskip`	only on the first line
`\indentskip`	the amount of indentation
`...`	the (optional) content
`\parinitrightskip`	only on the first line
`\parfillrightskip`	only on the last line
`\correctionskip`	the correction needed to stay within the `\hsize`
`\rightskip`	the value even when zero
`\righthangskip`	the hanging indentation (or zero)

The init and fill skips can both show up when we have a single line. The correction skip replaces the traditional juggling with the right skip and shift of the boxed line.

For now we leave the other options to your imagination. Some of these can be achieved by callbacks (as we did in older versions of ConTEXt) but having the engine do the work we get a better performance.

615 \normalizeparmode

For now we just mention the few options available. It is also worth mentioning that LuaMetaTEX tries to balance the direction nodes.

`0x01`	normalizepar	`0x04`	limitprevgraf
`0x02`	flattenvleaders	`0x08`	keepinterlinepenalties

616 \noscript

In math we can have multiple pre- and postscript. These get typeset in pairs and this primitive can be used to skip one. More about multiple scripts (and indices) can be found in the ConTEXt math manual.

617 \nospaces

When `\nospaces` is set to 1 no spaces are inserted, when its value is 2 a zero space is inserted. The default value is 0 which means that spaces become glue with properties depending on the font, specific parameters and/or space factors determined preceding characters. A value of 3 will inject a glyph node with code `\spacechar`.

618 \nosubprescript

This processes the given script in the current style, so:

comes out as: ${}_2x + {}_2x + {}_2x$.

619 \nosubscript

This processes the given script in the current style, so:

comes out as: $x_2 + x_2 + x_2$.

620 \nosuperprescript

This processes the given script in the current style, so:

comes out as: ${}^{2}x + {}^{2}x + {}^{2}x$.

621 \nosuperscript

This processes the given script in the current style, so:

comes out as: $x^{2} + {}^{2}x + {}^{2}x$.

622 \novrule

This is a rule but flagged as empty which means that the dimensions kick in as for a normal rule but the backend can decide not to show it.

623 \nulldelimiterspace

In fenced math delimiters can be invisible in which case this parameter determines the amount of space (width) that ghost delimiter takes.

624 \nullfont

This a symbolic reference to a font with no glyphs and a minimal set of font dimensions.

625 \number

This TEX primitive serializes the next token into a number, assuming that it is indeed a number, like

```
\number`A
\number65
\number\scratchcounter
```

For counters and such the `\the` primitive does the same, but when you're not sure if what follows is a verbose number or (for instance) a counter the `\number` primitive is a safer bet, because `\the 65` will not work.

626 \numericscale

This primitive can best be explained by a few examples:

```
\the\numericscale 1323
\the\numericscale 1323.0
\the\numericscale 1.323
\the\numericscale 13.23
```

In several places TEX uses a scale but due to the lack of floats it then uses 1000 as 1.0 replacement. This primitive can be used for ‘real’ scales:

1323000
1323000
1323
13230

627 \numericscaled

This is a variant if \numericscale:

```
\scratchcounter 1000
\the\numericscaled 1323   \scratchcounter
\the\numericscaled 1323.0 \scratchcounter
\the\numericscaled 1.323  \scratchcounter
\the\numericscaled 13.23  \scratchcounter
```

The second number gets multiplied by the first fraction:

1323000
1323000
1323
13230

628 \numexpr

This primitive was introduced by ε-TEX and supports a simple expression syntax:

```
\the\numexpr 10 * (1 + 2 - 5) / 2 \relax
```

gives: -10. You can mix in symbolic integers and dimensions.

629 \numexpression

The normal \numexpr primitive understands the +, -, * and / operators but in LuaMetaTEX we also can use : for a non rounded integer division (think of Lua's //). if you want more than that, you can use the new expression primitive where you can use the following operators.

add	+	
subtract	-	
multiply	*	
divide	/ :	
mod	%	mod
band	&	band
bxor	^	bxor
bor	| v	bor
and	&&	and
or	||	or
setbit	<undecided>	bset
resetbit	<undecided>	breset
left	<<	
right	>>	

less	<
lessequal	<=
equal	= ==
moreequal	>=
more	>
unequal	<> != ~=
not	! ~ not

An example of the verbose bitwise operators is:

```
\scratchcounter = \numexpression
    "00000 bor "00001 bor "00020 bor "00400 bor "08000 bor "F0000
\relax
```

In the table you might have notices that some operators have equivalents. This makes the scanner a bit less sensitive for catcode regimes.

When `\tracingexpressions` is set to one or higher the intermediate 'reverse polish notation' stack that is used for the calculation is shown, for instance:

```
4:8: {numexpression rpn: 2 5 > 4 5 > and}
```

When you want the output on your console, you need to say:

```
\tracingexpressions 1
\tracingonline      1
```

630 \omit

This primitive cancels the template set for the upcoming cell. Often it is used in combination with `\span`.

631 \optionalboundary

This boundary is used to mark optional content. An positive `\optionalboundary` starts a range and a zero one ends it. Nesting is not supported. Optional content is considered when an additional paragraph pass enables it as part of its recipe.

632 \or

This traditional primitive is part of the condition testing mechanism and relates to an `\ifcase` test (or a similar test to be introduced in later sections). Depending on the value, TEX will do a fast scanning till the right `\or` is seen, then it will continue expanding till it sees a `\or` or `\else` or `\orelse` (to be discussed later). It will then do a fast skipping pass till it sees an `\fi`.

633 \orelse

This primitive provides a convenient way to flatten your conditional tests. So instead of

```
\ifnum\scratchcounter<-10
```

```
    too small
\else\ifnum\scratchcounter>10
    too large
\else
    just right
\fi\fi
```

You can say this:

```
\ifnum\scratchcounter<-10
    too small
\orelse\ifnum\scratchcounter>10
    too large
\else
    just right
\fi
```

You can mix tests and even the case variants will work in most cases[6]

```
\ifcase\scratchcounter          zero
\or                             one
\or                             two
\orelse\ifnum\scratchcounter<10 less than ten
\else                           ten or more
\fi
```

Performance wise there are no real benefits although in principle there is a bit less housekeeping involved than with nested checks. However you might like this:

```
\ifnum\scratchcounter<-10
    \expandafter\toosmall
\orelse\ifnum\scratchcounter>10
    \expandafter\toolarge
\else
    \expandafter\justright
\fi
```

over:

```
\ifnum\scratchcounter<-10
    \expandafter\toosmall
\else\ifnum\scratchcounter>10
    \expandafter\expandafter\expandafter\toolarge
\else
    \expandafter\expandafter\expandafter\justright
\fi\fi
```

or the more ConTEXt specific:

```
\ifnum\scratchcounter<-10
```

[6] I just play safe because there are corner cases that might not work yet.

```
    \expandafter\toosmall
\else\ifnum\scratchcounter>10
    \doubleexpandafter\toolarge
\else
    \doubleexpandafter\justright
\fi\fi
```

But then, some TEXies like complex and obscure code and throwing away working old code that took ages to perfect and get working and also showed that one masters TEX might hurt.

634 \orphanpenalties

This an (single entry) array parameter: first the size is given followed by that amount of penalties. These penalties are injected before spaces, going backward from the end of a paragraph. When we see a math node with a penalty set then we take the max and jump over a (preceding) skip.

635 \orphanpenalty

This penalty is inserted before the last space in a paragraph, unless `\orphanpenalties` mandates otherwise.

636 \orunless

This is the negated variant of `\orelse` (prefixing that one with `\unless` doesn't work well.

637 \outer

An outer macro is one that can only be used at the outer level. This property is no longer supported. Like `\long`, the `\outer` prefix is now an no-op (and we don't expect this to have unfortunate side effects).

638 \output

This token list register holds the code that will be expanded when TEX enters the output routine. That code is supposed to do something with the content in the box with number `\outputbox`. By default this is box 255 but that can be changed with `\outputbox`.

639 \outputbox

This is where the split off page contend ends up when the output routine is triggered.

640 \outputpenalty

This is the penalty that triggered the output routine.

641 \over

This math primitive is actually a bit of a spoiler for the parser as it is one of the few that looks back. The `\Uover` variant is different and takes two arguments. We leave it to the user to predicts the results of:

```
$    {1} \over {x}    $
$     1  \over  x     $
$    12  \over  x / y $
$ a + 1  \over {x}    $
```

and:

```
$  \textstyle 1  \over x  $
$ {\textstyle 1} \over x  $
$  \textstyle {1 \over x} $
```

It's one of the reasons why macro packages provide **\frac**.

642 \overfullrule

When an overfull box is encountered a rule can be shown in the margin and this parameter sets its width. For the record: ConTEXt does it different.

643 \overline

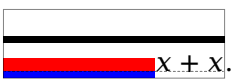
This is a math specific primitive that draws a line over the given content. It is a poor mans replacement for a delimiter. The thickness is set with `\Umathoverbarrule`, the distance between content and rule is set by `\Umathoverbarvgap` and `\Umathoverbarkern` is added above the rule. The style used for the content under the rule can be set with `\Umathoverlinevariant`.

Because ConTEXt set up math in a special way, the following example:

```
\normaloverline {
    \blackrule[color=red, height=1ex,depth=0ex,width=2cm]%
    \kern-2cm
    \blackrule[color=blue,height=0ex,depth=.5ex,width=2cm]
    x + x
}
```

gives:  , while:

```
\mathfontcontrol\zerocount
\Umathoverbarkern\allmathstyles10pt
\Umathoverbarvgap\allmathstyles5pt
\Umathoverbarrule\allmathstyles2.5pt
\Umathoverlinevariant\textstyle\scriptstyle
```

gives this:  . We have to disable the related `\mathfontcontrol` bits because otherwise the thickness is taken from the font. The variant is just there to overload the (in traditional TEX engines) default.

644 \overloaded

This prefix can be used to overload a frozen macro.

645 \overloadmode

The overload protection mechanism can be used to prevent users from redefining a control sequence. The mode can have several values, the higher the more strict we are:

		immutable	permanent	primitive	frozen	instance
1	warning	+	+	+		
2	error	+	+	+		
3	warning	+	+	+	+	
4	error	+	+	+	+	
5	warning	+	+	+	+	+
6	error	+	+	+	+	+

When you set a high error value, you can of course temporary lower or even zero the mode. In ConTEXt all macros and quantities are tagged so there setting the mode to 6 gives a proper protection against overloading. We need to zero the mode when we load for instance tikz, so when you use that generic package, you loose some.

646 \overshoot

This primitive is a companion to `\badness` and reports how much a box overflows.

```
\setbox0\hbox to 1em {mmm} \the\badness\quad\the\overshoot
\setbox0\hbox          {mm} \the\badness\quad\the\overshoot
\setbox0\hbox to 3em   {m} \the\badness\quad\the\overshoot
```

This reports:

```
1000000   18.44727pt
0   0.0pt
10000   0.0pt
```

When traditional TEX wraps up the lines in a paragraph it uses a mix of shift (a box property) to position the content suiting the hanging indentation and/or paragraph shape, and fills up the line using right skip glue, also in order to silence complaints in packaging. In LuaMetaTEX the lines can be normalized so that they all have all possible skips to the left and right (even if they're zero). The `\overshoot` primitive fits into this picture and is present as a compensation glue. This all fits better in a situation where the internals are opened up via Lua.

647 \overwithdelims

This is a variant of `\over` but with delimiters. It has a more advanced upgrade in `\Uoverwithdelims`.

648 \pageboundary

In order to avoid side effects of triggering the page builder with a specific penalty we can use this primitive which expects a value that actually gets inserted as zero penalty before triggering the page builder callback. Think of adding a no-op to the contribution list. We fake a zero penalty so that all gets processed. The main rationale is that we get a better indication of what we do. Of course a callback can remove this node so that it is never seen. Triggering from the callback is not doable. Consider this experimental code (which is actually used in ConTEXt anyway).

649 \pagedepth

This page property holds the depth of the page.

650 \pagediscards

The left-overs after a page is split of the main vertical list when glue and penalties are normally discarded. The discards can be pushed back in (for instance) trial runs.

651 \pageexcess

This page property hold the amount of overflow when a page break occurs.

652 \pageextragoal

This (experimental) dimension will be used when the page overflows but a bit of overshoot is considered okay.

653 \pagefilllstretch

The accumulated amount of third order stretch on the current page.

654 \pagefillstretch

The accumulated amount of second order stretch on the current page.

655 \pagefilstretch

The accumulated amount of first order stretch on the current page.

656 \pagefistretch

The accumulated amount of zero order stretch on the current page.

657 \pagegoal

The target height of a page (the running text). This value will be decreased by the height of inserts something to keep into mind when messing around with this and other (pseudo) page related parameters like `\pagetotal`.

658 \pagelastdepth

The accumulated depth of the current page.

659 \pagelastfilllstretch

The accumulated amount of third order stretch on the current page. Contrary to `\pagefilllstretch` this is the really contributed amount, not the upcoming.

660 \pagelastfillstretch

The accumulated amount of second order stretch on the current page. Contrary to `\pagefillstretch` this is the really contributed amount, not the upcoming.

661 \pagelastfilstretch

The accumulated amount of first order stretch on the current page. Contrary to `\pagefilstretch` this is the really contributed amount, not the upcoming.

662 \pagelastfistretch

The accumulated amount of zero order stretch on the current page. Contrary to `\pagefistretch` this is the really contributed amount, not the upcoming.

663 \pagelastheight

The accumulated height of the current page.

664 \pagelastshrink

The accumulated amount of shrink on the current page. Contrary to `\pageshrink` this is the really contributed amount, not the upcoming.

665 \pagelaststretch

The accumulated amount of stretch on the current page. Contrary to `\pagestretch` this is the really contributed amount, not the upcoming.

666 \pageshrink

The accumulated amount of shrink on the current page.

667 \pagestretch

The accumulated amount of stretch on the current page.

668 \pagetotal

The accumulated page total (height) of the current page.

669 \pagevsize

This parameter, when set, is used as the target page height. This lessens the change of `\vsize` interfering.

670 \par

This is the explicit 'finish paragraph' command. Internally we distinguish a par triggered by a new line, as side effect of another primitive or this `\par` command.

671 \parametercount

The number of parameters passed to the current macro.

672 \parameterdef

Here is an example of binding a variable to a parameter. The alternative is of course to use an `\edef`.

```
\def\foo#1#2%
  {\parameterdef\MyIndexOne\plusone % 1
   \parameterdef\MyIndexTwo\plustwo % 2
   \oof{P}\oof{Q}\oof{R}\norelax}

\def\oof#1%
  {<1:\MyIndexOne><1:\MyIndexOne>%
   #1%
   <2:\MyIndexTwo><2:\MyIndexTwo>}

\foo{A}{B}
```

The outcome is:

<1:A><1:A>P<2:B><2:B><1:A><1:A>Q<2:B><2:B><1:A><1:A>R<2:B><2:B>

673 \parameterindex

This gives the zero based position on the parameter stack. One reason for introducing `\parameterdef` is that the position remains abstract so there we don't need to use `\parameterindex`.

674 \parametermark

This is an equivalent for #.

675 \parametermode

Setting this internal integer to a positive value (best use 1 because future versions might use bit set) will enable the usage of # for escaped in the main text and body of macros.

676 \parattribute

This primitive takes an attribute index and value and sets that attribute on the current paragraph.

677 \pardirection

This set the text direction for the whole paragraph which in the case of `r2l` (1) makes the right edge the starting point.

678 \parfillleftskip

The glue inserted at the start of the last line.

679 \parfillrightskip

The glue inserted at the end of the last line (aka `\parfillskip`).

680 \parfillskip

The glue inserted at the end of the last line.

681 \parindent

The amount of space inserted at the start of the first line. When bit 2 is set in `\normalizelinemode` a glue is inserted, otherwise an empty `\hbox` with the given width is inserted.

682 \parinitleftskip

The glue inserted at the start of the first line.

683 \parinitrightskip

The glue inserted at the end of the first line.

684 \parpasses

Specifies one or more recipes for additional second linebreak passes. Examples can be found in the ConTEXt distribution.

685 \parshape

Stores a shape specification. The first argument is the length of the list, followed by that amount of indentation-width pairs (two dimensions).

686 \parshapedimen

This oddly named (ε-TEX) primitive returns the width component (dimension) of the given entry (an integer). Obsoleted by `\parshapewidth`.

687 \parshapeindent

Returns the indentation component (dimension) of the given entry (an integer).

688 \parshapelength

Returns the number of entries (an integer).

689 \parshapewidth

Returns the width component (dimension) of the given entry (an integer).

690 \parskip

This is the amount of glue inserted before a new paragraph starts.

691 \patterns

The argument to this primitive contains hyphenation patterns that are bound to the current language. In LuaTEX and LuaMetaTEX we can also manage this at the Lua end. In LuaMetaTEX we don't store patterns in te format file

692 \pausing

In LuaMetaTEX this variable is ignored but in other engines it can be used to single step thought the input file by setting it to a positive value.

693 \penalty

The given penalty (a number) is inserted at the current spot in the horizontal or vertical list. We also have `\vpenalty` and `\hpenalty` that first change modes.

694 \permanent

This is one of the prefixes that is part of the overload protection mechanism. It is normally used to flag a macro as being at the same level as a primitive: don't touch it. primitives are flagged as such but that property cannot be set on regular macros. The similar `\immutable` flag is normally used for variables.

695 \pettymuskip

A predefined mu skip register that can be used in math (inter atom) spacing. The current value is `1.0mu minus 0.5mu`. This one complements `\thinmuskip`, `\medmuskip`, `\thickmuskip` and the new `\tinymuskip`.

696 \positdef

The engine uses 32 bit integers for various purposes and has no (real) concept of a floating point quantity. We get around this by providing a floating point data type based on 32 bit unums (posits). These have the advantage over native floats of more precision in the lower ranges but at the cost of a software implementation.

The `\positdef` primitive is the floating point variant of `\integerdef` and `\dimensiondef`: an efficient way to implement named quantities other than registers.

```
\positdef     \MyFloatA 5.678
```

```
\positdef     \MyFloatB 567.8
[\the\MyFloatA] [\todimension\MyFloatA] [\tointeger\MyFloatA]
[\the\MyFloatB] [\todimension\MyFloatB] [\tointeger\MyFloatB]
```

For practical reasons we can map posit (or float) onto an integer or dimension:

```
[5.6780000030994415283] [5.678pt] [6]
[567.8000030517578125] [567.80005pt] [568]
```

697 \postdisplaypenalty

This is the penalty injected after a display formula.

698 \postexhyphenchar

This primitive expects a language number and a character code. A negative character code is equivalent to ignore. In case of an explicit discretionary the character is injected at the beginning of a new line.

699 \posthyphenchar

This primitive expects a language number and a character code. A negative character code is equivalent to ignore. In case of an automatic discretionary the character is injected at the beginning of a new line.

700 \postinlinepenalty

When set this penalty is inserted after an inline formula unless we have a short formula and `\postshortinlinepenalty` is set.

701 \postshortinlinepenalty

When set this penalty is inserted after a short inline formula. The criterium is set by `\shortinlinemaththreshold` but only applied when it is enabled for the class involved.

702 \prebinoppenalty

This internal quantity is a compatibility feature because normally we will use the inter atom spacing variables.

703 \predisplaydirection

This is the direction that the math sub engine will take into account when dealing with right to left typesetting.

704 \predisplaygapfactor

The heuristics related to determine if the previous line in a formula overlaps with a (display) formula are hard coded but in LuaTEX to be two times the quad of the current font. This parameter is a multiplier set to 2000 and permits you to change the overshoot in this heuristic.

705 \predisplaypenalty

This is the penalty injected before a display formula.

706 \predisplaysize

This parameter holds the length of the last line in a paragraph when a display formula is part of it.

707 \preexhyphenchar

This primitive expects a language number and a character code. A negative character code is equivalent to ignore. In case of an explicit discretionary the character is injected at the end of the line.

708 \prehyphenchar

This primitive expects a language number and a character code. A negative character code is equivalent to ignore. In case of an automatic discretionary the character is injected at the end of the line.

709 \preinlinepenalty

When set this penalty is inserted before an inline formula unless we have a short formula and `\preshortinlinepenalty` is set.

710 \prerelpenalty

This internal quantity is a compatibility feature because normally we will use the inter atom spacing variables.

711 \preshortinlinepenalty

When set this penalty is inserted before a short inline formula. The criterium is set by `\shortinlinemaththreshold` but only applied when it is enabled for the class involved.

712 \pretolerance

When the badness of a line in a paragraph exceeds this value a second linebreak pass will be enabled.

713 \prevdepth

The depth of current list. It can also be set to special (signal) values in order to inhibit line corrections. It is not an internal dimension but a (current) list property.

714 \prevgraf

The number of lines in a previous paragraph.

715 \previousloopiterator

```
\edef\testA{
    \expandedrepeat 2 {%
        \expandedrepeat 3 {%
            (\the\previousloopiterator1:\the\currentloopiterator)
        }%
    }%
}
\edef\testB{
    \expandedrepeat 2 {%
        \expandedrepeat 3 {%
            (#P:#I) % #G is two levels up
        }%
    }%
}
```

These give the same result:

```
\def \testA { (1:1) (1:2) (1:3) (2:1) (2:2) (2:3) }
\def \testB { (1:1) (1:2) (1:3) (2:1) (2:2) (2:3) }
```

The number indicates the number of levels we go up the loop chain.

716 \primescript

This is a math script primitive dedicated to primes (which are somewhat troublesome on math). It complements the six script primitives (like `\subscript` and `\presuperscript`).

717 \protected

A protected macro is one that doesn't get expanded unless it is time to do so. For instance, inside an `\edef` it just stays what it is. It often makes sense to pass macros as-is to (multi-pass) file (for tables of contents).

In ConTEXt we use either `\protected` or `\unexpanded` because the later was the command we used to achieve the same results before ε-TEX introduced this protection primitive. Originally the `\protected` macro was also defined but it has been dropped.

718 \protecteddetokenize

This is a variant of `\protecteddetokenize` that uses some escapes encoded as body parameters, like `#H` for a hash.

719 \protectedexpandeddetokenize

This is a variant of `\expandeddetokenize` that uses some escapes encoded as body parameters, like `#H` for a hash.

720 \protrudechars

This variable controls protrusion (into the margin). A value 2 is comparable with other engines, while a value of 3 does a bit more checking when we're doing right-to-left typesetting.

721 \protrusionboundary

This injects a boundary with the given value:

`0x00` skipnone
`0x01` skipnext
`0x02` skipprevious
`0x03` skipboth

This signal makes the protrusion checker skip over a node.

722 \pxdimen

The current numeric value of this dimension is 65781, 1.00374pt: one `bp`. We kept it around because it was introduced in pdfTEX and made it into LuaTEX, where it relates to the resolution of included images. In ConTEXt it is not used.

723 \quitloop

There are several loop primitives and they can be quit with `\quitloop` at the next the *next* iteration. An immediate quit is possible with `\quitloopnow`. An example is given with `\localcontrolledloop`.

724 \quitloopnow

There are several loop primitives and they can be quit with `\quitloopnow` at the spot.

725 \quitvmode

This primitive forces horizontal mode but has no side effects when we're already in that mode.

726 \radical

This old school radical constructor is replaced by `\Uradical`. It takes a number where the first byte is the small family, the next two index of this symbol from that family, and the next three the family and index of the first larger variant.

727 \raise

This primitive takes two arguments, a dimension and a box. The box is moved up. The operation only succeeds in horizontal mode.

728 \rdivide

This is variant of `\divide` that rounds the result. For integers the result is the same as `\edivide`.

```
\the\dimexpr .4999pt                    : 2 \relax           =.24994pt
\the\dimexpr .4999pt                    / 2 \relax           =.24995pt
\the\dimexpr .4999pt                    ; 2 \relax           =.00002pt
\scratchdimen.4999pt \divide \scratchdimen 2 \the\scratchdimen =.24994pt
\scratchdimen.4999pt \edivide\scratchdimen 2 \the\scratchdimen =.24995pt
\scratchdimen 4999pt \rdivide\scratchdimen 2 \the\scratchdimen =2500.0pt
\scratchdimen 5000pt \rdivide\scratchdimen 2 \the\scratchdimen =2500.0pt

\the\numexpr   1001                     : 2 \relax             =500
\the\numexpr   1001                     / 2 \relax             =501
\the\numexpr   1001                     ; 2 \relax             =1
\scratchcounter1001 \divide \scratchcounter 2 \the\scratchcounter=500
\scratchcounter1001 \edivide\scratchcounter 2 \the\scratchcounter=501
\scratchcounter1001 \rdivide\scratchcounter 2 \the\scratchcounter=501
```

```
0.24994pt=.24994pt
0.24995pt=.24995pt
0.00002pt=.00002pt
0.24994pt=.24994pt
0.24995pt=.24995pt
2500.0pt=2500.0pt
2500.0pt=2500.0pt

500=500
501=501
1=1
500=500
501=501
501=501
```

The integer division `:` and modulo `;` are an addition to the ε-TEX compatible expressions.

729 \rdivideby

This is the by-less companion to `\rdivide`.

730 \realign

Where `\omit` suspends a preamble template, this one overloads is for the current table cell. It expects two token lists as arguments.

731 \relax

This primitive does nothing and is often used to end a verbose number or dimension in a comparison, for example:

```
\ifnum \scratchcounter = 123\relax
```

which prevents a lookahead. A variant would be:

```
\ifnum \scratchcounter = 123 %
```

assuming that spaces are not ignored. Another application is finishing an expression like `\numexpr` or `\dimexpr`. I is also used to prevent lookahead in cases like:

```
\vrule height 3pt depth 2pt width 5pt\relax
\hskip 5pt plus 3pt minus 2pt\relax
```

Because `\relax` is not expandable the following:

```
\edef\foo{\relax}   \meaningfull\foo
\edef\oof{\norelax} \meaningfull\oof
```

gives this:

macro:\relax
macro:

A `\norelax` disappears here but in the previously mentioned scenarios it has the same function as `\relax`. It will not be pushed back either in cases where a lookahead demands that.

732 \relpenalty

This internal quantity is a compatibility feature because normally we will use the inter atom spacing variables.

733 \resetlocalboxes

Its purpose should be clear from the name.

734 \resetmathspacing

This initializes all parameters to their initial values.

735 \restorecatcodetable

This is an experimental feature that should be used with care. The next example shows usage. It was added when debugging and exploring a side effect.

```
\tracingonline1

\bgroup

    \catcode`6 = 11 \catcode`7 = 11

    \bgroup

    \tracingonline1

    current: \the\catcodetable

    original: \the\catcode`6\quad \the\catcode`7

    \catcode`6 = 11 \catcode`7 = 11
```

```
    \showcodestack\catcode

    assigned: \the\catcode`6\quad \the\catcode`7

    \showcodestack\catcode

    \catcodetable\ctxcatcodes switched: \the\catcodetable

    stored: \the\catcode`6\quad \the\catcode`7

    \showcodestack\catcode

    \restorecatcodetable\ctxcatcodes

    \showcodestack\catcode

    restored: \the\catcode`6\quad \the\catcode`7

    \showcodestack\catcode

    \egroup

    \catcodetable\ctxcatcodes

    inner: \the\catcode`6\quad\the\catcode`7

\egroup

outer: \the\catcode`6\quad\the\catcode`7
```

In ConTEXt this typesets:

```
current: 9
original: 11 11
assigned: 11 11
switched: 9
stored: 11 11
restored: 12 12
inner: 11 11
outer; 12 12
```

and on the console we see:

```
3:3: [codestack 1, size 3]
3:3: [1: level 2, code 54, value 12]
3:3: [2: level 2, code 55, value 12]
3:3: [3: level 3, code 54, value 11]
3:3: [4: level 3, code 55, value 11]
3:3: [codestack 1 bottom]
3:3: [codestack 1, size 3]
3:3: [1: level 2, code 54, value 12]
3:3: [2: level 2, code 55, value 12]
3:3: [3: level 3, code 54, value 11]
3:3: [4: level 3, code 55, value 11]
```

```
3:3: [codestack 1 bottom]
3:3: [codestack 1, size 3]
3:3: [1: level 2, code 54, value 12]
3:3: [2: level 2, code 55, value 12]
3:3: [3: level 3, code 54, value 11]
3:3: [4: level 3, code 55, value 11]
3:3: [codestack 1 bottom]
3:3: [codestack 1, size 7]
3:3: [1: level 2, code 54, value 12]
3:3: [2: level 2, code 55, value 12]
3:3: [3: level 3, code 54, value 11]
3:3: [4: level 3, code 55, value 11]
3:3: [5: level 3, code 55, value 11]
3:3: [6: level 3, code 54, value 11]
3:3: [7: level 3, code 55, value 11]
3:3: [8: level 3, code 54, value 11]
3:3: [codestack 1 bottom]
3:3: [codestack 1, size 7]
3:3: [1: level 2, code 54, value 12]
3:3: [2: level 2, code 55, value 12]
3:3: [3: level 3, code 54, value 11]
3:3: [4: level 3, code 55, value 11]
3:3: [5: level 3, code 55, value 11]
3:3: [6: level 3, code 54, value 11]
3:3: [7: level 3, code 55, value 11]
3:3: [8: level 3, code 54, value 11]
3:3: [codestack 1 bottom]
```

So basically `\restorecatcodetable` brings us (temporarily) back to the global settings.

736 \retained

When a value is assigned inside a group TEX pushes the current value on the save stack in order to be able to restore the original value after the group has ended. You can reach over a group by using the `\global` prefix. A mix between local and global assignments can be achieved with the `\retained` primitive.

```
\MyDim 15pt \bgroup \the\MyDim \space
\bgroup
    \bgroup
        \bgroup \advance\MyDim10pt \the\MyDim \egroup\space
        \bgroup \advance\MyDim10pt \the\MyDim \egroup\space
    \egroup
    \bgroup
        \bgroup \advance\MyDim10pt \the\MyDim \egroup\space
        \bgroup \advance\MyDim10pt \the\MyDim \egroup\space
    \egroup
\egroup
\egroup \the\MyDim
```

```
\MyDim 15pt \bgroup \the\MyDim \space
\bgroup
    \bgroup
        \bgroup \global\advance\MyDim10pt \the\MyDim \egroup\space
        \bgroup \global\advance\MyDim10pt \the\MyDim \egroup\space
    \egroup
    \bgroup
        \bgroup \global\advance\MyDim10pt \the\MyDim \egroup\space
        \bgroup \global\advance\MyDim10pt \the\MyDim \egroup\space
    \egroup
\egroup
\egroup \the\MyDim

\MyDim 15pt \bgroup \the\MyDim \space
    \constrained\MyDim\zeropoint
    \bgroup
        \bgroup \retained\advance\MyDim10pt \the\MyDim \egroup\space
        \bgroup \retained\advance\MyDim10pt \the\MyDim \egroup\space
    \egroup
    \bgroup
        \bgroup \retained\advance\MyDim10pt \the\MyDim \egroup\space
        \bgroup \retained\advance\MyDim10pt \the\MyDim \egroup\space
    \egroup
\egroup \the\MyDim
```

These lines result in:

15.0pt 25.0pt 25.0pt 25.0pt 25.0pt 15.0pt
15.0pt 25.0pt 35.0pt 45.0pt 55.0pt 55.0pt
15.0pt 10.0pt 20.0pt 30.0pt 40.0pt 15.0pt

Because LuaMetaTEX avoids redundant stack entries and reassignments this mechanism is a bit fragile but the `\constrained` prefix makes sure that we do have a stack entry. If it is needed depends on the usage pattern.

737 \retokenized

This is a companion of `\tokenized` that accepts a catcode table, so the whole repertoire is:

```
\tokenized                          {test $x$ test: current}
\tokenized   catcodetable \ctxcatcodes {test $x$ test: context}
\tokenized   catcodetable \vrbcatcodes {test $x$ test: verbatim}
\retokenized              \ctxcatcodes {test $x$ test: context}
\retokenized              \vrbcatcodes {test $x$ test: verbatim}
```

Here we pass the numbers known to ConTEXt and get:

test *x* test: current
test *x* test: context
test x test: verbatim
test *x* test: context

test x test: verbatim

738 \right

Inserts the given delimiter as right fence in a math formula.

739 \righthyphenmin

This is the minimum number of characters before the first hyphen in a hyphenated word.

740 \rightmarginkern

The dimension returned is the protrusion kern that has been added (if at all) to the left of the content in the given box.

741 \rightskip

This skip will be inserted at the right of every line.

742 \romannumeral

This converts a number into a sequence of characters representing a roman numeral. Because the Romans had no zero, a zero will give no output, a fact that is sometimes used for hacks and showing off ones macro coding capabilities. A large number will for sure result in a long string because after thousand we start duplicating.

743 \rpcode

This is the companion of `\lpcode` (see there) and also takes three arguments: font, character code and factor.

744 \savecatcodetable

This primitive stores the currently set catcodes in the current table.

745 \savinghyphcodes

When set to non-zero, this will trigger the setting of `\hjcodes` from `\lccodes` for the current font. These codes determine what characters are taken into account when hyphenating words.

746 \savingvdiscards

When set to a positive value the page builder will store the discarded items (like glues) so that they can later be retrieved and pushed back if needed with `\pagediscards` or `\splitdiscards`.

747 \scaledemwidth

Returns the current (font specific) emwidth scaled according to `\glyphscale` and `\glyphxscale`.

748 \scaledexheight

Returns the current (font specific) exheight scaled according to \glyphscale and \glyphyscale.

749 \scaledextraspace

Returns the current (font specific) extra space value scaled according to \glyphscale and \glyphxscale.

750 \scaledfontcharba

Returns the bottom accent position of the given font-character pair scaled according to \glyphscale and \glyphyscale.

751 \scaledfontchardp

Returns the depth of the given font-character pair scaled according to \glyphscale and \glyphyscale.

752 \scaledfontcharht

Returns the height of the given font-character pair scaled according to \glyphscale and \glyphyscale.

753 \scaledfontcharic

Returns the italic correction of the given font-character pair scaled according to \glyphscale and \glyphxscale. This property is only real for traditional fonts.

754 \scaledfontcharta

Returns the top accent position of the given font-character pair scaled according to \glyphscale and \glyphxscale.

755 \scaledfontcharwd

Returns width of the given font-character pair scaled according to \glyphscale and \glyphxscale.

756 \scaledfontdimen

Returns value of a (numeric) font dimension of the given font-character pair scaled according to \glyphscale and \glyphxscale and/or \glyphyscale.

757 \scaledinterwordshrink

Returns the current (font specific) shrink of a space value scaled according to \glyphscale and \glyphxscale.

758 \scaledinterwordspace

Returns the current (font specific) space value scaled according to \glyphscale and \glyphxscale.

759 \scaledinterwordstretch

Returns the current (font specific) stretch of a space value scaled according to \glyphscale and \glyphxscale.

760 \scaledmathaxis

This primitive returns the math axis of the given math style. It's a dimension.

761 \scaledmathemwidth

Returns the emwidth of the given style scaled according to \glyphscale and \glyphxscale.

762 \scaledmathexheight

Returns the exheight of the given style scaled according to \glyphscale and \glyphyscale.

763 \scaledmathstyle

This command inserts a signal in the math list that tells how to scale the (upcoming) part of the formula.

```
$ x + {\scaledmathstyle900 x} + x$
```

We get: $x + x+x$. Of course using this properly demands integration in the macro packages font system.

764 \scaledslantperpoint

This primitive is equivalent to **\scaledfontdimen**1**\font** where 'scaled' means that we multiply by the glyph scales.

765 \scantextokens

This primitive scans the input as if it comes from a file. In the next examples the \detokenize primitive turns tokenized code into verbatim code that is similar to what is read from a file.

```
\edef\whatever{\detokenize{This is {\bf bold} and this is not.}}
\detokenize   {This is {\bf bold} and this is not.}\crlf
\scantextokens{This is {\bf bold} and this is not.}\crlf
\scantextokens{\whatever}\crlf
\scantextokens\expandafter{\whatever}\par
```

This primitive does not have the end-of-file side effects of its precursor \scantokens.

This is {\bf bold} and this is not.
This is **bold** and this is not.
This is {\bf bold} and this is not.
This is **bold** and this is not.

766 \scantokens

Just forget about this ε-TEX primitive, just take the one in the next section.

767 \scriptfont

This primitive is like `\font` but with a family number as (first) argument so it is specific for math. It is the middle one of the three family members; its relatives are `\textfont` and `\scriptscriptfont`.

768 \scriptscriptfont

This primitive is like `\font` but with a family number as (first) argument so it is specific for math. It is the smallest of the three family members; its relatives are `\textfont` and `\scriptfont`.

769 \scriptscriptstyle

One of the main math styles, normally one size smaller than `\scriptstyle`: integer representation: 6.

770 \scriptspace

The math engine will add this amount of space after subscripts and superscripts. It can be seen as compensation for the often too small widths of characters (in the traditional engine italic correction is used too). It prevents scripts from running into what follows.

771 \scriptspaceafterfactor

This is a (1000 based) multiplier for `\Umathspaceafterscript`.

772 \scriptspacebeforefactor

This is a (1000 based) multiplier for `\Umathspacebeforescript`.

773 \scriptspacebetweenfactor

This is a (1000 based) multiplier for `\Umathspacebetweenscript`.

774 \scriptstyle

One of the main math styles, normally one size smaller than `\displaystyle` and `\textstyle`; integer representation: 4.

775 \scrollmode

This directive omits error stops.

776 \semiexpand

This command expands the next macro when it is protected with `\semprotected`. See that primitive there for an example.

777 \semiexpanded

This command expands the tokens in the given list including the macros protected by with `\semprotected`. See that primitive there for an example.

778 \semiprotected

The working of this prefix can best be explained with an example. We define a few macros first:

```
              \def\TestA{A}
\semiprotected\def\TestB{B}
    \protected\def\TestC{C}

\edef\TestD{\TestA           \TestB           \TestC}
\edef\TestE{\TestA\semiexpand\TestB\semiexpand\TestC}
\edef\TestF{\TestA\expand    \TestB\expand    \TestC}

\edef\TestG{\normalexpanded    {\TestA\TestB\TestC}}
\edef\TestH{\normalsemiexpanded{\TestA\TestB\TestC}}
```

The meaning of the macros that are made from the other three are:

Here we use the **\normal..** variants because (currently) we still have the macro with the **\expanded** in the ConTEXt core.

```
A\TestB \TestC
AB\TestC
ABC
A\TestB \TestC
AB\TestC
```

779 \setbox

This important primitive is used to set a box register. It expects a number and a box, like `\hbox` or `\box`. There is no `\boxdef` primitive (analogue to other registers) because it makes no sense but numeric registers or equivalents are okay as register value.

780 \setdefaultmathcodes

This sets the math codes of upper- and lowercase alphabet and digits and the delimiter code of the period. It's not so much a useful feature but more just an accessor to the internal initializer.

781 \setfontid

Internally a font instance has a number and this number is what gets assigned to a glyph node. You can get the number with `\fontid` an set it with `\setfontid`.

```
\setfontid\fontid\font
```

The code above shows both primitives and effectively does nothing useful but shows the idea.

782 \setlanguage

In LuaTEX and LuaMetaTEX this is equivalent to `\language` because we carry the language in glyph nodes instead of putting triggers in the list.

783 \setmathatomrule

The math engine has some built in logic with respect to neighboring atoms that change the class. The following combinations are intercepted and remapped:

old first	**old second**	new first	new second
begin	binary	ordinary	ordinary
operator	binary	operator	ordinary
open	binary	open	ordinary
punctuation	binary	punctuation	ordinary
binary	end	ordinary	ordinary
binary	binary	binary	ordinary
binary	close	ordinary	close
binary	punctuation	ordinary	punctuation
binary	relation	ordinary	relation
relation	binary	relation	ordinary
relation	close	ordinary	close
relation	punctuation	ordinary	punctuation

You can change this logic if needed, for instance:

```
\setmathatomrule 1 2 \allmathstyles 1 1
```

Keep in mind that the defaults are what users expect. You might set them up for additional classes that you define but even then you probably clone an existing class and patch its properties. Most extra classes behave like ordinary anyway.

784 \setmathdisplaypostpenalty

This penalty is inserted after an item of a given class but only in inline math when display style is used, for instance:

```
\setmathdisplayprepenalty 2 750
```

785 \setmathdisplayprepenalty

This penalty is inserted before an item of a given class but only in inline math when display style is used, for instance:

```
\setmathdisplayprepenalty 2 750
```

786 \setmathignore

You can flag a math parameter to be ignored, like:

```
\setmathignore \Umathxscale             2
\setmathignore \Umathyscale             2
\setmathignore \Umathspacebeforescript  1
\setmathignore \Umathspacebetweenscript 1
\setmathignore \Umathspaceafterscript   1
```

A value of two will not initialize the variable, so its old value (when set) is kept. This is somewhat experimental and more options might show up.

787 \setmathoptions

This primitive expects a class (number) and a bitset.

0x00000001	nopreslack	0x00004000	raiseprime
0x00000002	nopostslack	0x00008000	carryoverlefttopkern
0x00000004	lefttopkern	0x00010000	carryoverrighttopkern
0x00000008	righttopkern	0x00020000	carryoverleftbottomkern
0x00000010	leftbottomkern	0x00040000	carryoverrightbottomkern
0x00000020	rightbottomkern	0x00080000	preferdelimiterdimensions
0x00000040	lookaheadforend	0x00100000	autoinject
0x00000080	noitaliccorrection	0x00200000	removeitaliccorrection
0x00000100	checkligature	0x00400000	operatoritaliccorrection
0x00000200	checkitaliccorrection	0x00800000	shortinline
0x00000400	checkkernpair	0x01000000	pushnesting
0x00000800	flatten	0x02000000	popnesting
0x00001000	omitpenalty	0x04000000	obeynesting
0x00002000	unpack		

788 \setmathpostpenalty

This penalty is inserted after an item of a given class but only in inline math when text, script or scriptscript style is used, for instance:

```
\setmathpostpenalty 2 250
```

789 \setmathprepenalty

This penalty is inserted before an item of a given class but only in inline math when text, script or scriptscript style is used, for instance:

```
\setmathprepenalty 2 250
```

790 \setmathspacing

More details about this feature can be found in ConTEXt but it boils down to registering what spacing gets inserted between a pair of classes. It can be defined per style or for a set of styles, like:

```
\inherited\setmathspacing
  \mathimplicationcode \mathbinarycode
  \alldisplaystyles \thickermuskip
\inherited\setmathspacing
  \mathradicalcode \mathmiddlecode
  \allunsplitstyles \pettymuskip
```

Here the `\inherited` prefix signals that a change in for instance `\pettymuskip` is reflected in this spacing pair. In ConTEXt there is a lot of granularity with respect to spacing and it took years of experimenting (and playing with examples) to get at the current stage. In general users are not invited to mess around too much with these values, although changing the bound registers (here `\pettymuskip` and `thickermuskip`) is no problem as it consistently makes related spacing pairs follow.

791 \sfcode

You can set a space factor on a character. That factor is used when a space factor is applied (as part of spacing). It is (mostly) used for adding a different space (glue) after punctuation. In some languages different punctuation has different factors.

792 \shapingpenaltiesmode

Shaping penalties are inserted after the lines of a `\parshape` and accumulate according to this mode, a bitset of:

`0x01` interlinepenalty
`0x02` widowpenalty
`0x04` clubpenalty
`0x08` brokenpenalty

793 \shapingpenalty

In order to prevent a `\parshape` to break in unexpected ways we can add a dedicated penalty, specified by this parameter.

794 \shipout

Because there is no backend, this is not supposed to be used. As in traditional TEX a box is grabbed but instead of it being processed it gets shown and then wiped. There is no real benefit of turning it into a callback.

795 \shortinlinemaththreshold

This parameter determines when an inline formula is considered to be short. This criterium is used for for `\preshortinlinepenalty` and `\postshortinlinepenalty`.

796 \shortinlineorphanpenalty

Short formulas at the end of a line are normally not followed by something other than punctuation. This penalty will discourage a break before a short inline formula. In practice one can set this penalty to e.g. a relatively low 200 to get the desired effect.

797 \show

Prints to the console (and/or log) what the token after it represents.

798 \showbox

The given box register is shown in the log and on te console (depending on `\tracingonline`. How much is shown depends on `\showboxdepth` and `\showboxbreadth`. In LuaMetaTEX we show more detailed information than in the other engines; some specific information is provided via callbacks.

799 \showboxbreadth

This primitives determine how much of a box is shown when asked for or when tracing demands it.

800 \showboxdepth

This primitives determine how deep tracing a box goes into the box. Some boxes, like the ones that has the assembled page.

801 \showcodestack

This inspector is only useful for low level debugging and reports the current state of for instance the current catcode table: **`\showcodestack\catcode`**. See `\restorecatcodes` for an example.

802 \showgroups

This primitive reports the group nesting. At this spot we have a not so impressive nesting:

```
2:3: simple group entered at line 9375:
1:3: semisimple group: \begingroup
0:3: bottomlevel
```

803 \showifs

This primitive will show the conditional stack in the log file or on the console (assuming `\tracingonline` being non-zero). The shown data is different from other engines because we have more conditionals and also support a more flat nesting model

804 \showlists

This shows the currently built list.

805 \shownodedetails

When set to a positive value more details will be shown of nodes when applicable. Values larger than one will also report attributes. What gets shown depends on related callbacks being set.

806 \showstack

This tracer is only useful for low level debugging of macros, for instance when you run out of save space or when you encounter a performance hit.

```
  test\scratchcounter0 \showstack
 {test\scratchcounter1 \showstack}
{{test\scratchcounter1 \showstack}}
```

reports

```
1:3: [savestack size 0]
1:3: [savestack bottom]

2:3: [savestack size 2]
2:3: [1: restore, level 1, cs \scratchcounter=integer 1]
2:3: [0: boundary, group 'bottomlevel', boundary 0, attrlist 3600, line 0]
2:3: [savestack bottom]

3:3: [savestack size 3]
3:3: [2: restore, level 1, cs \scratchcounter=integer 1]
3:3: [1: boundary, group 'simple', boundary 0, attrlist 3600, line 12]
3:3: [0: boundary, group 'bottomlevel', boundary 0, attrlist 3600, line 0]
3:3: [savestack bottom]
```

while

```
  test\scratchcounter1 \showstack
 {test\scratchcounter1 \showstack}
{{test\scratchcounter1 \showstack}}
```

shows this:

```
1:3: [savestack size 0]
1:3: [savestack bottom]

2:3: [savestack size 1]
2:3: [0: boundary, group 'bottomlevel', boundary 0, attrlist 3600, line 0]
2:3: [savestack bottom]

3:3: [savestack size 2]
3:3: [1: boundary, group 'simple', boundary 0, attrlist 3600, line 16]
3:3: [0: boundary, group 'bottomlevel', boundary 0, attrlist 3600, line 0]
```

```
3:3: [savestack bottom]
```

Because in the second example the value of `\scratchcounter` doesn't really change inside the group there is no need for a restore entry on the stack. In LuaMetaTEX there are checks for that so that we consume less stack space. We also store some states (like the line number and current attribute list pointer) in a stack boundary.

807 \showthe

Prints to the console (and/or log) the value of token after it.

808 \showtokens

This command expects a (balanced) token list, like

```
\showtokens{a few tokens}
```

Depending on what you want to see you need to expand:

```
\showtokens\expandafter{\the\everypar}
```

which is equivalent to `\showthe\everypar`. It is an ε-TEX extension.

809 \singlelinepenalty

This is a penalty that gets injected before a paragraph that has only one line. It is a one-shot parameter, so like `\looseness` it only applies to the upcoming (or current) paragraph.

810 \skewchar

This is an (imaginary) character that is used in math fonts. The kerning pair between this character and the current one determines the top anchor of a possible accent. In OpenType there is a dedicated character property for this (but for some reason not for the bottom anchor).

811 \skip

This is the accessor for an indexed skip (glue) register.

812 \skipdef

This command associates a control sequence with a skip register (accessed by number).

813 \snapshotpar

There are many parameters involved in typesetting a paragraph. One complication is that parameters set in the middle might have unpredictable consequences due to grouping, think of:

```
text  text <some setting> text   text \par
text {text <some setting> text } text \par
```

This makes in traditional TEX because there is no state related to the current paragraph. But in LuaTEX we have the initial so called par node that remembers the direction as well as local boxes. In LuaMetaTEX we store way more when this node is created. That means that later settings no longer replace the stored ones.

The `\snapshotpar` takes a bitset that determine what stored parameters get updated to the current values.

`0x00000001`	hsize	`0x00000400`	lastline	`0x00100000`	shapingpenalty
`0x00000002`	skip	`0x00000800`	linepenalty	`0x00200000`	orphanpenalty
`0x00000004`	hang	`0x00001000`	clubpenalty	`0x00400000`	toddlerpenalty
`0x00000008`	indent	`0x00002000`	widowpenalty	`0x00800000`	emergency
`0x00000010`	parfill	`0x00004000`	displaypenalty	`0x01000000`	parpasses
`0x00000020`	adjust	`0x00008000`	brokenpenalty	`0x02000000`	singlelinepenalty
`0x00000040`	protrude	`0x00010000`	demerits	`0x04000000`	hyphenpenalty
`0x00000080`	tolerance	`0x00020000`	shape	`0x08000000`	exhyphenpenalty
`0x00000100`	stretch	`0x00040000`	line		
`0x00000200`	looseness	`0x00080000`	hyphenation		

One such value covers multiple values, so for instance `skip` is good for storing the current `\leftskip` and `\rightskip` values. More about this feature can be found in the ConTEXt documentation.

The list of parameters that gets reset after a paragraph is longer than for pdfTEX and LuaMetaTEX: `\emergencyleftskip`, `\emergencyrightskip`, `\hangafter`, `\hangindent`, `\interlinepenalties`, `\localbrokenpenalty`, `\localinterlinepenalty`, `\localpretolerance`, `\localtolerance`, `\looseness`, `\parshape` and `\singlelinepenalty`.

814 \spacechar

When `\nospaces` is set to 3 a glyph node with the character value of this parameter is injected.

815 \spacefactor

The space factor is a somewhat complex feature. When during scanning a character is appended that has a `\sfcode` other than 1000, that value is saved. When the time comes to insert a space triggered glue, and that factor is 2000 or more, and when `\xspaceskip` is nonzero, that value is used and we're done.

If these criteria are not met, and `\spaceskip` is nonzero, that value is used, otherwise the space value from the font is used. Now, it if the space factor is larger than 2000 the extra space value from the font is added to the set value. Next the engine is going to tweak the stretch and shrink if that value and in LuaMetaTEX that can be done in different ways, depending on `\spacefactormode`, `\spacefactorstretchlimit` and `\spacefactorshrinklimit`.

First the stretch. When the set limit is 1000 or more and the saved space factor is also 1000 or more, we multiply the stretch by the limit, otherwise the saved space factor is used.

Shrink is done differently. When the shrink limit and space factor are both 1000 or more, we will scale the shrink component by the limit, otherwise we multiply by the saved space factor but here we have three variants, determined by the value of `\spacefactormode`.

In the first case, when the limit kicks in, a mode value 1 will multiply by limit and divides by 1000. A value of 2 multiplies by 2000 and divides by the limit. Other mode values multiply by 1000 and divide by the limit. When the limit is not used, the same happens but with the saved space factor.

If this sounds complicated, here is what regular TEX does: stretch is multiplied by the factor and divided by 1000 while shrink is multiplied by 1000 and divided by the saved factor. The (new) mode driven alternatives are the result of extensive experiments done in the perspective of enhancing the rendering of inline math as well as additional par builder passes. For sure alternative strategies are possible and we can always add more modes.

A better explanation of the default strategy around spaces can be found in (of course) The TEXbook and TEX by Topic.

816 \spacefactormode

Its setting determines the way the glue components (currently only shrink) adapts itself to the current space factor (determined by by the character preceding a space).

817 \spacefactoroverload

When set to value between zero and thousand, this value will be used when TEX encounters a below thousand space factor situation (usually used to suppress additional space after a period following an uppercase character which then gets (often) a 999 space factor. This feature only kicks in when the overload flag is set in the glyph options, so it can be applied selectively.

818 \spacefactorshrinklimit

This limit is used when `\spacefactormode` is set. See `\spacefactor` for a bit more explanation.

819 \spacefactorstretchlimit

This limit is used when `\spacefactormode` is set. See `\spacefactor` for a bit more explanation.

820 \spaceskip

Normally the glue inserted when a space is encountered is taken from the font but this parameter can overrule that.

821 \span

This primitive combined two upcoming cells into one. Often it is used in combination with `\omit`. However, in the preamble it forces the next token to be expanded, which means that nested `\tabskips` and align content markers are seen.

822 \splitbotmark

This is a reference to the last mark on the currently split off box, it gives back tokens.

823 \splitbotmarks

This is a reference to the last mark with the given id (a number) on the currently split off box, it gives back tokens.

824 \splitdiscards

When a box is split off, items like glue are discarded. This internal register keeps the that list so that it can be pushed back if needed.

825 \splitfirstmark

This is a reference to the first mark on the currently split off box, it gives back tokens.

826 \splitfirstmarks

This is a reference to the first mark with the given id (a number) on the currently split off box, it gives back tokens.

827 \splitmaxdepth

The depth of the box that results from a `\vsplit`.

828 \splittopskip

This is the amount of glue that is added to the top of a (new) split of part of a box when `\vsplit` is applied.

829 \srule

This inserts a rule with no width. When a `font` and a `char` are given the height and depth of that character are taken. Instead of a font `fam` is also accepted so that we can use it in math mode.

830 \string

We mention this original primitive because of the one in the next section. It expands the next token or control sequence as if it was just entered, so normally a control sequence becomes a backslash followed by characters and a space.

831 \subprescript

Instead of three or four characters with catcode 8 (__ or ____) this primitive can be used. It will add the following argument as lower left script to the nucleus.

832 \subscript

Instead of one or two characters with catcode 7 (_ or __) this primitive can be used. It will add the following argument as upper left script to the nucleus.

833 \superprescript

Instead of three or four characters with catcode 7 (^^^ or ^^^^) this primitive can be used. It will add the following argument as upper left script to the nucleus.

834 \superscript

Instead of one or two character with catcode 7 (^ or ^^)this primitive can be used. It will add the following argument as upper right script to the nucleus.

835 \supmarkmode

As in other languages, TEX has ways to escape characters and get whatever character needed into the input. By default multiple ^ are used for this. The dual ^^ variant is a bit weird as it is not continuous but ^^^^ and ^^^^^^ provide four or six byte hexadecimal references ot characters. The single ^ is also used for superscripts but because we support prescripts and indices we get into conflicts with the escapes.

When this internal quantity is set to zero, multiple ^'s are interpreted in the input and produce characters. Other values disable the multiple parsing in text and/or math mode:

```
\normalsupmarkmode0 $ X^58 \quad X^^58 $ ^^58
\normalsupmarkmode1 $ X^58 \quad X^^58 $ ^^58
\normalsupmarkmode2 $ X^58 \quad X^^58 $ % ^^58 : error
```

In ConTEXt we default to one but also have the `\catcode` set to 12and the `\amcode` to 7.

X^58 X^X X
X^58 X^58 X
X^58 X^58

836 \swapcsvalues

Because we mention some `def` and `let` primitives here, it makes sense to also mention a primitive that will swap two values (meanings). This one has to be used with care. Of course that what gets swapped has to be of the same type (or at least similar enough not to cause issues). Registers for instance store their values in the token, but as soon as we are dealing with token lists we also need to keep an eye on reference counting. So, to some extend this is an experimental feature.

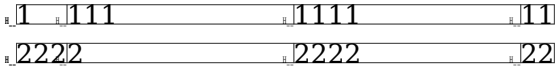
837 \tabsize

This primitive can be used in the preamble of an alignment and sets the size of a column, as in:

```
\halign{%
    \aligncontent              \aligntab
    \aligncontent\tabsize 3cm \aligntab
    \aligncontent              \aligntab
    \aligncontent\tabsize 0cm \cr
    1  \aligntab 111\aligntab 1111\aligntab 11\cr
    222\aligntab 2  \aligntab 2222\aligntab 22\cr
```

```
}
```

As with `\tabskip` you need to reset the value explicitly, so that is why we get two wide columns:

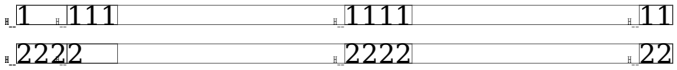


838 \tabskip

This traditional primitive can be used in the preamble of an alignment and sets the space added between columns, for example:

```
\halign{%
    \aligncontent             \aligntab
    \aligncontent\tabskip 3cm \aligntab
    \aligncontent             \aligntab
    \aligncontent\tabskip 0cm \cr
    1  \aligntab 111\aligntab 1111\aligntab 11\cr
    222\aligntab 2  \aligntab 2222\aligntab 22\cr
}
```

You need to reset the skip explicitly, which is why we get it applied twice here:



839 \textdirection

This set the text direction to `l2r` (0) or `r2l` (1). It also triggers additional checking for balanced flipping in node lists.

840 \textfont

This primitive is like `\font` but with a family number as (first) argument so it is specific for math. It is the largest one of the three family members; its relatives are `\scriptfont` and `\scriptscriptfont`.

841 \textstyle

One of the main math styles; integer representation: 2.

842 \the

The `\the` primitive serializes the following token, when applicable: integers, dimensions, token registers, special quantities, etc. The catcodes of the result will be according to the current settings, so in `\the\dimen0`, the `pt` will have catcode 'letter' and the number and period will become 'other'.

843 \thewithoutunit

The `\the` primitive, when applied to a dimension variable, adds a `pt` unit. because dimensions are the only traditional unit with a fractional part they are sometimes used as pseudo floats in which

case `\thewithoutunit` can be used to avoid the unit. This is more convenient than stripping it off afterwards (via an expandable macro).

844 \thickmuskip

A predefined mu skip register that can be used in math (inter atom) spacing. The current value is `5.0mu plus 3.0mu minus 1.0mu`. In traditional TEX most inter atom spacing is hard coded using the predefined registers.

845 \thinmuskip

A predefined mu skip register that can be used in math (inter atom) spacing. The current value is `3.0mu`. In traditional TEX most inter atom spacing is hard coded using the predefined registers.

846 \time

This internal number starts out with minute (starting at midnight) that the job started.

847 \tinymuskip

A predefined mu skip register that can be used in math (inter atom) spacing. The current value is `2.0mu minus 1.0mu`. This one complements `\thinmuskip`, `\medmuskip`, `\thickmuskip` and the new `\pettymuskip`

848 \tocharacter

The given number is converted into an utf-8 sequence. In LuaTEX this one is named `\Uchar`.

849 \toddlerpenalty

This penalty controls line breaks after a single glyph. A high value prevents single character at the end of a line.

850 \todimension

The following code gives this: 1234.0pt and like its numeric counterparts accepts anything that resembles a number this one goes beyond (user, internal or pseudo) registers values too.

```
\scratchdimen = 1234pt \todimension\scratchdimen
```

851 \tohexadecimal

The following code gives this: 4D2 with uppercase letters.

```
\scratchcounter = 1234 \tohexadecimal\scratchcounter
```

852 \tointeger

The following code gives this: 1234 and is equivalent to \number.

```
\scratchcounter = 1234 \tointeger\scratchcounter
```

853 \tokenized

Just as \expanded has a counterpart \unexpanded, it makes sense to give \detokenize a companion:

```
\edef\foo{\detokenize{\inframed{foo}}}
\edef\oof{\detokenize{\inframed{oof}}}

\meaning\foo \crlf \dontleavehmode\foo

\edef\foo{\tokenized{\foo\foo}}

\meaning\foo \crlf \dontleavehmode\foo

\dontleavehmode\tokenized{\foo\oof}
```

```
macro:\inframed {foo}
\inframed {foo}

macro:\inframed {foo}\inframed {foo}
```

foo	foo

foo	foo	oof

This primitive is similar to:

```
\def\tokenized#1{\scantextokens\expandafter{\normalexpanded{#1}}}
```

and should be more efficient, not that it matters much as we don't use it that much (if at all).

854 \toks

This is the accessor of a token register so it expects a number or \toksdef'd macro.

855 \toksapp

One way to append something to a token list is the following:

```
\scratchtoks\expandafter{\the\scratchtoks more stuff}
```

This works all right, but it involves a copy of what is already in \scratchtoks. This is seldom a real issue unless we have large token lists and many appends. This is why LuaTEX introduced:

```
\toksapp\scratchtoks{more stuff}
\toksapp\scratchtoksone\scratchtokstwo
```

At some point, when working on LuaMetaTEX, I realized that primitives like this one and the next appenders and prependers to be discussed were always on the radar of Taco and me. Some were

even implemented in what we called eetex: extended ε-TEX, and we even found back the prototypes, dating from pre-pdfTEX times.

856 \toksdef

The given name (control sequence) will be bound to the given token register (a number). Often this primitive is hidden in a high level macro that manages allocation.

857 \tokspre

Where appending something is easy because of the possible \expandafter trickery a prepend would involve more work, either using temporary token registers and/or using a mixture of the (no)expansion added by ε-TEX, but all are kind of inefficient and cumbersome.

```
\tokspre\scratchtoks{less stuff}
\tokspre\scratchtoksone\scratchtokstwo
```

This prepends the token list that is provided.

858 \tolerance

When the par builder runs into a line with a badness larger than this value and when \emergencystretch is set a third pass is enabled. In LuaMetaTEX we can have more than one second pass and there are more parameters that influence the process.

859 \tolerant

This prefix tags the following macro as being tolerant with respect to the expected arguments. It only makes sense when delimited arguments are used or when braces are mandate.

```
\tolerant\def\foo[#1]#*[#2]{(#1)(#2)}
```

This definition makes \foo tolerant for various calls:

```
\foo \foo[1] \foo [1] \foo[1] [2] \foo [1] [2]
```

these give: ()()(1)()(1)()(1)(2) (1)(2). The spaces after the first call disappear because the macro name parser gobbles it, while in the second case the #* gobbles them. Here is a variant:

```
\tolerant\def\foo[#1]#,[#2]{!#1!#2!}

\foo[?] x
\foo[?] [?] x

\tolerant\def\foo[#1]#*[#2]{!#1!#2!}

\foo[?] x
\foo[?] [?] x
```

We now get the following:

!?!! x !?!?! x

!?!!x !?!?! x

Here the `#,` remembers that spaces were gobbles and they will be put back when there is no further match. These are just a few examples of this tolerant feature. More details can be found in the lowlevel manuals.

860 \tomathstyle

Internally math styles are numbers, where `\displaystyle` is 0 and `\crampedscriptscriptstyle` is 7. You can convert the verbose style to a number with `\tomathstyle`.

861 \topmark

This is a reference to the last mark on the previous (split off) page, it gives back tokens.

862 \topmarks

This is a reference to the last mark with the given id (a number) on the previous page, it gives back tokens.

863 \topskip

This is the amount of glue that is added to the top of a (new) page.

864 \toscaled

The following code gives this: 1234.0 is similar to `\todimension` but omits the `pt` so that we don't need to revert to some nasty stripping code.

```
\scratchdimen = 1234pt \toscaled\scratchdimen
```

865 \tosparsedimension

The following code gives this: 1234pt where ‘sparse’ indicates that redundant trailing zeros are not shown.

```
\scratchdimen = 1234pt \tosparsedimension\scratchdimen
```

866 \tosparsescaled

The following code gives this: 1234 where ‘sparse’ means that redundant trailing zeros are omitted.

```
\scratchdimen = 1234pt \tosparsescaled\scratchdimen
```

867 \tpack

This primitive is like `\vtop` but without the callback overhead.

868 \tracingadjusts

In LuaMetaTEX the adjust feature has more functionality and also is carried over. When set to a positive values `\vadjust` processing reports details. The higher the number, the more you'll get.

869 \tracingalignments

When set to a positive value the alignment mechanism will keep you informed about what is done in various stages. Higher values unleash more information, including what callbacks kick in.

870 \tracingassigns

When set to a positive values assignments to parameters and variables are reported on the console and/or in the log file. Because LuaMetaTEX avoids redundant assignments these don't get reported.

871 \tracingcommands

When set to a positive values the commands (primitives) are reported on the console and/or in the log file.

872 \tracingexpressions

The extended expression commands like `\numexpression` and `\dimexpression` can be traced by setting this parameter to a positive value.

873 \tracingfitness

Because we have more fitness classes we also have (need) a (bit) more detailed tracing.

874 \tracingfullboxes

When set to a positive value the box will be shown in case of an overfull box. When a quality callback is set this will not happen as all reporting is then delegated.

875 \tracinggroups

When set to a positive values grouping is reported on the console and/or in the log file.

876 \tracinghyphenation

When set to a positive values the hyphenation process is reported on the console and/or in the log file.

877 \tracingifs

When set some details of what gets tested and what results are seen is reported.

878 \tracinginserts

A positive value enables tracing where values larger than 1 will report more details.

879 \tracinglevels

The lines in a log file can be prefixed with some details, depending on the bits set:

`0x1` current group
`0x2` current input
`0x4` catcode table

880 \tracinglists

At various stages the lists being processed can be shown. This is mostly an option for developers.

881 \tracingloners

With loners we mean 'widow' and 'club' lines. This tracer can be handy when `\doublepenaltymode` is set and facing pages have different penalty values.

882 \tracinglostchars

When set to one characters not present in a font will be reported in the log file, a value of two will also report this on the console.

883 \tracingmacros

This parameter controls reporting of what macros are seen and expanded.

884 \tracingmarks

Marks are information blobs that track states that can be queried when a page is handled over to the shipout routine. They travel through the system in a bit different than traditionally: like like adjusts and inserts deeply buried ones bubble up to outer level boxes. This parameters controls what progress gets reported.

885 \tracingmath

The higher the value, the more information you will get about the various stages in rendering math. Because tracing of nodes is rather verbose you need to know a bit what this engine does. Conceptually there are differences between the LuaMetaTEX and traditional engine, like more passes, inter-atom spacing, different low level mechanisms. This feature is mostly meant for developers who tweak the many available parameters.

886 \tracingnesting

A positive value triggers log messages about the current level.

887 \tracingnodes

When set to a positive value more details about nodes (in boxes) will be reported. Because this is also controlled by callbacks what gets reported is macro package dependent.

888 \tracingonline

The engine has two output channels: the log file and the console and by default most tracing (when enabled) goes to the log file. When this parameter is set to a positive value tracing will also happen in the console. Messages from the Lua end can be channeled independently.

889 \tracingoutput

Values larger than one result in some information about what gets passed to the output routine.

890 \tracingpages

Values larger than one result in some information about the page building process. In LuaMetaTEX there is more info for higher values.

891 \tracingparagraphs

Values larger than one result in some information about the par building process. In LuaMetaTEX there is more info for higher values.

892 \tracingpasses

In LuaMetaTEX you can configure additional second stage par builder passes and this parameter controls what gets reported on the console and/or in the log file.

893 \tracingpenalties

This setting triggers reporting of actions due to special penalties in the page builder.

894 \tracingrestores

When set to a positive values (re)assignments after grouping to parameters and variables are reported on the console and/or in the log file. Because LuaMetaTEX avoids redundant assignments these don't get reported.

895 \tracingstats

This parameter is a dummy in LuaMetaTEX. There are anyway some statistic reported when the format is made but for a regular run it is up to the macro package to come up with useful information.

896 \tsplit

This splits like `\vsplit` but it returns a `\vtop` box instead.

897 \uccode

When the `\uppercase` operation is applied the uppercase code of a character is used for the replacement. This primitive is used to set that code, so it expects two character number.

898 \uchyph

When set to a positive number words that start with a capital will be hyphenated.

899 \uleaders

This leader adapts itself after a paragraph has been typeset. Here are a few examples:

```
test \leaders  \hbox      {x}\hfill\              test
test \uleaders \hbox{x x x x}\hfill\              test
test           \hbox{x x x x}\hskip 3cm plus 1cm\ test
test \uleaders \hbox{x x x x}\hskip 3cm plus 1cm\ test
```

When an `\uleaders` is used the glue in the given box will be adapted to the available space.

test xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx test
test x x x x test
test x x x x test
test x x x x test

Optionally the `callback` followed by a number can be given, in which case a callback kicks in that gets that the node, a group identifier, and the number passed. It permits (for instance) adaptive graphics: 1=i 6=vi 11=xi 16=xvi 21=xxi 26=xxvi 31=xxxi 36=xxxvi 41=xli 46=xlvi 51=li 56=lvi 61=lxi 66=lxvi 71=lxxi 76=lxxvi 81=lxxxi 86=lxxxvi 91=xci 96=xcvi .

900 \unboundary

When possible a preceding boundary node will be removed.

901 \undent

When possible the already added indentation will be removed.

902 \underline

This is a math specific primitive that draws a line under the given content. It is a poor mans replacement for a delimiter. The thickness is set with `\Umathunderbarrule`, the distance between content and rule is set by `\Umathunderbarvgap` and `\Umathunderbarkern` is added above the rule. The style used for the content under the rule can be set with `\Umathunderlinevariant`. See `\overline` for what these parameters do.

903 \unexpanded

This is an ε-TEX enhancement. The content will not be expanded in a context where expansion is happening, like in an \edef. In ConTEXt you need to use \normalunexpanded because we already had a macro with that name.

```
\def \A{!}                          \meaning\A
\def \B{?}                          \meaning\B
\edef\C{\A\B}                       \meaning\C
\edef\C{\normalunexpanded{\A}\B} \meaning\C
```

```
macro:!
macro:?
macro:!?
macro:\A ?
```

904 \unexpandedendless

This one loops forever so you need to quit explicitly.

905 \unexpandedloop

As follow up on \expandedloop we now show its counterpart:

```
\edef\whatever
  {\unexpandedloop 1 10 1
     {\scratchcounter=\the\currentloopiterator\relax}}

\meaningasis\whatever
```

```
\def \whatever {\scratchcounter =0\relax \scratchcounter =0\relax \scratchcounter =0\relax \scratchcounter
=0\relax \scratchcounter =0\relax \scratchcounter =0\relax \scratchcounter =0\relax \scratchcounter =0\relax
\scratchcounter =0\relax \scratchcounter =0\relax }
```

The difference between the (un)expanded loops and a local controlled one is shown here. Watch the out of order injection of A's.

```
\edef\TestA{\localcontrolledloop 1 5 1 {A}} % out of order
\edef\TestB{\expandedloop        1 5 1 {B}}
\edef\TestC{\unexpandedloop      1 5 1 {C\relax}}
```

AAAAA

We show the effective definition as well as the outcome of using them

```
\meaningasis\TestA
\meaningasis\TestB
\meaningasis\TestC
```

```
A: \TestA
B: \TestB
C: \TestC
```

```
\def \TestA {}
\def \TestB {BBBBB}
\def \TestC {C\relax C\relax C\relax C\relax C\relax }

A:
B: BBBBB
C: CCCCC
```

Watch how because it is empty `\TestA` has become a constant macro because that's what deep down empty boils down to.

906 \unexpandedrepeat

This one takes one instead of three arguments which looks better in simple loops.

907 \unhbox

A box is a packaged list and once packed travels through the system as a single object with properties, like dimensions. This primitive injects the original list and discards the wrapper.

908 \unhcopy

This is like `\unhbox` but keeps the original. It is one of the more costly operations.

909 \unhpack

This primitive is like `\unhbox` but without the callback overhead.

910 \unkern

This removes the last kern, if possible.

911 \unless

This ε-TEX prefix will negate the test (when applicable).

```
      \ifx\one\two YES\else NO\fi
\unless\ifx\one\two NO\else YES\fi
```

This primitive is hardly used in ConTEXt and we probably could get rid of these few cases.

912 \unletfrozen

A frozen macro cannot be redefined: you get an error. But as nothing in TEX is set in stone, you can do this:

```
\frozen\def\MyMacro{...}
\unletfrozen\MyMacro
```

and \MyMacro is no longer protected from overloading. It is still undecided to what extend ConTEXt will use this feature.

913 \unletprotected

The complementary operation of \letprotected can be used to unprotect a macro, so that it gets expandable.

```
               \def  \MyMacroA{alpha}
\protected     \def  \MyMacroB{beta}
               \edef \MyMacroC{\MyMacroA\MyMacroB}
\unletprotected      \MyMacroB
               \edef \MyMacroD{\MyMacroA\MyMacroB}
\meaning             \MyMacroC\crlf
\meaning             \MyMacroD\par
```

Compare this with the example in the previous section:

```
macro:alpha\MyMacroB
macro:alphabeta
```

914 \unpenalty

This removes the last penalty, if possible.

915 \unskip

This removes the last glue, if possible.

916 \untraced

Related to the meaning providers is the \untraced prefix. It marks a macro as to be reported by name only. It makes the macro look like a primitive.

```
        \def\foo{}
\untraced\def\oof{}

\scratchtoks{\foo\foo\oof\oof}

\tracingall \the\scratchtoks \tracingnone
```

This will show up in the log as follows:

```
1:4: {\the}
1:5: \foo ->
1:5: \foo ->
1:5: \oof
1:5: \oof
```

This is again a trick to avoid too much clutter in a log. Often it doesn't matter to users what the meaning of a macro is (if they trace at all).[7]

917 \unvbox

A box is a packaged list and once packed travels through the system as a single object with properties, like dimensions. This primitive injects the original list and discards the wrapper.

918 \unvcopy

This is like `\unvbox` but keeps the original. It is one of the more costly operations.

919 \unvpack

This primitive is like `\unvbox` but without the callback overhead.

920 \uppercase

See its counterpart `\lowercase` for an explanation.

921 \vadjust

This injects a node that stores material that will injected before or after the line where it has become part of. In LuaMetaTEX there are more features, driven by keywords.

922 \valign

This command starts vertically aligned material. Its counterpart `\halign` is used more frequently. Most macro packages provide wrappers around these commands. First one specifies a preamble which is then followed by entries (rows and columns).

923 \variablefam

In traditional TEX sets the family of what are considered variables (class 7) to the current family (which often means that they adapt to the current alphabet) and then injects a math character of class ordinary. This parameter can be used to obey the given class when the family set for a character is the same as this parameter. So we then use the given class with the current family. It is mostly there for compatibility with LuaTEX and experimenting (outside ConTEXt).

924 \vbadness

This sets the threshold for reporting a (vertical) badness value, its current value is 0.

[7] An earlier variant could also hide the expansion completely but that was just confusing.

925 \vbox

This creates a vertical box. In the process callbacks can be triggered that can preprocess the content, influence line breaking as well as assembling the resulting paragraph. More can be found in dedicated manuals. The baseline is at the bottom.

926 \vcenter

In traditional TEX this box packer is only permitted in math mode but in LuaMetaTEX it also works in text mode. The content is centered in the vertical box.

927 \vfil

This is a shortcut for `\vskip plus 1 fil` (first order filler).

928 \vfill

This is a shortcut for `\vskip plus 1 fill` (second order filler).

929 \vfilneg

This is a shortcut for `\vskip plus - 1 fil` so it can compensate `\vfil`.

930 \vfuzz

This dimension sets the threshold for reporting vertical boxes that are under- or overfull. The current value is 0.1pt.

931 \virtualhrule

This is a horizontal rule with zero dimensions from the perspective of the frontend but the backend can access them as set.

932 \virtualvrule

This is a vertical rule with zero dimensions from the perspective of the frontend but the backend can access them as set.

933 \vkern

This primitive is like `\kern` but will force the engine into vertical mode if it isn't yet.

934 \vpack

This primitive is like `\vbox` but without the callback overhead.

935 \vpenalty

This primitive is like \penalty but will force the engine into vertical mode if it isn't yet.

936 \vrule

This creates a vertical rule. Unless the height and depth are set they will stretch to fix the available space. In addition to the traditional width, height and depth specifiers some more are accepted. These are discussed in other manuals. See \hrule for a simple example.

937 \vsize

This sets (or gets) the current vertical size. While setting the \hsize inside a \vbox has consequences, setting the \vsize mostly makes sense at the outer level (the page).

938 \vskip

The given glue is injected in the vertical list. If possible vertical mode is entered.

939 \vsplit

This operator splits a given amount from a vertical box. In LuaMetaTEX we can split to but also upto, so that we don't have to repack the result in order to see how much is actually in there.

940 \vss

This is the vertical variant of \hss. See there for what it means.

941 \vtop

This creates a vertical box. In the process callbacks can be triggered that can preprocess the content, influence line breaking as well as assembling the resulting paragraph. More can be found in dedicated manuals. The baseline is at the top.

942 \wd

Returns the width of the given box.

943 \widowpenalties

This is an array of penalty put before the last lines in a paragraph. High values discourage (or even prevent) a lone line at the beginning of a next page. This command expects a count value indicating the number of entries that will follow. The first entry is ends up before the last line.

944 \widowpenalty

This is the penalty put before a widow line in a paragraph. High values discourage (or even prevent) a lone line at the beginning of a next page.

945 \wordboundary

The hypenation routine has to decide where a word begins and ends. If you want to make sure that there is a proper begin or end of a word you can inject this boundary.

946 \wrapuppar

What this primitive does can best be shown with an example:

```
some text\wrapuppar{one} and some\wrapuppar{two} more
```

We get:

some text and some more twoone

So, it is a complementary command to \everypar. It can only be issued inside a paragraph.

947 \xdef

This is an alternative for **\global\edef**:

```
\xdef\MyMacro{...}
```

948 \xdefcsname

This is the companion of \xdef:

```
\expandafter\xdef\csname MyMacro:1\endcsname{...}
            \xdefcsname MyMacro:1\endcsname{...}
```

949 \xleaders

See \gleaders for an explanation.

950 \xspaceskip

Normally the glue inserted when a space is encountered after a character with a space factor other than 1000 is taken from the font (fontdimen 7) unless this parameter is set in which case its value is added.

951 \xtoks

This is the global variant of \etoks.

952 \xtoksapp

This is the global variant of \etoksapp.

953 \xtokspre

This is the global variant of \etokspre.

954 \year

This internal number starts out with the year that the job started.

Obsolete

The LuaMetaTEX engine has more than its LuaTEX ancestor but it also has less. Because in the end the local control mechanism performed quite okay I decided to drop the \immediateassignment and \immediateassigned variants. They sort of used the same trick so there isn't much to gain and it was less generic (read: error prone).

Syntax

1 accent

t \accent
[xoffset *dimension*] [yoffset *dimension*] *integer character*

2 aftersomething

l \afterassigned
{ *tokens* }
t \afterassignment
token
t \aftergroup
token
l \aftergrouped
{ *tokens* }
l \atendoffile
token
l \atendoffiled
[reverse] { *tokens* }
l \atendofgroup
token
l \atendofgrouped
{ *tokens* }

3 alignmenttab

l \aligntab

4 arithmic

t \advance
quantity [by] *quantity*
l \advanceby
quantity quantity
t \divide
quantity [by] *quantity*
l \divideby
quantity quantity
l \edivide
quantity quantity
l \edivideby
quantity quantity
t \multiply
quantity [by] *quantity*
l \multiplyby
quantity quantity
l \rdivide
quantity quantity
l \rdivideby
quantity quantity

5 association

l \associateunit
\cs [=] *integer*
> \cs : *integer*

6 auxiliary

l \insertmode
integer
: *integer*
e \interactionmode
integer
: *integer*
t \prevdepth
dimension
: *dimension*
t \prevgraf
integer
: *integer*
t \spacefactor
integer
: *integer*

7 begingroup

t \begingroup
l \beginmathgroup
l \beginsimplegroup

8 beginlocal

l \beginlocalcontrol
l \expandedendless
{ *tokens* }
l \expandedloop
integer integer integer { *tokens* }
l \expandedrepeat
integer { *tokens* }

l \localcontrol
tokens\endlocalcontrol
l \localcontrolled
{ *tokens* }
l \localcontrolledendless
{ *tokens* }
l \localcontrolledloop
see \expandedloop
l \localcontrolledrepeat
integer { *tokens* }
l \unexpandedendless
{ *tokens* }
l \unexpandedloop
see \expandedloop
l \unexpandedrepeat
integer { *tokens* }

9 beginparagraph

t \indent
t \noindent
l \parattribute
integer [=] *integer*
l \quitvmode
l \snapshotpar
cardinal
: *integer*
l \undent
l \wrapuppar
[reverse] { *tokens* }

10 boundary

l \boundary
[=] *integer*
l \luaboundary
[=] *integer* *integer*
l \mathboundary
[=] *integer* [*integer*]
l \noboundary
l \optionalboundary
[=] *integer*
l \pageboundary
[=] *integer*
l \protrusionboundary
[=] *integer*
l \wordboundary

11 boxproperty

l \boxadapt
(index | *box*) [=] *integer*
> (index | *box*) : *dimension*
l \boxanchor
see \boxadapt
l \boxanchors
(index | *box*) [=] *integer* *integer*
> (index | *box*) : *integer*
l \boxattribute
(index | *box*) *integer* [=] *integer*
> (index | *box*) *integer* : *integer*
l \boxdirection
see \boxadapt
l \boxfinalize
see \boxadapt
l \boxfreeze
see \boxadapt
l \boxgeometry
see \boxadapt
l \boxlimit
TODO
l \boxlimitate
see \boxadapt
l \boxorientation
see \boxadapt
l \boxrepack
(index | *box*)
> (index | *box*) : *dimension*
l \boxshift
(index | *box*) [=] *dimension*
> (index | *box*) : *dimension*
l \boxshrink
see \boxrepack
l \boxsource
see \boxadapt
l \boxstretch
see \boxrepack
l \boxtarget
see \boxadapt
l \boxtotal
see \boxrepack
l \boxvadjust
(index | *box*) { *tokens* }
> (index | *box*) : cardinal
l \boxxmove
see \boxshift

l \boxxoffset
see \boxshift
l \boxymove
see \boxshift
l \boxyoffset
see \boxshift
t \dp
see \boxshift
t \ht
see \boxshift
t \wd
see \boxshift

12 caseshift

t \lowercase
{*tokens*}
t \uppercase
{*tokens*}

13 catcodetable

l \initcatcodetable
integer
l \restorecatcodetable
TODO
l \savecatcodetable
integer

14 charnumber

t \char
integer
l \glyph
[xoffset *dimension*] [yoffset *dimension*] [scale *integer*] [xscale *integer*] [yscale *integer*] [left *dimension*] [right *dimension*] [raise *dimension*] [options *integer*] [*font* *integer*] [id *integer*] *integer*

15 combinetoks

l \etoks
toks {*tokens*}
l \etoksapp
toks {*tokens*}
l \etokspre
toks {*tokens*}
l \gtoksapp
toks {*tokens*}
l \gtokspre
toks {*tokens*}
l \toksapp
toks {*tokens*}
l \tokspre
toks {*tokens*}
l \xtoks
toks {*tokens*}
l \xtoksapp
toks {*tokens*}
l \xtokspre
toks {*tokens*}

16 convert

l \csactive
> *token* : *tokens*
l \csstring
> *token* : *tokens*
l \detokened
> (\cs | {*tokens*} | *toks*) : *tokens*
l \detokenized
> {*tokens*} : *tokens*
l \directlua
> {*tokens*} : *tokens*
l \expanded
> {*tokens*} : *tokens*
t \fontname
> (*font* | *integer*) : *tokens*
l \fontspecifiedname
> (*font* | *integer*) : *tokens*
l \formatname
: *tokens*
t \jobname
: *tokens*
l \luabytecode
> *integer* : *tokens*
l \luaescapestring
> {*tokens*} : *tokens*
l \luafunction
> *integer* : *tokens*
l \luatexbanner
: *tokens*
t \meaning
> *token* : *tokens*

l \meaningasis
> *token* : *tokens*
l \meaningful
> *token* : *tokens*
l \meaningfull
> *token* : *tokens*
l \meaningles
> *token* : *tokens*
l \meaningless
> *token* : *tokens*
t \number
> *integer* : *tokens*
t \romannumeral
> *integer* : *tokens*
l \semiexpanded
> {*tokens*} : *tokens*
t \string
> *token* : *tokens*
l \tocharacter
> *integer* : *tokens*
l \todimension
> *dimension* : *tokens*
l \tohexadecimal
> *integer* : *tokens*
l \tointeger
> *integer* : *tokens*
l \tomathstyle
> *mathstyle* : *tokens*
l \toscaled
> *dimension* : *tokens*
l \tosparsedimension
> *dimension* : *tokens*
l \tosparsescaled
> *dimension* : *tokens*

17 csname

l \begincsname
tokens\endcsname
t \csname
tokens\endcsname
l \futurecsname
tokens\endcsname
l \lastnamedcs

18 def

l \cdef
\cs [*preamble*] {*tokens*}
l \cdefcsname
tokens\endcsname [*preamble*] {*tokens*}
t \def
\cs [*preamble*] {*tokens*}
l \defcsname
tokens\endcsname [*preamble*] {*tokens*}
t \edef
\cs [*preamble*] {*tokens*}
l \edefcsname
tokens\endcsname [*preamble*] {*tokens*}
t \gdef
\cs [*preamble*] {*tokens*}
l \gdefcsname
tokens\endcsname [*preamble*] {*tokens*}
t \xdef
\cs [*preamble*] {*tokens*}
l \xdefcsname
tokens\endcsname [*preamble*] {*tokens*}

19 definecharcode

l \Udelcode
integer [=] *integer*
> *integer* : *integer*
l \Umathcode
integer [=] *integer*
> *integer* : *integer*
l \amcode
integer [=] *integer*
> *integer* : *integer*
t \catcode
integer [=] *integer*
> *integer* : *integer*
t \delcode
integer [=] *integer*
> *integer* : *integer*
l \hccode
integer [=] *integer*
> *integer* : *integer*
l \hmcode
integer [=] *integer*
> *integer* : *integer*
t \lccode
integer [=] *integer*
> *integer* : *integer*
t \mathcode
integer [=] *integer*
> *integer* : *integer*

t \sfcode
integer [=] *integer*
> *integer* : *integer*
t \uccode
integer [=] *integer*
> *integer* : *integer*

20 definefamily

t \scriptfont
family (*font* | *integer*)
> family : *integer*
t \scriptscriptfont
see \scriptfont
t \textfont
see \scriptfont

21 definefont

t \font
\cs ({ filename } | filename) [(at *dimension* | scaled *integer*)]
: *tokens*

22 delimiternumber

l \Udelimiter
integer *integer* *integer*
t \delimiter
integer

23 discretionary

t \-
l \automaticdiscretionary
t \discretionary
[penalty] [postword] [preword]
[break] [nobreak] [options] [class]
{ *tokens* } { *tokens* } { *tokens* }
l \explicitdiscretionary

24 endcsname

t \endcsname

25 endgroup

t \endgroup
l \endmathgroup
l \endsimplegroup

26 endjob

t \dump
t \end

27 endlocal

l \endlocalcontrol

28 endparagraph

t \par

29 endtemplate

l \aligncontent
t \cr
t \crcr
t \noalign
{ *tokens* }
t \omit
l \realign
TODO
t \span

30 equationnumber

t \eqno
{ *tokens* }
t \leqno
{ *tokens* }

31 expandafter

l \expand
token
l \expandactive
token
t \expandafter
token *token*
l \expandafterpars
token

l \expandafterspaces
token
l \expandcstoken
token
l \expandedafter
token {*tokens*}
l \expandparameter
integer
l \expandtoken
token
l \expandtoks
{*tokens*}
l \futureexpand
token token token
l \futureexpandis
TODO
l \futureexpandisap
TODO
l \semiexpand
token
e \unless

32 explicitspace

**t **
l \explicitspace
TODO

33 fontproperty

l \cfcode
(*font* | *integer*) *integer* [=] *integer*
> (*font* | *integer*) *integer* : *integer*
l \efcode
see \cfcode
t \fontdimen
(*font* | *integer*) *integer* [=] *dimension*
> (*font* | *integer*) *integer* : *dimension*
t \hyphenchar
(*font* | *integer*) [=] *integer*
> (*font* | *integer*) : *integer*
l \lpcode
see \fontdimen
l \rpcode
see \fontdimen
l \scaledfontdimen
see \hyphenchar
t \skewchar
see \hyphenchar

34 getmark

t \botmark
e \botmarks
integer
l \currentmarks
integer
t \firstmark
e \firstmarks
integer
t \splitbotmark
e \splitbotmarks
integer
t \splitfirstmark
e \splitfirstmarks
integer
t \topmark
e \topmarks
integer

35 halign

t \halign
[attr *integer integer*] [callback *integer*] [discard] [noskips] [reverse] [to *dimension*] [spread *dimension*] {*tokens*}

36 hmove

t \moveleft
dimension box
t \moveright
dimension box

37 hrule

t \hrule
[attr *integer* [=] *integer*] [width *dimension*] [height *dimension*] [depth *dimension*] [left *dimension*] [right *dimension*] [top *dimension*] [bottom *dimension*] [xoffset *dimension*] [yoffset *dimension*] [*font integer*] [fam *integer*] [char *integer*]

l \nohrule
see \hrule
l \virtualhrule
[attr *integer* [=] *integer*] [width *dimension*] [height *dimension*] [depth *dimension*] [left *dimension*] [right *dimension*] [top *dimension*] [bottom *dimension*] [xoffset *dimension*] [yoffset *dimension*]

38 hskip

t \hfil
t \hfill
t \hfilneg
t \hskip
dimension [plus (*dimension* | fi [n*l])] [minus (*dimension* | fi [n*l])]
t \hss

39 hyphenation

l \hjcode
integer [=] *integer*
t \hyphenation
{ *tokens* }
l \hyphenationmin
[=] *integer*
t \patterns
{ *tokens* }
l \postexhyphenchar
[=] *integer*
l \posthyphenchar
[=] *integer*
l \preexhyphenchar
[=] *integer*
l \prehyphenchar
[=] *integer*

40 iftest

t \else
t \fi
t \if
l \ifabsdim
dimension (! | < | = | > | ∈ | ∉ | ≠ | ≤ | ≥ | ≰ | ≱) *dimension*
l \ifabsfloat
float (! | < | = | > | ∈ | ∉ | ≠ | ≤ | ≥ | ≰ | ≱) *float*
l \ifabsnum
integer (! | < | = | > | ∈ | ∉ | ≠ | ≤ | ≥ | ≰ | ≱) *integer*
l \ifarguments
l \ifboolean
integer
t \ifcase
integer
t \ifcat
token
l \ifchkdim
tokens\or
l \ifchkdimension
tokens\or
l \ifchknum
tokens\or
l \ifchknumber
tokens\or
l \ifcmpdim
dimension dimension
l \ifcmpnum
integer integer
l \ifcondition
\if...
l \ifcramped
TODO
e \ifcsname
tokens\endcsname
l \ifcstok
tokens\relax
e \ifdefined
token
t \ifdim
see \ifabsdim
l \ifdimexpression
tokens\relax
l \ifdimval
tokens\or
l \ifempty
(*token* | { *tokens* })
t \iffalse
l \ifflags
\cs

l \iffloat
see \ifabsfloat
e \iffontchar
integer integer
l \ifhaschar
token {*tokens*}
l \ifhastok
token {*tokens*}
l \ifhastoks
tokens\relax
l \ifhasxtoks
tokens\relax
t \ifhbox
(index | *box*)
t \ifhmode
l \ifinalignment
l \ifincsname
tokens\endcsname
t \ifinner
l \ifinsert
integer
l \ifintervaldim
dimension dimension dimension
l \ifintervalfloat
integer integer integer
l \ifintervalnum
float float float
l \iflastnamedcs
l \ifmathparameter
integer
l \ifmathstyle
mathstyle
t \ifmmode
t \ifnum
see \ifabsnum
l \ifnumexpression
tokens\relax
l \ifnumval
tokens\or
t \ifodd
integer
l \ifparameter
parameter\or
l \ifparameters
l \ifrelax
token
l \iftok
tokens\relax
t \iftrue
t \ifvbox
see \ifhbox
t \ifvmode
t \ifvoid
see \ifhbox
t \ifx
token
l \ifzerodim
dimension
l \ifzerofloat
float
l \ifzeronum
integer
t \or
l \orelse
l \orunless

41 ignoresomething

l \ignorearguments
l \ignorenestedupto
token
l \ignorepars
l \ignorerest
t \ignorespaces
l \ignoreupto
token

42 input

t \endinput
t \eofinput
{*tokens*} ({filename} | filename)
t \input
({filename} | filename)
l \quitloop
l \quitloopnow
l \retokenized
[catcodetable] {*tokens*}
l \scantextokens
{*tokens*}
e \scantokens
{*tokens*}
l \tokenized
{*tokens*}

43 insert

t \insert
integer

44 interaction

t \batchmode
t \errorstopmode
t \nonstopmode
t \scrollmode

45 internaldimension

t \boxmaxdepth
[=] *dimension*
: *dimension*
t \delimitershortfall
[=] *dimension*
: *dimension*
t \displayindent
[=] *dimension*
: *dimension*
t \displaywidth
[=] *dimension*
: *dimension*
t \emergencyextrastretch
[=] *dimension*
: *dimension*
t \emergencystretch
[=] *dimension*
: *dimension*
l \glyphxoffset
[=] *dimension*
: *dimension*
l \glyphyoffset
[=] *dimension*
: *dimension*
t \hangindent
[=] *dimension*
: *dimension*
t \hfuzz
[=] *dimension*
: *dimension*
t \hsize
[=] *dimension*
: *dimension*
l \ignoredepthcriterion
[=] *dimension*
: *dimension*
t \lineskiplimit
[=] *dimension*
: *dimension*
t \mathsurround
[=] *dimension*
: *dimension*
t \maxdepth
[=] *dimension*
: *dimension*
t \nulldelimiterspace
[=] *dimension*
: *dimension*
t \overfullrule
[=] *dimension*
: *dimension*
l \pageextragoal
[=] *dimension*
: *dimension*
t \parindent
[=] *dimension*
: *dimension*
t \predisplaysize
[=] *dimension*
: *dimension*
l \pxdimen
[=] *dimension*
: *dimension*
t \scriptspace
[=] *dimension*
: *dimension*
l \shortinlinemaththreshold
[=] *dimension*
: *dimension*
t \splitmaxdepth
[=] *dimension*
: *dimension*
l \tabsize
[=] *dimension*
: *dimension*
t \vfuzz
[=] *dimension*
: *dimension*
t \vsize
[=] *dimension*
: *dimension*

46 internalglue

t \abovedisplayshortskip
[=] *glue*
: *glue*
t \abovedisplayskip
[=] *glue*
: *glue*
l \additionalpageskip
[=] *glue*
: *glue*
t \baselineskip
[=] *glue*
: *glue*
t \belowdisplayshortskip
[=] *glue*
: *glue*
t \belowdisplayskip
[=] *glue*
: *glue*
l \emergencyleftskip
[=] *glue*
: *glue*
l \emergencyrightskip
[=] *glue*
: *glue*
l \initialpageskip
[=] *glue*
: *glue*
l \initialtopskip
[=] *glue*
: *glue*
t \leftskip
[=] *glue*
: *glue*
t \lineskip
[=] *glue*
: *glue*
l \mathsurroundskip
[=] *glue*
: *glue*
l \maththreshold
[=] *glue*
: *glue*
l \parfillleftskip
[=] *glue*
: *glue*
l \parfillrightskip
[=] *glue*
: *glue*
t \parfillskip
[=] *glue*
: *glue*
l \parinitleftskip
[=] *glue*
: *glue*
l \parinitrightskip
[=] *glue*
: *glue*
t \parskip
[=] *glue*
: *glue*
t \rightskip
[=] *glue*
: *glue*
t \spaceskip
[=] *glue*
: *glue*
t \splittopskip
[=] *glue*
: *glue*
t \tabskip
[=] *glue*
: *glue*
t \topskip
[=] *glue*
: *glue*
t \xspaceskip
[=] *glue*
: *glue*

47 internalinteger

t \adjdemerits
[=] *integer*
: *integer*
l \adjustspacing
[=] *integer*
: *integer*
l \adjustspacingshrink
[=] *integer*
: *integer*
l \adjustspacingstep
[=] *integer*
: *integer*
l \adjustspacingstretch
[=] *integer*
: *integer*

l \alignmentcellsource
[=] *integer*
: *integer*
l \alignmentwrapsource
[=] *integer*
: *integer*
l \automatichyphenpenalty
[=] *integer*
: *integer*
l \automigrationmode
[=] *integer*
: *integer*
l \autoparagraphmode
[=] *integer*
: *integer*
t \binoppenalty
[=] *integer*
: *integer*
l \boxlimitmode
TODO
t \brokenpenalty
[=] *integer*
: *integer*
l \catcodetable
[=] *integer*
: *integer*
t \clubpenalty
[=] *integer*
: *integer*
t \day
[=] *integer*
: *integer*
t \defaulthyphenchar
[=] *integer*
: *integer*
t \defaultskewchar
[=] *integer*
: *integer*
t \delimiterfactor
[=] *integer*
: *integer*
l \discretionaryoptions
[=] *integer*
: *integer*
t \displaywidowpenalty
[=] *integer*
: *integer*
t \doublehyphendemerits
[=] *integer*
: *integer*
l \doublepenaltymode
TODO
t \endlinechar
[=] *integer*
: *integer*
t \errorcontextlines
[=] *integer*
: *integer*
t \escapechar
[=] *integer*
: *integer*
l \eufactor
[=] *integer*
: *integer*
l \exceptionpenalty
[=] *integer*
: *integer*
t \exhyphenchar
[=] *integer*
: *integer*
t \exhyphenpenalty
[=] *integer*
: *integer*
l \explicithyphenpenalty
[=] *integer*
: *integer*
t \fam
[=] *integer*
: *integer*
t \finalhyphendemerits
[=] *integer*
: *integer*
l \firstvalidlanguage
[=] *integer*
: *integer*
t \floatingpenalty
[=] *integer*
: *integer*
t \globaldefs
[=] *integer*
: *integer*
l \glyphdatafield
[=] *integer*
: *integer*
l \glyphoptions
[=] *integer*
: *integer*

l \glyphscale
[=] *integer*
: *integer*
l \glyphscriptfield
[=] *integer*
: *integer*
l \glyphscriptscale
[=] *integer*
: *integer*
l \glyphscriptscriptscale
[=] *integer*
: *integer*
l \glyphslant
[=] *integer*
: *integer*
l \glyphstatefield
[=] *integer*
: *integer*
l \glyphtextscale
[=] *integer*
: *integer*
l \glyphweight
[=] *integer*
: *integer*
l \glyphxscale
[=] *integer*
: *integer*
l \glyphyscale
[=] *integer*
: *integer*
t \hangafter
[=] *integer*
: *integer*
t \hbadness
[=] *integer*
: *integer*
t \holdinginserts
[=] *integer*
: *integer*
l \holdingmigrations
[=] *integer*
: *integer*
l \hyphenationmode
[=] *integer*
: *integer*
t \hyphenpenalty
[=] *integer*
: *integer*
t \interlinepenalty
[=] *integer*
: *integer*
t \language
[=] *integer*
: *integer*
e \lastlinefit
[=] *integer*
: *integer*
t \lefthyphenmin
[=] *integer*
: *integer*
l \linebreakoptional
[=] *integer*
: *integer*
l \linebreakpasses
[=] *integer*
: *integer*
l \linedirection
[=] *integer*
: *integer*
t \linepenalty
[=] *integer*
: *integer*
l \localbrokenpenalty
[=] *integer*
: *integer*
l \localinterlinepenalty
[=] *integer*
: *integer*
l \localpretolerance
[=] *integer*
: *integer*
l \localtolerance
[=] *integer*
: *integer*
t \looseness
[=] *integer*
: *integer*
l \luacopyinputnodes
[=] *integer*
: *integer*
l \mathbeginclass
[=] *integer*
: *integer*
l \mathcheckfencesmode
[=] *integer*
: *integer*

l \mathdictgroup
[=] *integer*
: *integer*
l \mathdictproperties
[=] *integer*
: *integer*
l \mathdirection
[=] *integer*
: *integer*
l \mathdisplaymode
[=] *integer*
: *integer*
l \mathdisplaypenaltyfactor
[=] *integer*
: *integer*
l \mathdisplayskipmode
[=] *integer*
: *integer*
l \mathdoublescriptmode
[=] *integer*
: *integer*
l \mathendclass
[=] *integer*
: *integer*
l \matheqnogapstep
[=] *integer*
: *integer*
l \mathfontcontrol
[=] *integer*
: *integer*
l \mathgluemode
[=] *integer*
: *integer*
l \mathgroupingmode
[=] *integer*
: *integer*
l \mathinlinepenaltyfactor
[=] *integer*
: *integer*
l \mathleftclass
[=] *integer*
: *integer*
l \mathlimitsmode
[=] *integer*
: *integer*
l \mathnolimitsmode
[=] *integer*
: *integer*
l \mathpenaltiesmode
[=] *integer*
: *integer*
l \mathpretolerance
[=] *integer*
: *integer*
l \mathrightclass
[=] *integer*
: *integer*
l \mathrulesfam
[=] *integer*
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l \mathrulesmode
[=] *integer*
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[=] *integer*
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[=] *integer*
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l \mathspacingmode
[=] *integer*
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l \mathsurroundmode
[=] *integer*
: *integer*
l \mathtolerance
[=] *integer*
: *integer*
t \maxdeadcycles
[=] *integer*
: *integer*
t \month
[=] *integer*
: *integer*
t \newlinechar
[=] *integer*
: *integer*
l \normalizelinemode
[=] *integer*
: *integer*
l \normalizeparmode
[=] *integer*
: *integer*
l \nospaces
[=] *integer*
: *integer*

l \orphanpenalty
[=] *integer*
: *integer*
l \outputbox
[=] *integer*
: *integer*
t \outputpenalty
[=] *integer*
: *integer*
l \overloadmode
[=] *integer*
: *integer*
l \parametermode
[=] *integer*
: *integer*
l \pardirection
[=] *integer*
: *integer*
t \pausing
[=] *integer*
: *integer*
t \postdisplaypenalty
[=] *integer*
: *integer*
l \postinlinepenalty
[=] *integer*
: *integer*
l \postshortinlinepenalty
[=] *integer*
: *integer*
l \prebinoppenalty
[=] *integer*
: *integer*
e \predisplaydirection
[=] *integer*
: *integer*
l \predisplaygapfactor
[=] *integer*
: *integer*
t \predisplaypenalty
[=] *integer*
: *integer*
l \preinlinepenalty
[=] *integer*
: *integer*
l \prerelpenalty
[=] *integer*
: *integer*
l \preshortinlinepenalty
[=] *integer*
: *integer*
t \pretolerance
[=] *integer*
: *integer*
l \protrudechars
[=] *integer*
: *integer*
t \relpenalty
[=] *integer*
: *integer*
t \righthyphenmin
[=] *integer*
: *integer*
e \savinghyphcodes
[=] *integer*
: *integer*
e \savingvdiscards
[=] *integer*
: *integer*
l \scriptspaceafterfactor
TODO
l \scriptspacebeforefactor
TODO
l \scriptspacebetweenfactor
TODO
l \setfontid
[=] *integer*
: *integer*
t \setlanguage
[=] *integer*
: *integer*
l \shapingpenaltiesmode
[=] *integer*
: *integer*
l \shapingpenalty
[=] *integer*
: *integer*
l \shortinlineorphanpenalty
[=] *integer*
: *integer*
t \showboxbreadth
[=] *integer*
: *integer*
t \showboxdepth
[=] *integer*
: *integer*

t \shownodedetails
[=] *integer*
: *integer*
l \singlelinepenalty
[=] *integer*
: *integer*
l \spacechar
TODO
l \spacefactormode
[=] *integer*
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l \spacefactoroverload
TODO
l \spacefactorshrinklimit
[=] *integer*
: *integer*
l \spacefactorstretchlimit
[=] *integer*
: *integer*
l \supmarkmode
[=] *integer*
: *integer*
l \textdirection
[=] *integer*
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t \time
[=] *integer*
: *integer*
l \toddlerpenalty
TODO
t \tolerance
[=] *integer*
: *integer*
l \tracingadjusts
[=] *integer*
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l \tracingalignments
[=] *integer*
: *integer*
e \tracingassigns
[=] *integer*
: *integer*
t \tracingcommands
[=] *integer*
: *integer*
l \tracingexpressions
[=] *integer*
: *integer*
l \tracingfitness
TODO
l \tracingfullboxes
[=] *integer*
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e \tracinggroups
[=] *integer*
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l \tracinghyphenation
[=] *integer*
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e \tracingifs
[=] *integer*
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l \tracinginserts
[=] *integer*
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l \tracinglevels
[=] *integer*
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l \tracinglists
[=] *integer*
: *integer*
t \tracingloners
TODO
t \tracinglostchars
[=] *integer*
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t \tracingmacros
[=] *integer*
: *integer*
l \tracingmarks
[=] *integer*
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l \tracingmath
[=] *integer*
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e \tracingnesting
[=] *integer*
: *integer*
l \tracingnodes
[=] *integer*
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t \tracingonline
[=] *integer*
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t \tracingoutput
[=] *integer*
: *integer*

t \tracingpages
[=] *integer*
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t \tracingparagraphs
[=] *integer*
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l \tracingpasses
[=] *integer*
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l \tracingpenalties
[=] *integer*
: *integer*
t \tracingrestores
[=] *integer*
: *integer*
t \tracingstats
[=] *integer*
: *integer*
t \uchyph
[=] *integer*
: *integer*
l \variablefam
[=] *integer*
: *integer*
t \vbadness
[=] *integer*
: *integer*
t \widowpenalty
[=] *integer*
: *integer*
t \year
[=] *integer*
: *integer*

48 internalmuglue

t \medmuskip
[=] *muglue*
: *muglue*
l \pettymuskip
[=] *muglue*
: *muglue*
t \thickmuskip
[=] *muglue*
: *muglue*
t \thinmuskip
[=] *muglue*
: *muglue*
l \tinymuskip
[=] *muglue*
: *muglue*

49 internaltoks

t \errhelp
[=] *toks*
: *toks*
l \everybeforepar
[=] *toks*
: *toks*
t \everycr
[=] *toks*
: *toks*
t \everydisplay
[=] *toks*
: *toks*
e \everyeof
[=] *toks*
: *toks*
t \everyhbox
[=] *toks*
: *toks*
t \everyjob
[=] *toks*
: *toks*
t \everymath
[=] *toks*
: *toks*
l \everymathatom
[=] *toks*
: *toks*
t \everypar
[=] *toks*
: *toks*
l \everytab
[=] *toks*
: *toks*
t \everyvbox
[=] *toks*
: *toks*
t \output
[=] *toks*
: *toks*

50 italiccorrection

t \/

l \explicititaliccorrection
TODO
l \forcedleftcorrection
TODO
l \forcedrightcorrection
TODO

51 kern

t \hkern
dimension
t \kern
dimension
t \vkern
dimension

52 leader

t \cleaders
(*box* | *rule* | glyph) *glue*
l \gleaders
see \cleaders
t \leaders
see \cleaders
l \uleaders
[callback *integer*] (*box* | *rule* | glyph)
glue
t \xleaders
see \cleaders

53 legacy

t \shipout
{ *tokens* }

54 let

l \futuredef
\cs \cs
t \futurelet
\cs [=] \cs
l \glet
\cs
l \gletcsname
tokens\endcsname
l \glettonothing
\cs
t \let
\cs
l \letcharcode
\cs
l \letcsname
tokens\endcsname
l \letfrozen
\cs
l \letprotected
\cs
l \lettolastnamedcs
\cs
l \lettonothing
\cs
l \swapcsvalues
\cs \cs
l \unletfrozen
\cs
l \unletprotected
\cs

55 localbox

l \localleftbox
box
l \localmiddlebox
box
l \localrightbox
box
l \resetlocalboxes
TODO

56 luafunctioncall

l \luabytecodecall
integer
l \luafunctioncall
integer

57 makebox

t \box
(index | *box*)
t \copy
see \box
l \dbox
[target *integer*] [to *dimension*]
[adapt] [attr *integer integer*]

[anchor *integer*] [axis *integer*]
[shift *dimension*] [spread *dimension*]
[source *integer*] [direction *integer*]
[delay] [orientation *integer*]
[xoffset *dimension*] [xmove *dimension*] [yoffset *dimension*]
[ymove *dimension*] [reverse] [retain]
[container] [mathtext] [class *integer*] { *tokens* }

l \dpack
see \dbox

l \dsplit
[attr] [to] [upto] { *tokens* }

t \hbox
see \dbox

l \hpack
see \dbox

l \insertbox
integer

l \insertcopy
integer

t \lastbox

l \localleftboxbox

l \localmiddleboxbox

l \localrightboxbox

l \tpack
see \dbox

l \tsplit
see \dsplit

t \vbox
see \dbox

l \vpack
see \dbox

t \vsplit
see \dsplit

t \vtop
see \dbox

58 mark

l \clearmarks
integer

l \flushmarks

t \mark
{ *tokens* }

e \marks
integer { *tokens* }

59 mathaccent

l \Umathaccent
[attr *integer* *integer*] [center]
[class *integer*] [exact] [source *integer*] [stretch] [shrink]
[fraction *integer*] [fixed]
[keepbase] [nooverflow] [base]
(both [fixed] *character* [fixed] *character* | bottom [fixed] | top [fixed] | overlay *character* | *character*)

t \mathaccent
{ *tokens* }

60 mathcharnumber

l \Umathchar
integer

t \mathchar
integer

l \mathclass
integer

l \mathdictionary
integer mathchar

l \nomathchar
TODO

61 mathchoice

t \mathchoice
{ *tokens* } { *tokens* } { *tokens* } { *tokens* }

l \mathdiscretionary
[class *integer*] { *tokens* } { *tokens* } { *tokens* }

l \mathstack
{ *tokens* }

62 mathcomponent

l \mathatom
[attr *integer* *integer*] [all *integer*]
[leftclass *integer*] [limits]
[rightclass *integer*] [class *integer*]
[unpack] [unroll] [single] [source *integer*] [text*font*] [math*font*]
[options *integer*] [nolimits]

[nooverflow] [void] [phantom]
[continuation] [*integer*]

t \mathbin
{ *tokens* }

t \mathclose
{ *tokens* }

t \mathinner
{ *tokens* }

t \mathop
{ *tokens* }

t \mathopen
{ *tokens* }

t \mathord
{ *tokens* }

t \mathpunct
{ *tokens* }

t \mathrel
{ *tokens* }

t \overline
{ *tokens* }

t \underline
{ *tokens* }

63 mathfence

l \Uleft
[auto] [attr *integer integer*] [axis]
[bottom *dimension*] [depth *dimension*]
[factor *integer*] [height *dimension*]
[noaxis] [nocheck] [nolimits]
[nooverflow] [leftclass *integer*]
[limits] [exact] [void] [phantom]
[class *integer*] [rightclass *integer*]
[scale] [source *integer*] [top]
delimiter

l \Umiddle
see \Uleft

l \Uoperator
see \Uleft

l \Uright
see \Uleft

l \Uvextensible
see \Uleft

t \left
see \Uleft

t \middle
see \Uleft

t \right
see \Uleft

64 mathfraction

l \Uabove
dimension [attr *integer integer*]
[class *integer*] [center] [exact]
[proportional] [noaxis]
[nooverflow] [style *mathstyle*]
[source *integer*] [hfactor *integer*]
[vfactor *integer*] [*font*] [thickness
dimension] [usecallback]

l \Uabovewithdelims
delimiter delimiter *dimension* [attr
integer integer] [class *integer*]
[center] [exact] [proportional]
[noaxis] [nooverflow] [style
mathstyle] [source *integer*] [hfactor
integer] [vfactor *integer*] [*font*]
[thickness *dimension*] [usecallback]

l \Uatop
see \Uabove

l \Uatopwithdelims
see \Uabovewithdelims

l \Uover
[attr *integer integer*] [class
integer] [center] [exact]
[proportional] [noaxis]
[nooverflow] [style *mathstyle*]
[source *integer*] [hfactor *integer*]
[vfactor *integer*] [*font*] [thickness
dimension] [usecallback]

l \Uoverwithdelims
delimiter delimiter [attr *integer*
integer] [class *integer*] [center]
[exact] [proportional] [noaxis]
[nooverflow] [style *mathstyle*]
[source *integer*] [hfactor *integer*]
[vfactor *integer*] [*font*] [thickness
dimension] [usecallback]

l \Uskewed
delimiter [attr *integer integer*]
[class *integer*] [center] [exact]
[proportional] [noaxis]
[nooverflow] [style *mathstyle*]
[source *integer*] [hfactor *integer*]
[vfactor *integer*] [*font*] [thickness
dimension] [usecallback]

l \Uskewedwithdelims
delimiter delimiter delimiter [attr
integer integer] [class *integer*]

[center] [exact] [proportional] [noaxis] [nooverflow] [style *mathstyle*] [source *integer*] [hfactor *integer*] [vfactor *integer*] [*font*] [thickness *dimension*] [usecallback]

l \Ustretched
see \Uskewed

l \Ustretchedwithdelims
see \Uskewedwithdelims

t \above
dimension

t \abovewithdelims
delimiter delimiter *dimension*

t \atop
dimension

t \atopwithdelims
delimiter delimiter *dimension*

t \over

t \overwithdelims
delimiter delimiter

65 mathmodifier

l \Umathadapttoleft

l \Umathadapttoright

l \Umathlimits

l \Umathnoaxis

l \Umathnolimits

l \Umathopenupdepth
dimension

l \Umathopenupheight
dimension

l \Umathphantom

l \Umathsource
[nucleus] *integer*

l \Umathuseaxis

l \Umathvoid

t \displaylimits

t \limits

t \nolimits

66 mathparameter

l \Umathaccentbasedepth
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathaccentbaseheight
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathaccentbottomovershoot
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathaccentbottomshiftdown
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathaccentextendmargin
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathaccentsuperscriptdrop
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathaccentsuperscriptpercent
mathstyle [=] *integer*
> *mathstyle* : *integer*

l \Umathaccenttopovershoot
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathaccenttopshiftup
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathaccentvariant
[=] *mathstyle*
: *mathstyle*

l \Umathaxis
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathbottomaccentvariant
[=] *mathstyle*
: *mathstyle*

l \Umathconnectoroverlapmin
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathdegreevariant
[=] *mathstyle*
: *mathstyle*

l \Umathdelimiterextendmargin
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathdelimiterovervariant
[=] *mathstyle*
: *mathstyle*

l \Umathdelimiterpercent
mathstyle [=] *integer*
> *mathstyle* : *integer*

l \Umathdelimitershortfall
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l **\Umathdelimiterundervariant**
[=] *mathstyle*
: *mathstyle*
l **\Umathdenominatorvariant**
[=] *mathstyle*
: *mathstyle*
l **\Umathexheight**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathextrasubpreshift**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathextrasubprespace**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathextrasubshift**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathextrasubspace**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathextrasuppreshift**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathextrasupprespace**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathextrasupshift**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathextrasupspace**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathflattenedaccentbasedepth**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathflattenedaccentbaseheight**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathflattenedaccentbottomshiftdown**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathflattenedaccenttopshiftup**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathfractiondelsize**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathfractiondenomdown**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathfractiondenomvgap**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathfractionnumup**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathfractionnumvgap**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathfractionrule**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathfractionvariant**
[=] *mathstyle*
: *mathstyle*
l **\Umathhextensiblevariant**
[=] *mathstyle*
: *mathstyle*
l **\Umathlimitabovebgap**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathlimitabovekern**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathlimitabovevgap**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathlimitbelowbgap**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathlimitbelowkern**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathlimitbelowvgap**
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l **\Umathnolimitsubfactor**
mathstyle [=] *integer*
> *mathstyle* : *integer*
l **\Umathnolimitsupfactor**
mathstyle [=] *integer*
> *mathstyle* : *integer*
l **\Umathnumeratorvariant**
[=] *mathstyle*
: *mathstyle*

l \Umathoperatorsize
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathoverbarkern
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathoverbarrule
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathoverbarvgap
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathoverdelimiterbgap
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathoverdelimitervariant
[=] *mathstyle*
: *mathstyle*
l \Umathoverdelimitervgap
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathoverlayaccentvariant
[=] *mathstyle*
: *mathstyle*
l \Umathoverlinevariant
[=] *mathstyle*
: *mathstyle*
l \Umathprimeraise
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathprimeraisecomposed
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathprimeshiftdrop
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathprimeshiftup
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathprimespaceafter
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathprimevariant
[=] *mathstyle*
: *mathstyle*
l \Umathquad
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathradicaldegreeafter
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathradicaldegreebefore
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathradicaldegreeraise
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathradicalextensibleafter
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathradicalextensiblebefore
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathradicalkern
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathradicalrule
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathradicalvariant
[=] *mathstyle*
: *mathstyle*
l \Umathradicalvgap
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathruledepth
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathruleheight
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathskeweddelimitertolerance
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathskewedfractionhgap
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathskewedfractionvgap
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathspaceafterscript
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathspacebeforescript
mathstyle [=] *dimension*
> *mathstyle* : *dimension*

l \Umathspacebetweenscript
TODO
l \Umathstackdenomdown
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathstacknumup
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathstackvariant
[=] *mathstyle*
: *mathstyle*
l \Umathstackvgap
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathsubscriptsnap
TODO
l \Umathsubscriptvariant
[=] *mathstyle*
: *mathstyle*
l \Umathsubshiftdown
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathsubshiftdrop
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathsubsupshiftdown
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathsubsupvgap
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathsubtopmax
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathsupbottommin
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathsuperscriptsnap
TODO
l \Umathsuperscriptvariant
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathsupshiftdrop
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathsupshiftup
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathsupsubbottommax
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathtopaccentvariant
[=] *mathstyle*
: *mathstyle*
l \Umathunderbarkern
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathunderbarrule
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathunderbarvgap
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathunderdelimiterbgap
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathunderdelimitervariant
[=] *mathstyle*
: *mathstyle*
l \Umathunderdelimitervgap
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \Umathunderlinevariant
[=] *mathstyle*
: *mathstyle*
l \Umathvextensiblevariant
[=] *mathstyle*
: *mathstyle*
l \Umathxscale
mathstyle [=] *integer*
> *mathstyle* : *integer*
l \Umathyscale
mathstyle [=] *integer*
> *mathstyle* : *integer*
l \copymathatomrule
integer *integer*
l \copymathparent
integer *integer*
l \copymathspacing
integer *integer*
l \letmathatomrule
integer *integer* *integer* *integer*
integer
l \letmathparent
integer *integer*
l \letmathspacing
see \letmathatomrule

l \resetmathspacing
l \setdefaultmathcodes
l \setmathatomrule
integer integer mathstyle integer integer
l \setmathdisplaypostpenalty
integer [=] *integer*
l \setmathdisplayprepenalty
integer [=] *integer*
l \setmathignore
mathparameter *integer*
l \setmathoptions
integer [=] *integer*
l \setmathpostpenalty
integer [=] *integer*
l \setmathprepenalty
integer [=] *integer*
l \setmathspacing
integer integer mathstyle glue

67 mathradical

l \Udelimited
[attr *integer integer*] [bottom] [exact] [top] [style *mathstyle*] [source *integer*] [stretch] [shrink] [width *dimension*] [height *dimension*] [depth *dimension*] [left] [middle] [right] [nooverflow] [usecallback] delimiter delimiter [delimiter] [delimiter] (mathatom | { *tokens* })
l \Udelimiterover
[attr *integer integer*] [bottom] [exact] [top] [style *mathstyle*] [source *integer*] [stretch] [shrink] [width *dimension*] [height *dimension*] [depth *dimension*] [left] [middle] [right] [nooverflow] [usecallback] delimiter [delimiter] [delimiter] (mathatom | { *tokens* })
l \Udelimiterunder
see \Udelimiterover
l \Uhextensible
see \Udelimiterover
l \Uoverdelimiter
see \Udelimiterover
l \Uradical
see \Udelimiterover
l \Uroot
[attr *integer integer*] [bottom] [exact] [top] [style *mathstyle*] [source *integer*] [stretch] [shrink] [width *dimension*] [height *dimension*] [depth *dimension*] [left] [middle] [right] [nooverflow] [usecallback] delimiter [delimiter] [delimiter] (mathatom | { *tokens* }) (mathatom | { *tokens* })
l \Urooted
[attr *integer integer*] [bottom] [exact] [top] [style *mathstyle*] [source *integer*] [stretch] [shrink] [width *dimension*] [height *dimension*] [depth *dimension*] [left] [middle] [right] [nooverflow] [usecallback] delimiter delimiter [delimiter] [delimiter] (mathatom | { *tokens* }) (mathatom | { *tokens* })
l \Uunderdelimiter
see \Udelimiterover
t \radical
see \Uroot

68 mathscript

l \indexedsubprescript
(mathatom | { *tokens* })
l \indexedsubscript
see \indexedsubprescript
l \indexedsuperprescript
see \indexedsubprescript
l \indexedsuperscript
see \indexedsubprescript
l \noatomruling
t \nonscript
l \noscript
TODO
l \nosubprescript
l \nosubscript
l \nosuperprescript
l \nosuperscript
l \primescript
see \indexedsubprescript
l \subprescript
see \indexedsubprescript
l \subscript
see \indexedsubprescript

l \superprescript
see \indexedsubprescript
l \superscript
see \indexedsubprescript

69 mathshiftcs

l \Ustartdisplaymath
l \Ustartmath
l \Ustartmathmode
l \Ustopdisplaymath
l \Ustopmath
l \Ustopmathmode

70 mathstyle

l \allcrampedstyles
l \alldisplaystyles
l \allmainstyles
l \allmathstyles
l \allscriptscriptstyles
l \allscriptstyles
l \allsplitstyles
l \alltextstyles
l \alluncrampedstyles
l \allunsplitstyles
l \crampeddisplaystyle
l \crampedscriptscriptstyle
l \crampedscriptstyle
l \crampedtextstyle
l \currentlysetmathstyle
TODO
t \displaystyle
l \givenmathstyle
mathstyle
l \scaledmathstyle
integer
> *mathstyle* : *integer*
t \scriptscriptstyle
t \scriptstyle
t \textstyle

71 message

t \errmessage
{ *tokens* }
t \message
{ *tokens* }

72 mkern

t \mkern
dimension

73 mskip

l \mathatomskip
muglue
t \mskip
muglue

74 noexpand

t \noexpand
token

75 pageproperty

t \deadcycles
[=] *integer*
: *integer*
l \insertdepth
integer [=] *dimension*
> *integer* : *dimension*
l \insertdistance
integer [=] *dimension*
> *integer* : *dimension*
l \insertheight
integer [=] *dimension*
> *integer* : *dimension*
l \insertheights
[=] *dimension*
: *dimension*
l \insertlimit
integer [=] *dimension*
> *integer* : *dimension*
l \insertmaxdepth
integer [=] *dimension*
> *integer* : *dimension*
l \insertmultiplier
integer [=] *integer*
> *integer* : *integer*
t \insertpenalties
[=] *integer*
: *integer*
l \insertpenalty
integer [=] *integer*

> *integer* : *integer*
l \insertstorage
integer [=] *integer*
> *integer* : *integer*
l \insertstoring
[=] *integer*
: *integer*
l \insertwidth
integer [=] *dimension*
> *integer* : *dimension*
l \pagedepth
[=] *dimension*
: *dimension*
l \pageexcess
[=] *dimension*
: *dimension*
t \pagefilllstretch
[=] *dimension*
: *dimension*
t \pagefillstretch
[=] *dimension*
: *dimension*
t \pagefilstretch
[=] *dimension*
: *dimension*
l \pagefistretch
[=] *dimension*
: *dimension*
t \pagegoal
[=] *dimension*
: *dimension*
l \pagelastdepth
[=] *dimension*
: *dimension*
l \pagelastfilllstretch
[=] *dimension*
: *dimension*
l \pagelastfillstretch
[=] *dimension*
: *dimension*
l \pagelastfilstretch
[=] *dimension*
: *dimension*
l \pagelastfistretch
TODO
l \pagelastheight
[=] *dimension*
: *dimension*
l \pagelastshrink
[=] *dimension*
: *dimension*
l \pagelaststretch
[=] *dimension*
: *dimension*
t \pageshrink
[=] *dimension*
: *dimension*
t \pagestretch
[=] *dimension*
: *dimension*
t \pagetotal
[=] *dimension*
: *dimension*
l \pagevsize
[=] *dimension*
: *dimension*

76 parameter

l \alignmark
l \parametermark

77 penalty

l \hpenalty
integer
t \penalty
integer
l \vpenalty
integer

78 prefix

l \aliased
l \constant
l \constrained
l \deferred
l \enforced
l \frozen
t \global
l \immediate
l \immutable
l \inherited
l \instance
t \long
l \mutable

l \noaligned
t \outer
l \overloaded
l \permanent
e \protected
l \retained
l \semiprotected
l \tolerant
l \untraced

79 register

l \attribute
(index | *box*) [=] *integer*
> (index | *box*) : *integer*
t \count
see \attribute
t \dimen
(index | *box*) [=] *dimension*
> (index | *box*) : *dimension*
l \float
(index | *box*) [=] *float*
> (index | *box*) : *float*
t \muskip
(index | *box*) [=] *muglue*
> (index | *box*) : *muglue*
t \skip
(index | *box*) [=] *glue*
> (index | *box*) : *glue*
t \toks
(index | *box*) [=] { *tokens* }
> (index | *box*) : { *tokens* }

80 relax

l \norelax
t \relax

81 removeitem

t \unboundary
t \unkern
t \unpenalty
t \unskip

82 setbox

t \setbox
(index | *box*) [=]

83 setfont

t \nullfont

84 shorthanddef

l \Umathchardef
\cs *integer*
l \Umathdictdef
\cs *integer integer*
l \attributedef
\cs *integer*
t \chardef
\cs *integer*
t \countdef
\cs *integer*
t \dimendef
\cs *integer*
l \dimensiondef
\cs *integer*
l \floatdef
\cs *integer*
l \fontspecdef
\cs (*font* | *integer*)
l \gluespecdef
\cs *integer*
l \integerdef
\cs *integer*
l \luadef
\cs *integer*
t \mathchardef
\cs *integer*
l \mugluespecdef
\cs *integer*
t \muskipdef
\cs *integer*
l \parameterdef
\cs *integer*
l \positdef
\cs *integer*
t \skipdef
\cs *integer*
t \toksdef
\cs *integer*

85 someitem

t \badness
[=] *integer*
: *integer*
e \currentgrouplevel
[=] *integer*
: *integer*
e \currentgrouptype
[=] *integer*
: *integer*
e \currentifbranch
[=] *integer*
: *integer*
e \currentiflevel
[=] *integer*
: *integer*
e \currentiftype
[=] *integer*
: *integer*
l \currentloopiterator
[=] *integer*
: *integer*
l \currentloopnesting
[=] *integer*
: *integer*
e \currentstacksize
[=] *integer*
: *integer*
e \dimexpr
tokens\relax [=] *dimension*
> *tokens*\relax : *dimension*
l \dimexpression
tokens\relax [=] *dimension*
> *tokens*\relax : *dimension*
l \floatexpr
tokens\relax [=] *float*
> *tokens*\relax : *float*
l \fontcharba
integer [=] *dimension*
> *integer* : *dimension*
e \fontchardp
integer [=] *dimension*
> *integer* : *dimension*
e \fontcharht
integer [=] *dimension*
> *integer* : *dimension*
e \fontcharic
integer [=] *dimension*
> *integer* : *dimension*
l \fontcharta
integer [=] *dimension*
> *integer* : *dimension*
e \fontcharwd
integer [=] *dimension*
> *integer* : *dimension*
l \fontid
(*font* | *integer*) [=] *integer*
> (*font* | *integer*) : *integer*
l \fontmathcontrol
see \fontid
l \fontspecid
see \fontid
l \fontspecifiedsize
see \fontid
l \fontspecscale
see \fontid
l \fontspecslant
see \fontid
l \fontspecweight
see \fontid
l \fontspecxscale
see \fontid
l \fontspecyscale
see \fontid
l \fonttextcontrol
see \fontid
e \glueexpr
tokens\relax [=] *glue*
> *tokens*\relax : *glue*
e \glueshrink
glue [=] *dimension*
> *glue* : *dimension*
e \glueshrinkorder
glue [=] *dimension*
> *glue* : *dimension*
e \gluestretch
glue [=] *integer*
> *glue* : *integer*
e \gluestretchorder
glue [=] *integer*
> *glue* : *integer*
e \gluetomu
glue [=] *glue*
> *glue* : *glue*
l \glyphxscaled
[=] *integer*
: *integer*

l \glyphyscaled
[=] *integer*
: *integer*
l \indexofcharacter
integer [=] *integer*
> *integer* : *integer*
l \indexofregister
integer [=] *integer*
> *integer* : *integer*
t \inputlineno
[=] *integer*
: *integer*
l \insertprogress
integer [=] *dimension*
> *integer* : *dimension*
l \lastarguments
[=] *integer*
: *integer*
l \lastatomclass
[=] *integer*
: *integer*
l \lastboundary
[=] *integer*
: *integer*
l \lastchkdimension
[=] *dimension*
: *dimension*
l \lastchknumber
[=] *integer*
: *integer*
t \lastkern
[=] *dimension*
: *dimension*
l \lastleftclass
[=] *integer*
: *integer*
l \lastloopiterator
[=] *integer*
: *integer*
l \lastnodesubtype
[=] *integer*
: *integer*
e \lastnodetype
[=] *integer*
: *integer*
l \lastpageextra
[=] *dimension*
: *dimension*
l \lastparcontext
[=] *integer*
: *integer*
l \lastpartrigger
TODO
t \lastpenalty
[=] *integer*
: *integer*
l \lastrightclass
[=] *integer*
: *integer*
t \lastskip
[=] *glue*
: *glue*
l \leftmarginkern
[=] *dimension*
: *dimension*
l \luatexrevision
[=] { *tokens* }
: { *tokens* }
l \luatexversion
[=] { *tokens* }
: { *tokens* }
l \mathatomglue
[=] *glue*
: *glue*
l \mathcharclass
integer [=] *integer*
> *integer* : *integer*
l \mathcharfam
integer [=] *integer*
> *integer* : *integer*
l \mathcharslot
integer [=] *integer*
> *integer* : *integer*
l \mathmainstyle
[=] *integer*
: *integer*
l \mathparentstyle
TODO
l \mathscale
[=] *integer*
: *integer*
l \mathstackstyle
[=] *integer*
: *integer*
l \mathstyle
[=] *integer*
: *integer*

l \mathstylefontid
[=] *integer*
: *integer*
e \muexpr
tokens\relax [=] *muglue*
> *tokens*\relax : *muglue*
e \mutoglue
muglue [=] *glue*
> *muglue* : *glue*
l \nestedloopiterator
[=] *integer*
: *integer*
l \numericscale
(*integer* | *float*) [=] *integer*
> (*integer* | *float*) : *integer*
l \numericscaled
see \numericscale
e \numexpr
tokens\relax [=] *integer*
> *tokens*\relax : *integer*
l \numexpression
tokens\relax [=] *integer*
> *tokens*\relax : *integer*
l \overshoot
[=] *dimension*
: *dimension*
l \parametercount
[=] *integer*
: *integer*
l \parameterindex
[=] *integer*
: *integer*
e \parshapedimen
integer [=] *dimension*
> *integer* : *dimension*
e \parshapeindent
integer [=] *dimension*
> *integer* : *dimension*
e \parshapelength
[=] *dimension*
: *dimension*
l \parshapewidth
TODO
l \previousloopiterator
[=] *integer*
: *integer*
l \rightmarginkern
[=] *dimension*
: *dimension*
l \scaledemwidth
(*font* | *integer*) [=] *dimension*
> (*font* | *integer*) : *dimension*
l \scaledexheight
see \scaledemwidth
l \scaledextraspace
see \scaledemwidth
l \scaledfontcharba
integer [=] *dimension*
> *integer* : *dimension*
l \scaledfontchardp
integer [=] *dimension*
> *integer* : *dimension*
l \scaledfontcharht
integer [=] *dimension*
> *integer* : *dimension*
l \scaledfontcharic
integer [=] *dimension*
> *integer* : *dimension*
l \scaledfontcharta
integer [=] *dimension*
> *integer* : *dimension*
l \scaledfontcharwd
integer [=] *dimension*
> *integer* : *dimension*
l \scaledinterwordshrink
see \scaledemwidth
l \scaledinterwordspace
see \scaledemwidth
l \scaledinterwordstretch
see \scaledemwidth
l \scaledmathaxis
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \scaledmathemwidth
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \scaledmathexheight
mathstyle [=] *dimension*
> *mathstyle* : *dimension*
l \scaledslantperpoint
see \scaledemwidth

86 specification

l \brokenpenalties
TODO
e \clubpenalties
[options] *integer* n * (*integer*)

: *integer*

e \displaywidowpenalties
see \clubpenalties

l \fitnessdemerits
TODO

e \interlinepenalties
see \clubpenalties

l \mathbackwardpenalties
see \clubpenalties

l \mathforwardpenalties
see \clubpenalties

l \orphanpenalties
see \clubpenalties

l \parpasses
[options] n * ([adjdemerits *integer*] [adjustspacing *integer*] [adjustspacingstep *integer*] [adjustspacingshrink *integer*] [adjustspacingstretch *integer*] [badness *integer*] [classes *integer*] [callback *integer*] [doubleadjdemerits *integer*] [doublehyphendemerits *integer*] [emergencystretch *dimension*] [extrahyphenpenalty *integer*] [finalhyphendemerits *integer*] [identifier *integer*] [ifadjustspacing *integer*] [looseness *integer*] [linebreakcriterium *integer*] [linebreakoptional *integer*] [linepenalty *integer*] [next] [orphanpenalty *integer*] [quit] [skip] [threshold *dimension*] [tolerance *integer*])
: *integer*

t \parshape
[options] *integer* n * (*dimension* *dimension*)
: *integer*

e \widowpenalties
see \clubpenalties

87 the

e \detokenize
{ *tokens* }

l \expandeddetokenize
{ *tokens* }

l \protecteddetokenize
{ *tokens* }

l \protectedexpandeddetokenize
{ *tokens* }

t \the
dimension

l \thewithoutunit
quantity

e \unexpanded
{ *tokens* }

88 unhbox

t \unhbox
integer

t \unhcopy
integer

l \unhpack
integer

89 unvbox

l \insertunbox
integer

l \insertuncopy
integer

e \pagediscards

e \splitdiscards

t \unvbox
integer

t \unvcopy
integer

l \unvpack
integer

90 vadjust

t \vadjust
[pre] [post] [baseline] [before] [index *integer*] [after] [attr *integer* *integer*] [depth (after | before | check | last)] { *tokens* }

91 valign

t \valign
[attr *integer* *integer*] [callback

integer [discard] [noskips]
[reverse] [to *dimension*] [spread
dimension] { *tokens* }

92 vcenter

t \vcenter
[target *integer*] [to *dimension*]
[adapt] [attr *integer integer*]
[anchor *integer*] [axis *integer*]
[shift *dimension*] [spread *dimension*]
[source *integer*] [direction *integer*]
[delay] [orientation *integer*]
[xoffset *dimension*] [xmove
dimension] [yoffset *dimension*]
[ymove *dimension*] [reverse] [retain]
[container] [mathtext] [class
integer] { *tokens* }

93 vmove

t \lower
dimension box
t \raise
dimension box

94 vrule

l \novrule
[attr *integer* [=] *integer*] [width
dimension] [height *dimension*] [depth
dimension] [left *dimension*] [right
dimension] [top *dimension*] [bottom
dimension] [xoffset *dimension*]
[yoffset *dimension*] [*font integer*]
[fam *integer*] [char *integer*]
l \srule
see \novrule
l \virtualvrule
[attr *integer* [=] *integer*] [width
dimension] [height *dimension*] [depth
dimension] [left *dimension*] [right
dimension] [top *dimension*] [bottom
dimension] [xoffset *dimension*]
[yoffset *dimension*]
t \vrule
see \novrule

95 vskip

t \vfil
t \vfill
t \vfilneg
t \vskip
dimension [plus
(*dimension* | fi [n*l])] [minus
(*dimension* | fi [n*l])]
t \vss

96 xray

t \show
token
t \showbox
(index | *box*)
l \showcodestack
TODO
e \showgroups
e \showifs
t \showlists
l \showstack
t \showthe
quantity
e \showtokens
{ *tokens* }

Rationale

Some words about the why and how it came. One of the early adopters of ConTEXt was Taco Hoekwater and we spent numerous trips to TEX meetings all over the globe. He was also the only one I knew who had read the TEX sources. Because ConTEXt has always been on the edge of what is possible and at that time we both used it for rather advanced rendering, we also ran into the limitations. I'm not talking of TEX features here. Naturally old school TEX is not really geared for dealing with images of all kind, colors in all kind of color spaces, highly interactive documents, input methods like xml, etc. The nice thing is that it offers some escapes, like specials and writes and later execution of programs that opened up lots of possibilities, so in practice there were no real limitations to what one could do. But coming up with a consistent and extensible (multi lingual) user interface was non trivial, because it had an impact in memory usage and performance. A lot could be done given some programming, as ConTEXt MkII proves, but it was not always pretty under the hood. The move to LuaTEX and MkIV transferred some action to Lua, and because LuaTEX effectively was a ConTEXt related project, we could easily keep them in sync.

Our traveling together, meeting several times per year, and eventually email and intense LuaTEX developments (lots of Skype sessions) for a couple of years, gave us enough opportunity to discuss all kind of nice features not present in the engine. The previous century we discussed lots of them, rejected some, stayed with others, and I admit that forgot about most of the arguments already. Some that we did was already explored in `eetex`, some of those ended up in LuaTEX, and eventually what we have in LuaMetaTEX can been seen as the result of years of programming in TEX, improving macros, getting more performance and efficiency out of existing ConTEXt code and inspiration that we got out of the ConTEXt community, a demanding lot, always willing to experiment with us.

Once I decided to work on LuaMetaTEX and bind its source to the ConTEXt distribution so that we can be sure that it won't get messed up and might interfere with the ConTEXt expectations, some more primitives saw their way into it. It is very easy to come up with all kind of bells and whistles but it is equally easy to hurt performance of an engine and what might go unnoticed in simple tests can really affect a macro package that depends on stability. So, what I did was mostly looking at the ConTEXt code and wondering how to make some of the low level macros look more natural, also because I know that there are users who look into these sources. We spend a lot of time making them look consistent and nice and the nicer the better. Getting a better performance was seldom an argument because much is already as fast as can be so there is not that much to gain, but less clutter in tracing was an argument for some new primitives. Also, the fact that we soon might need to fall back on our phones to use TEX a smaller memory footprint and less byte shuffling also was a consideration. The LuaMetaTEX memory footprint is somewhat smaller than the LuaTEX footprint. By binding LuaMetaTEX to ConTEXt we can also guarantee that the combinations works as expected.

I'm aware of the fact that ConTEXt is in a somewhat unique position. First of all it has always been kind of cutting edge so its users are willing to experiment. There are users who immediately update and run tests, so bugs can and will be fixed fast. Already for a long time the community has an convenient infrastructure for updating and the build farm for generating binaries (also for other engines) is running smoothly.

Then there is the ConTEXt user interface that is quite consistent and permits extensions with staying backward compatible. Sometimes users run into old manuals or examples and then complain that ConTEXt is not compatible but that then involves obsolete technology: we no longer need font and input encodings and font definitions are different for OpenType fonts. We always had an abstract backend model, but nowadays pdf is kind of dominant and drives a lot of expectations. So, some of the MkII commands are gone and MkIV has some more. Also, as MetaPost evolved that department

in ConTEXt also evolved. Think of it like cars: soon all are electric so one cannot expect a hole to poor in some fluid but gets a (often incompatible) plug instead. And buttons became touch panels. There is no need to use much force to steer or brake. Navigation is different, as are many controls. And do we need to steer ourselves a decade from now?

So, just look at TEX and ConTEXt in the same way. A system from the nineties in the previous century differs from one three decades later. Demands differ, input differs, resources change, editing and processing moves on, and so on. Manuals, although still being written are seldom read from cover to cover because online searching replaced them. And who buys books about programming? So LuaMetaTEX, while still being TEX also moves on, as do the way we do our low level coding. This makes sense because the original TEX ecosystem was not made with a huge and complex macro package in mind, that just happened. An author was supposed to make a style for each document. An often used argument for using another macro package over ConTEXt was that the later evolved and other macro packages would work the same forever and not change from the perspective of the user. In retrospect those arguments were somewhat strange because the world, computers, users etc. do change. Standards come and go, as do software politics and preferences. In many aspects the TEX community is not different from other large software projects, operating system wars, library devotees, programming language addicts, paradigm shifts. But, don't worry, if you don't like LuaMetaTEX and its new primitives, just forget about them. The other engines will be there forever and are a safe bet, although LuaTEX already stirred up the pot I guess. But keep in mind that new features in the latest greatest ConTEXt version will more and more rely on LuaMetaTEX being used; after all that is where it's made for. And this manual might help understand its users why, where and how the low level code differs between MkII, MkIV and LMTX.

Can we expect more new primitives than the ones introduced here? Given the amount of time I spent on experimenting and considering what made sense and what not, the answer probably is “no”, or at least “not that much”. As in the past no user ever requested the kind of primitives that were added, I don't expect users to come up with requests in the future either. Of course, those more closely related to ConTEXt development look at it from the other end. Because it's there where the low level action really is, demands might still evolve.

Basically there are wo areas where the engine can evolve: the programming part and the rendering. In this manual we focus on the programming and writing the manual sort of influences how details get filled in. Rendering in more complex because there heuristics and usage plays a more dominant role. Good examples are the math, par and page builder. They were extended and features were added over time but improved rendering came later. Not all extensions are critical, some are there (and got added) in order to write more readable code but there is only so much one can do in that area. Occasionally a feature pops up that is a side effect of a challenge. No matter what gets added it might not affect complexity too much and definitely not impact performance significantly!

Hans Hagen
Hasselt NL

To be checked primitives (new)

To be checked primitives (math)

Uabove
Udelcode
Udelimited
Udelimiter
Udelimiterover
Udelimiterunder
Uhextensible
Uleft
Umathaccentbasedepth
Umathaccentbaseheight
Umathaccentbottomovershoot
Umathaccentbottomshiftdown
Umathaccentextendmargin
Umathaccentsuperscriptdrop
Umathaccentsuperscriptpercent
Umathaccenttopovershoot
Umathaccenttopshiftup
Umathaccentvariant
Umathadapttoleft
Umathadapttoright
Umathaxis
Umathbottomaccentvariant
Umathcode
Umathconnectoroverlapmin
Umathdegreevariant
Umathdelimiterextendmargin
Umathdelimiterovervariant
Umathdelimiterpercent
Umathdelimitershortfall
Umathdelimiterundervariant
Umathdenominatorvariant
Umathdictdef
Umathexheight
Umathextrasubpreshift
Umathextrasubprespace
Umathextrasubshift
Umathextrasubspace
Umathextrasuppreshift
Umathextrasupprespace
Umathextrasupshift
Umathextrasupspace
Umathflattenedaccentbasedepth
Umathflattenedaccentbaseheight
Umathflattenedaccentbottomshiftdown
Umathflattenedaccenttopshiftup
Umathfractiondelsize
Umathfractiondenomdown
Umathfractiondenomvgap
Umathfractionnumup
Umathfractionnumvgap
Umathfractionrule
Umathfractionvariant
Umathhextensiblevariant
Umathlimitabovebgap
Umathlimitabovekern
Umathlimitabovevgap
Umathlimitbelowbgap
Umathlimitbelowkern
Umathlimitbelowvgap
Umathlimits
Umathnoaxis
Umathnolimits
Umathnumeratorvariant
Umathopenupdepth
Umathopenupheight
Umathoperatorsize
Umathoverdelimiterbgap
Umathoverdelimitervariant
Umathoverdelimitervgap
Umathoverlayaccentvariant
Umathphantom
Umathprimeraise
Umathprimeraisecomposed
Umathprimeshiftdrop
Umathprimeshiftup
Umathprimespaceafter
Umathprimevariant
Umathquad
Umathradicaldegreeafter
Umathradicaldegreebefore
Umathradicaldegreeraise
Umathradicalextensibleafter
Umathradicalextensiblebefore
Umathradicalkern
Umathradicalrule
Umathradicalvariant
Umathradicalvgap
Umathruledepth
Umathruleheight
Umathskeweddelimitertolerance
Umathskewedfractionhgap
Umathskewedfractionvgap
Umathsource
Umathstackdenomdown

```
Umathstacknumup
Umathstackvariant
Umathstackvgap
Umathsubscriptsnap
Umathsubscriptvariant
Umathsubshiftdown
Umathsubshiftdrop
Umathsubsupshiftdown
Umathsubsupvgap
Umathsubtopmax
Umathsupbottommin
Umathsuperscriptsnap
Umathsuperscriptvariant
Umathsupshiftdrop
Umathsupshiftup
Umathsupsubbottommax
Umathtopaccentvariant
Umathunderdelimiterbgap
Umathunderdelimitervariant
Umathunderdelimitervgap
Umathuseaxis
Umathvextensiblevariant
Umathvoid
Umathxscale
Umathyscale
Umiddle
Uoperator
Uoverdelimiter
Uroot
Urooted
Uskewed
Uskewedwithdelims
Ustartdisplaymath
Ustartmath
Ustartmathmode
Ustopdisplaymath
Ustopmath
Ustopmathmode
Ustretched
Ustretchedwithdelims
Uunderdelimiter
Uvextensible
currentlysetmathstyle
nomathchar
```

Many primitives starting with `Umath` are math parameters that are discussed elsewhere, if at all.

To be checked primitives (old)

Indexed primitives

boxdirection
boxfinalize
boxfreeze
boxgeometry
boxlimit
boxlimitate
boxlimitmode
boxmaxdepth
boxorientation
boxrepack
boxshift
boxshrink
boxsource
boxstretch
boxtarget
boxtotal
boxvadjust
boxxmove
boxxoffset
boxymove
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eufactor
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everymath
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spacefactorstretchlimit
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splitbotmarks
splitdiscards
splitfirstmark
splitfirstmarks
splitmaxdepth
splittopskip
srule

string
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subscript
superprescript
superscript
supmarkmode
swapcsvalues
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tabskip
tabskips
textdirection
textfont
textstyle
the
thewithoutunit
thickmuskip
thinmuskip
time
tinymuskip
tocharacter
toddlerpenalty
todimension
tohexadecimal
tointeger
tokenized
toks
toksapp
toksdef
tokspre
tolerance
tolerant
tomathstyle
topmark
topmarks
topskip
toscaled
tosparsedimension
tosparsescaled
tpack
tracingadjusts
tracingalignments
tracingassigns
tracingcommands
tracingexpressions
tracingfitness
tracingfullboxes
tracinggroups
tracinghyphenation
tracingifs
tracinginserts
tracinglevels
tracinglists
tracingloners
tracinglostchars
tracingmacros
tracingmarks
tracingmath
tracingnesting
tracingnodes
tracingonline
tracingoutput
tracingpages
tracingparagraphs
tracingpasses
tracingpenalties
tracingrestores
tracingstats
tsplit
uccode
uchyph
uleaders
unboundary
undent
underline
unexpanded
unexpandedendless
unexpandedloop
unexpandedrepeat
unhbox
unhcopy
unhpack
unkern
unless
unletfrozen
unletprotected
unpenalty
unskip
untraced
unvbox
unvcopy
unvpack
uppercase
vadjust
valign
variablefam
vbadness
vbox
vcenter

vfil
vfill
vfilneg
vfuzz
virtualhrule
virtualvrule
vkern
vpack
vpenalty
vrule
vsize
vskip
vsplit
vss
vtop
wd
widowpenalties
widowpenalty
wordboundary
wrapuppar
write
xdef
xdefcsname
xleaders
xspaceskip
xtoks
xtoksapp
xtokspre
year