low level TEX

alignments

Contents

1 Introduction

TEX has a couple of subsystems and alignments is one of them. This mechanism is used to construct tables or alike. Because alignments use low level primitives to set up and construct a table, and because such a setup can be rather extensive, in most cases users will rely on macros that hide this.

```
\halign {
        \alignmark\hss \aligntab
    \hss\alignmark\hss \aligntab
    \hss\alignmark     \cr
    1.1     \aligntab 2,2     \aligntab 3=3     \cr
    11.11   \aligntab 22,22   \aligntab 33=33   \cr
    111.111 \aligntab 222,222 \aligntab 333=333 \cr
}
```

That one doesn't look too complex and comes out as:

```
1.1         2,2         3=3
11.11     22,22     33=33
111.111 222,222 333=333
```

This is how the previous code comes out when we use one of the ConTEXt table mechanism.

```
\starttabulate[|l|c|r|]
  \NC 1.1     \NC 2,2     \NC 3=3     \NC \NR
  \NC 11.11   \NC 22,22   \NC 33=33   \NC \NR
```

```
  \NC 111.111 \NC 222,222 \NC 333=333 \NC \NR
\stoptabulate
```

```
1.1         2,2         3=3
11.11      22,22      33=33
111.111  222,222  333=333
```

That one looks a bit different with respect to spaces, so let's go back to the low level variant:

```
\halign {
        \alignmark\hss \aligntab
    \hss\alignmark\hss \aligntab
    \hss\alignmark     \cr
  1.1\aligntab     2,2\aligntab     3=3\cr
  11.11\aligntab   22,22\aligntab   33=33\cr
  111.111\aligntab 222,222\aligntab 333=333\cr
}
```

Here we don't have spaces in the content part and therefore also no spaces in the result:

```
1.1       2,2       3=3
11.11    22,22    33=33
111.111222,222333=333
```

You can automate dealing with unwanted spacing:

```
\halign {
      \ignorespaces\alignmark\unskip\hss \aligntab
  \hss\ignorespaces\alignmark\unskip\hss \aligntab
  \hss\ignorespaces\alignmark\unskip     \cr
  1.1     \aligntab 2,2     \aligntab 3=3     \cr
  11.11   \aligntab 22,22   \aligntab 33=33   \cr
  111.111 \aligntab 222,222 \aligntab 333=333 \cr
}
```

We get:

```
1.1       2,2       3=3
11.11    22,22    33=33
111.111222,222333=333
```

By moving the space skipping and cleanup to the so called preamble we don't need to deal with it in the content part. We can also deal with inter-column spacing there:

```
\halign {
      \ignorespaces\alignmark\unskip\hss \tabskip 1em \aligntab
  \hss\ignorespaces\alignmark\unskip\hss \tabskip 1em \aligntab
  \hss\ignorespaces\alignmark\unskip     \tabskip 0pt \cr
  1.1     \aligntab 2,2     \aligntab 3=3     \cr
  11.11   \aligntab 22,22   \aligntab 33=33   \cr
  111.111 \aligntab 222,222 \aligntab 333=333 \cr
}
```

```
1.1         2,2         3=3
11.11      22,22      33=33
111.111  222,222  333=333
```

If for the moment we forget about spanning columns (`\span`) and locally ignoring preamble entries (`\omit`) these basic commands are not that complex to deal with. Here we use `\alignmark` but that is just a primitive that we use instead of # while `\aligntab` is the same as &, but using the characters instead also assumes that they have the catcode that relates to a parameter and alignment tab (and in ConTEXt that is not the case). The TEXbook has plenty alignment examples so if you really want to learn about them, consult that must-have-book.

2 Between the lines

The individual rows of a horizontal alignment are treated as lines. This means that, as we see in the previous section, the interline spacing is okay. However, that also means that when we mix the lines with rules, the normal TEX habits kick in. Take this:

```
\halign {
      \ignorespaces\alignmark\unskip\hss \tabskip 1em \aligntab
  \hss\ignorespaces\alignmark\unskip\hss \tabskip 1em \aligntab
  \hss\ignorespaces\alignmark\unskip     \tabskip 0pt \cr
  \noalign{\hrule}
  1.1     \aligntab 2,2     \aligntab 3=3     \cr
  \noalign{\hrule}
  11.11   \aligntab 22,22   \aligntab 33=33   \cr
  \noalign{\hrule}
  111.111 \aligntab 222,222 \aligntab 333=333 \cr
  \noalign{\hrule}
}
```

The result doesn't look pretty and actually, when you see documents produced by TEX using alignments you should not be surprised to notice rather ugly spacing. The user (or the macropackage) should deal with that explicitly, and this is not always the case.

1.1	2,2	3=3
11.11	22,22	33=33
111.111	222,222	333=333

The solution is often easy:

```
\halign {
      \ignorespaces\strut\alignmark\unskip\hss \tabskip 1em \aligntab
  \hss\ignorespaces\strut\alignmark\unskip\hss \tabskip 1em \aligntab
  \hss\ignorespaces\strut\alignmark\unskip     \tabskip 0pt \cr
  \noalign{\hrule}
  1.1     \aligntab 2,2     \aligntab 3=3     \cr
  \noalign{\hrule}
  11.11   \aligntab 22,22   \aligntab 33=33   \cr
  \noalign{\hrule}
  111.111 \aligntab 222,222 \aligntab 333=333 \cr
  \noalign{\hrule}
}
```

1.1	2,2	3=3
11.11	22,22	33=33
111.111	222,222	333=333

The user will not notice it but alignments put some pressure on the general TEX scanner. Actually, the scanner is either scanning an alignment or it expects regular text (including math). When you look at the previous example you see `\noalign`. When the preamble is read, TEX will pick up rows till it finds the final brace. Each row is added to a temporary list and the `\noalign` will enter a mode where other stuff gets added to that list. It all involves subtle look ahead but with minimal overhead. When the whole alignment is collected a final pass over that list will package the cells and rows (lines) in the appropriate way using information collected (like the maximum width of a cell and width of the current cell. It will also deal with spanning cells then.

So let's summarize what happens:

1. scan the preamble that defines the cells (where the last one is repeated when needed)
2. check for `\cr`, `\noalign` or a right brace; when a row is entered scan for cells in parallel the preamble so that cell specifications can be applied (then start again)
3. package the preamble based on information with regards to the cells in a column

4. apply the preamble packaging information to the columns and also deal with pending cell spans
5. flush the result to the current list, unless packages in a box a `\halign` is seen as paragraph and rows as lines (such a table can split)

The second (repeated) step is complicated by the fact that the scanner has to look ahead for a `\noalign`, `\cr`, `\omit` or `\span` and when doing that it has to expand what comes. This can give side effects and often results in obscure error messages. When for instance an `\if` is seen and expanded, the wrong branch can be entered. And when you use protected macros embedded alignment commands are not seen at all; of course they still need to produce valid operations in the current context.

All these side effects are to be handled in a macro package when it wraps alignments in a high level interface and ConTEXt does that for you. But because the code doesn't always look pretty then, in LuaMetaTEX the alignment mechanism has been extended a bit over time.

Nesting `\noalign` is normally not permitted (but one can redefine this primitive such that a macro package nevertheless handles it). The first extension permits nested usage of `\noalign`. This has resulted of a little reorganization of the code. A next extension showed up when overload protection was introduced and extra prefixes were added. We can signal the scanner that a macro is actually a `\noalign` variant:[1]

```
\noaligned\protected\def\InBetween{\noalign{...}}
```

Here the `\InBetween` macro will get the same treatment as `\noalign` and it will not trigger an error. This extension resulted in a second bit of reorganization (think of internal command codes and such) but still the original processing of alignments was there.

A third overhaul of the code actually did lead to some adaptations in the way alignments are constructed so let's move on to that.

3 Pre-, inter- and post-tab skips

The basic structure of a preamble and row is actually not that complex: it is a mix of tab skip glue and cells (that are just boxes):

```
\tabskip 10pt
```

[1] One can argue for using the name `\peekaligned` because in the meantime other alignment primitives also can use this property.

```
\halign {
  \strut\alignmark\tabskip 12pt\aligntab
  \strut\alignmark\tabskip 14pt\aligntab
  \strut\alignmark\tabskip 16pt\cr
  \noalign{\hrule}
  cell 1.1\aligntab cell 1.2\aligntab cell 1.3\cr
  \noalign{\hrule}
  cell 2.1\aligntab cell 2.2\aligntab cell 2.3\cr
  \noalign{\hrule}
}
```

The tab skips are set in advance and apply to the next cell (or after the last one).

TB:10.000 cell 1.1 SP:31497	TB:12.000 cell 1.2 SP:31497	TB:14.000 cell 1.3 SP:31497 TB:16.000
TB:10.000 cell 2.1 SP:31497	TB:12.000 cell 2.2 SP:31497	TB:14.000 cell 2.3 SP:31497 TB:16.000

In the ConTEXt table mechanisms the value of `\tabskip` is zero in most cases. As in:

```
\tabskip 0pt
\halign {
  \strut\alignmark\aligntab
  \strut\alignmark\aligntab
  \strut\alignmark\cr
  \noalign{\hrule}
  cell 1.1\aligntab cell 1.2\aligntab cell 1.3\cr
  \noalign{\hrule}
  cell 2.1\aligntab cell 2.2\aligntab cell 2.3\cr
  \noalign{\hrule}
}
```

When these ships are zero, they still show up in the end:

cell 1.1	cell 1.2	cell 1.3
cell 2.1	cell 2.2	cell 2.3

Normally, in order to achieve certain effects there will be more align entries in the preamble than cells in the table, for instance because you want vertical lines between cells. When these are not used, you can get quite a bit of empty boxes and zero skips. Now, of course this is seldom a problem, but when you have a test document where you want to show font properties in a table and that font supports a script with some ten thousand glyphs, you can imagine that it accumulates and in LuaTEX (and LuaMetaTEX) nodes are larger so it is one of these cases where in ConTEXt we get messages on the console that node memory is bumped.[2]

After playing a bit with stripping zero tab skips I found that the code would not really benefit from such a feature: lots of extra tests made it quite ugly. As a result a first alternative was to just strip zero skips before an alignment got flushed. At least we're then a bit leaner in the processes that come after it. This feature is now available as one of the normalizer bits.

But, as we moved on, a more natural approach was to keep the skips in the preamble, because that is where a guaranteed alternating skip/box is assumed. It also makes that the original documentation is still valid. However, in the rows construction we can be lean. This is driven by a keyword to `\halign`:

```
\tabskip 0pt
\halign noskips {
  \strut\alignmark\aligntab
  \strut\alignmark\aligntab
  \strut\alignmark\cr
  \noalign{\hrule}
  cell 1.1\aligntab cell 1.2\aligntab cell 1.3\cr
  \noalign{\hrule}
```

[2] I suppose it was a coincidence that a few weeks after these features came available a user consulted the mailing list about a few thousand page table that made the engine run out of memory, something that could be cured by enabling these new features.

```
  cell 2.1\aligntab cell 2.2\aligntab cell 2.3\cr
  \noalign{\hrule}
}
```

No zero tab skips show up here:

cell 1.1	cell 1.2	cell 1.3
cell 2.1	cell 2.2	cell 2.3

When playing with all this the LuaMetaTEX engine also got a tracing option for alignments. We already had one that showed some of the `\noalign` side effects, but showing the preamble was not yet there. This is what `\tracingalignments = 2` results in:

```
<preamble>
\glue[ignored][...] 0.0pt
\alignrecord
..{\strut }
..<content>
..{\endtemplate }
\glue[ignored][...] 0.0pt
\alignrecord
..{\strut }
..<content>
..{\endtemplate }
\glue[ignored][...] 0.0pt
\alignrecord
..{\strut }
..<content>
..{\endtemplate }
\glue[ignored][...] 0.0pt
```

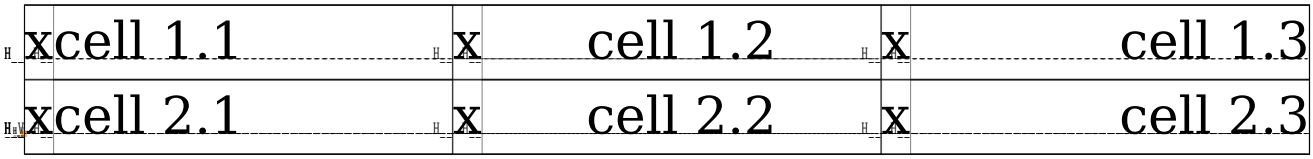
The `ignored` subtype is (currently) only used for these alignment tab skips and it triggers a check later on when the rows are constructed. The `<content>` is what get injected in the cell (represented by `\alignmark`). The pseudo primitives are internal and not public.

4 Cell widths

Imagine this:

```
\halign {
  x\hbox to 3cm{\strut    \alignmark\hss}\aligntab
  x\hbox to 3cm{\strut\hss\alignmark\hss}\aligntab
  x\hbox to 3cm{\strut\hss\alignmark    }\cr
  cell 1.1\aligntab cell 1.2\aligntab cell 1.3\cr
  cell 2.1\aligntab cell 2.2\aligntab cell 2.3\cr
}
```

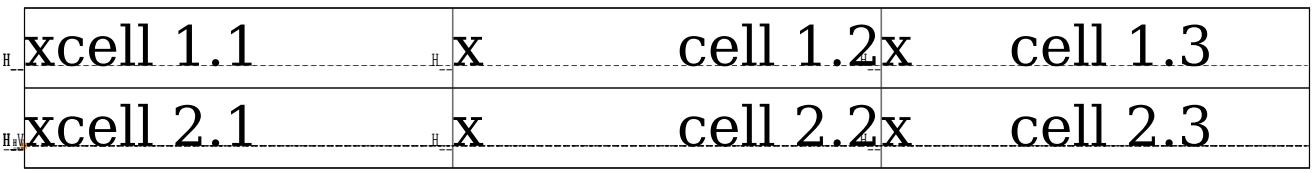
which renders as:



A reason to have boxes here is that it enforces a cell width but that is done at the cost of an extra wrapper. In LuaMetaTEX the `hlist` nodes are rather large because we have more options than in original TEX, for instance offsets and orientation. In a table with 10K rows of 4 cells yet get 40K extra `hlist` nodes allocated. Now, one can argue that we have plenty of memory but being lazy is not really a sign of proper programming.

```
\halign {
  x\tabsize 3cm\strut    \alignmark\hss\aligntab
  x\tabsize 3cm\strut\hss\alignmark\aligntab
  x\tabsize 3cm\strut\hss\alignmark\hss\cr
  cell 1.1\aligntab cell 1.2\aligntab cell 1.3\cr
  cell 2.1\aligntab cell 2.2\aligntab cell 2.3\cr
}
```

If you look carefully you will see that this time we don't have the embedded boxes:



So, both the sparse skip and new `\tabsize` feature help to make these extreme tables (spanning hundreds of pages) not consume irrelevant memory and also make that later on we don't have to consult useless nodes.

5 Plugins

Yet another LuaMetaTEX extension is a callback that kicks in between the preamble preroll and finalizing the alignment. Initially as test and demonstration a basic character alignment feature was written but that works so well that in some places it can replace (or compliment) the already existing features in the ConTEXt table mechanisms.

```
\starttabulate[|lG{.}|cG{,}|rG{=}|cG{x}|]
\NC 1.1     \NC 2,2     \NC 3=3     \NC a 0xFF   \NC \NR
\NC 11.11   \NC 22,22   \NC 33=33   \NC b 0xFFF  \NC \NR
\NC 111.111 \NC 222,222 \NC 333=333 \NC c 0xFFFF \NC \NR
\stoptabulate
```

The tabulate mechanism in ConTEXt is rather old and stable and it is the preferred way to deal with tabular content in the text flow. However, adding the `G` specifier (as variant of the `g` one) could be done without interference or drop in performance. This new `G` specifier tells the tabulate mechanism that in that column the given character is used to vertically align the content that has this character.

1.1	2,2	3=3	a 0xFF
11.11	22,22	33=33	b 0xFFF
111.111	222,222	333=333	c 0xFFFF

Let's make clear that this is *not* an engine feature but a ConTEXt one. It is however made easy by this callback mechanism. We can of course use this feature with the low level alignment primitives, assuming that you tell the machinery that the plugin is to be kicked in.

```
\halign noskips \alignmentcharactertrigger \bgroup
    \tabskip2em
        \setalignmentcharacter.\ignorespaces\alignmark\unskip\hss \aligntab
    \hss\setalignmentcharacter,\ignorespaces\alignmark\unskip\hss \aligntab
    \hss\setalignmentcharacter=\ignorespaces\alignmark\unskip     \aligntab
    \hss                       \ignorespaces\alignmark\unskip\hss \cr
      1.1   \aligntab   2,2   \aligntab   3=3   \aligntab \setalignmentcharacter{.}\relax 4.4\cr
     11.11  \aligntab  22,22  \aligntab  33=33  \aligntab \setalignmentcharacter{,}\relax 44,44\cr
    111.111 \aligntab 222,222 \aligntab 333=333 \aligntab \setalignmentcharacter{!}\relax 444!444\cr
        x   \aligntab     x   \aligntab     x   \aligntab \setalignmentcharacter{/}\relax /\cr
       .1   \aligntab    ,2   \aligntab    =3   \aligntab \setalignmentcharacter{?}\relax ?4\cr
       .111 \aligntab    ,222 \aligntab    =333 \aligntab \setalignmentcharacter{=}\relax 44=444\cr
\egroup
```

This rather verbose setup renders as:

1.1	2,2	3=3	4 . 4
11.11	22,22	33=33	44 , 44

```
111.111    222,222    333=333    444!444
x              x              x       /
    .1         ,2         =3         ?4
    .111       ,222       =333     44=444
```

Using a high level interface makes sense but local control over such alignment too, so here follow some more examples. Here we use different alignment characters:

```
\starttabulate[|lG{.}|cG{,}|rG{=}|cG{x}|]
\NC 1.1     \NC 2,2     \NC 3=3     \NC a 0xFF   \NC \NR
\NC 11.11   \NC 22,22   \NC 33=33   \NC b 0xFFF  \NC \NR
\NC 111.111 \NC 222,222 \NC 333=333 \NC c 0xFFFF \NC \NR
\stoptabulate
```

```
  1.1       2,2       3=3     a 0xFF
 11.11     22,22     33=33    b 0xFFF
111.111   222,222   333=333   c 0xFFFF
```

In this example we specify the characters in the cells. We still need to add a specifier in the preamble definition because that will trigger the plugin.

```
\starttabulate[|lG{}|rG{}|]
\NC left                                        \NC right                                       \NC\NR
\NC \showglyphs \setalignmentcharacter{.}1.1    \NC \setalignmentcharacter{.}1.1    \NC\NR
\NC \showglyphs \setalignmentcharacter{,}11,11  \NC \setalignmentcharacter{,}11,11  \NC\NR
\NC \showglyphs \setalignmentcharacter{=}111=111 \NC \setalignmentcharacter{=}111=111 \NC\NR
\stoptabulate
```

```
left              right
   1.1             1 . 1
  11,11          11 , 11
111=111        111=111
```

You can mix these approaches:

```
\starttabulate[|lG{.}|rG{}|]
\NC left    \NC right                              \NC\NR
\NC 1.1     \NC \setalignmentcharacter{.}1.1     \NC\NR
\NC 11.11   \NC \setalignmentcharacter{.}11.11   \NC\NR
\NC 111.111 \NC \setalignmentcharacter{.}111.111 \NC\NR
\stoptabulate
```

```
left           right
  1.1           1.1
```

```
 11.11     11.11
111.111   111.111
```

Here the already present alignment feature, that at some point in tabulate might use this new feature, is meant for numbers, but here we can go wild with words, although of course you need to keep in mind that we deal with typeset text, so there may be no match.

```
\starttabulate[|lG{.}|rG{.}|]
\NC foo.bar \NC foo.bar \NC \NR
\NC  oo.ba  \NC  oo.ba  \NC \NR
\NC   o.b   \NC   o.b   \NC \NR
\stoptabulate
```

```
foo.bar   foo.bar
 oo.ba     oo.ba
  o.b       o.b
```

This feature will only be used in know situations and those seldom involve advanced typesetting. However, the following does work:[3]

```
\starttabulate[|cG{d}|]
\NC \smallcaps abcdefgh \NC \NR
\NC              xdy    \NC \NR
\NC \sl          xdy    \NC \NR
\NC \tttf        xdy    \NC \NR
\NC \tfd          d     \NC \NR
\stoptabulate
```

```
abc d efgh
   x d y
   x d y
   x d y
     d
```

As always with such mechanisms, the question is “Where to stop?” But it makes for nice demos and as long as little code is needed it doesn't hurt.

[3] Should this be an option instead?

6 Pitfalls and tricks

The next example mixes bidirectional typesetting. It might look weird at first sight but the result conforms to what we discussed in previous paragraphs.

```
\starttabulate[|lG{.}|lG{}|]
\NC \righttoleft 1.1   \NC \righttoleft \setalignmentcharacter{.}1.1   \NC\NR
\NC              1.1   \NC              \setalignmentcharacter{.}1.1   \NC\NR
\NC \righttoleft 1.11  \NC \righttoleft \setalignmentcharacter{.}1.11  \NC\NR
\NC              1.11  \NC              \setalignmentcharacter{.}1.11  \NC\NR
\NC \righttoleft 1.111 \NC \righttoleft \setalignmentcharacter{.}1.111 \NC\NR
\NC              1.111 \NC              \setalignmentcharacter{.}1.111 \NC\NR
\stoptabulate
```

```
  1.1    1.1
1.1    1.1
 11.1   11.1
1.11   1.11
111.1  111.1
1.111  1.111
```

In case of doubt, look at this:

```
\starttabulate[|lG{.}|lG{}|lG{.}|lG{}|]
\NC \righttoleft 1.1   \NC \righttoleft \setalignmentcharacter{.}1.1   \NC
                 1.1   \NC              \setalignmentcharacter{.}1.1   \NC\NR
\NC \righttoleft 1.11  \NC \righttoleft \setalignmentcharacter{.}1.11  \NC
                 1.11  \NC              \setalignmentcharacter{.}1.11  \NC\NR
\NC \righttoleft 1.111 \NC \righttoleft \setalignmentcharacter{.}1.111 \NC
                 1.111 \NC              \setalignmentcharacter{.}1.111 \NC\NR
\stoptabulate
```

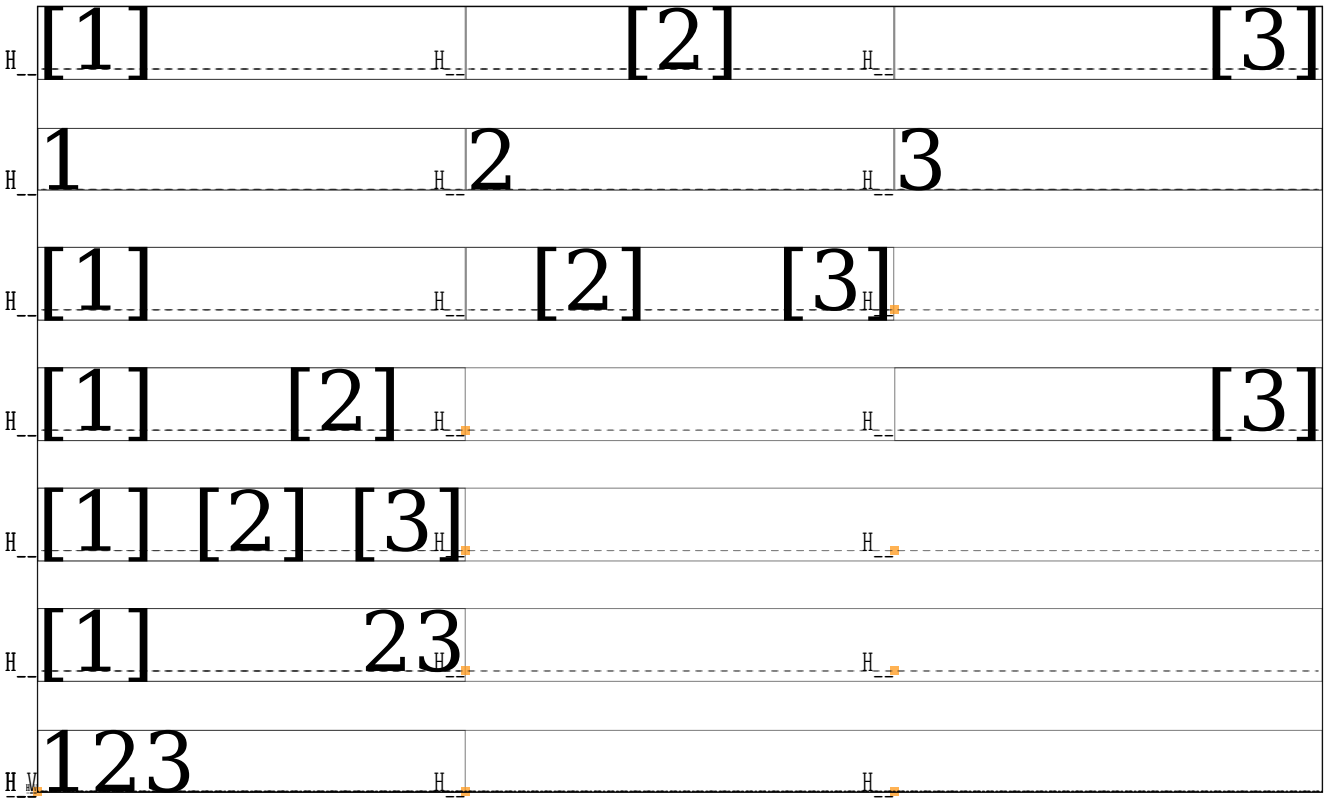
```
  1.1    1.1  1.1    1.1
 11.1   11.1  1.11   1.11
111.1  111.1  1.111  1.111
```

The next example shows the effect of `\omit` and `\span`. The first one makes that in this cell the preamble template is ignored.

```
\halign \bgroup
    \tabsize 2cm\relax     [\alignmark]\hss \aligntab
    \tabsize 2cm\relax \hss[\alignmark]\hss \aligntab
    \tabsize 2cm\relax \hss[\alignmark]\cr
           1\aligntab       2\aligntab       3\cr
     \omit 1\aligntab \omit 2\aligntab \omit 3\cr
           1\aligntab       2\span           3\cr
           1\span           2\aligntab       3\cr
```

```
            1\span           2\span           3\cr
            1\span \omit     2\span \omit     3\cr
      \omit 1\span \omit     2\span \omit     3\cr
\egroup
```

Spans are applied at the end so you see a mix of templates applied.



When you define an alignment inside a macro, you need to duplicate the `\alignmark` signals. This is similar to embedded macro definitions. But in LuaMetaTEX we can get around that by using `\aligncontent`. Keep in mind that when the preamble is scanned there is no doesn't expand with the exception of the token after `\span`.

```
\halign \bgroup
    \tabsize 2cm\relax     \aligncontent\hss \aligntab
    \tabsize 2cm\relax \hss\aligncontent\hss \aligntab
    \tabsize 2cm\relax \hss\aligncontent\cr
    1\aligntab 2\aligntab 3\cr
    A\aligntab B\aligntab C\cr
\egroup
```

1	2	3
A	B	C

In this example we still have to be verbose in the way we align but we can do this:

```
\halign \bgroup
    \tabsize 2cm\relax \aligncontentleft  \aligntab
    \tabsize 2cm\relax \aligncontentmiddle\aligntab
    \tabsize 2cm\relax \aligncontentright \cr
    1\aligntab 2\aligntab 3\cr
    A\aligntab B\aligntab C\cr
\egroup
```

Where the helpers are defined as:

```
\noaligned\protected\def\aligncontentleft
  {\ignorespaces\aligncontent\unskip\hss}

\noaligned\protected\def\aligncontentmiddle
  {\hss\ignorespaces\aligncontent\unskip\hss}

\noaligned\protected\def\aligncontentright
  {\hss\ignorespaces\aligncontent\unskip}
```

The preamble scanner see such macros as candidates for a single level expansion so it will inject the meaning and see the `\aligncontent` eventually.

1	2	3
A	B	C

The same effect could be achieved by using the `\span` prefix:

```
\def\aligncontentleft{\ignorespaces\aligncontent\unskip\hss}

\halign { ... \span\aligncontentleft ...}
```

One of the reasons for not directly using the low level `\halign` command is that it's a lot of work but by providing a set of helpers like here might change that a bit. Keep in mind that much of the above is not new in the sense that we could not achieve the same already, it's just a bit programmer friendly.

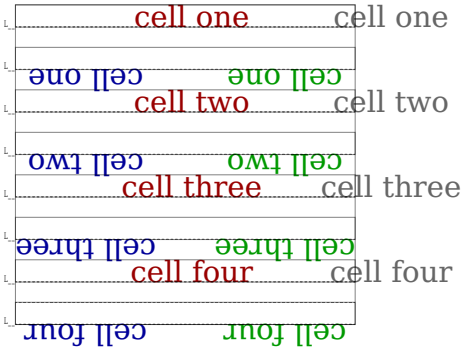
7 Rows

Alignment support is what the documented source calls ‘interwoven’. When the engine scans for input it processing text, math or alignment content. While doing alignments it collects rows, and inside these cells but also deals with material that ends up in

between. In LuaMetaTEX I tried to isolate the bits and pieces as good as possible but it remains complicated (for all good reasons). Cells as well as rows are finalized after the whole alignment has been collected and processed. In the end cells and rows are boxes but till we're done they are in an 'unset' state.

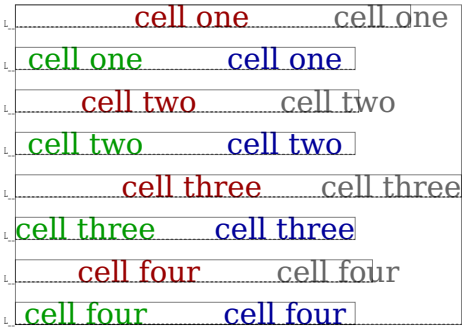
Scanning starts with interpreting the preamble, and then grabbing rows. There is some nasty lookahead involved for `\noalign`, `\span`, `\omit`, `\cr` and `\crcr` and that is not code one wants to tweak too much (although we did in LuaMetaTEX). This means for instance that adding 'let's start a row here' primitive is sort of tricky (but it might happen some day) which in turn means that it is not really possible to set row properties. As an experiment we can set some properties now by hijacking `\noalign` and storing them on the alignment stack (indeed: at the cost of some extra overhead and memory). This permits the following:

```
\halign {
    \hss
    \ignorespaces \alignmark \removeunwantedspaces
    \hss
    \quad \aligntab \quad
    \hss
    \ignorespaces \alignmark \removeunwantedspaces
    \hss
    \cr
    \noalign xoffset 40pt {}
    {\darkred   cell one}   \aligntab {\darkgray cell one}   \cr
    \noalign orientation "002 {}
    {\darkgreen cell one}   \aligntab {\darkblue cell one}   \cr
    \noalign xoffset 40pt {}
    {\darkred   cell two}   \aligntab {\darkgray cell two}   \cr
    \noalign orientation "002 {}
    {\darkgreen cell two}   \aligntab {\darkblue cell two}   \cr
    \noalign xoffset 40pt {}
    {\darkred   cell three} \aligntab {\darkgray cell three} \cr
    \noalign orientation "002 {}
    {\darkgreen cell three} \aligntab {\darkblue cell three} \cr
    \noalign xoffset 40pt {}
    {\darkred   cell four}  \aligntab {\darkgray cell four}  \cr
    \noalign orientation "002 {}
    {\darkgreen cell four}  \aligntab {\darkblue cell four}  \cr
}
```



The supported keywords are similar to those for boxes: `source`, `target`, `anchor`, `orientation`, `shift`, `xoffset`, `yoffset`, `xmove` and `ymove`. The dimensions can be prefixed by `add` and `reset` wipes all. Here is another example:

```
\halign {
    \hss
    \ignorespaces \alignmark \removeunwantedspaces
    \hss
    \quad \aligntab \quad
    \hss
    \ignorespaces \alignmark \removeunwantedspaces
    \hss
    \cr
    \noalign xmove 40pt {}
    {\darkred   cell one}   \aligntab {\darkgray cell one}   \cr
    {\darkgreen cell one}   \aligntab {\darkblue cell one}   \cr
    \noalign xmove 20pt {}
    {\darkred   cell two}   \aligntab {\darkgray cell two}   \cr
    {\darkgreen cell two}   \aligntab {\darkblue cell two}   \cr
    \noalign xmove 40pt {}
    {\darkred   cell three} \aligntab {\darkgray cell three} \cr
    {\darkgreen cell three} \aligntab {\darkblue cell three} \cr
    \noalign xmove 20pt {}
    {\darkred   cell four}  \aligntab {\darkgray cell four}  \cr
    {\darkgreen cell four}  \aligntab {\darkblue cell four}  \cr
}
```



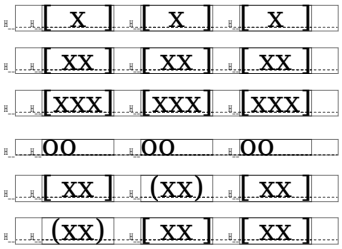
Some more features might be added in the future as is it an interesting playground. It is to be seen how this ends up in ConTEXt high level interfaces like tabulate.

8 Templates

The `\omit` command signals that the template should not be applied. But what if we actually want something at the left and right of the content? Here is how it's done:

```
\tabskip10pt \showboxes
\halign\bgroup
    [\hss\aligncontent\hss]\aligntab
    [\hss\aligncontent\hss]\aligntab
    [\hss\aligncontent\hss]\cr
           x\aligntab                        x\aligntab        x\cr
          xx\aligntab                       xx\aligntab       xx\cr
         xxx\aligntab                      xxx\aligntab      xxx\cr
    \omit  oo\aligntab\omit                 oo\aligntab\omit  oo\cr
           xx\aligntab\realign{\hss(}{)\hss}xx\aligntab       xx\cr
    \realign{\hss(}{)\hss}xx\aligntab xx\aligntab xx\cr
\egroup
```

The `\realign` command is like an `omit` but it expects two token lists that will for this cell be used instead of the ones from the preamble. While `\omit` also skips insertion of `\everytab`, here it is inserted, just like with normal preambles.



It will probably take a while before I'll apply this in ConTEXt because changing existing (stable) table environment is not something done lightly.

9 Pitfalls

Alignment have a few properties that can catch you off-guard. One is the use of `\everycr`. The next example demonstrates that it is also injected after the preamble definition.

```
\everycr{\noalign{\hrule}}
\halign\bgroup \hsize 5cm \strut \alignmark\cr one\cr two\cr\egroup
```

This makes sense because it is one way to make sure that for instance a rule gets the width of the cell.

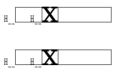
The sam eis of course true for a vertical align:

```
\everycr{\noalign{\vrule}}
\valign\bgroup \hsize 4cm \strut \aligncontent\cr one\cr two\cr\egroup
```

We set the width because otherwise the current text width is used.

Something similar happens with a `\tabskip`: the value set before the alignment is used left of the first cell.

```
\tabskip10pt
\halign\bgroup \tabskip20pt\relax\aligncontent\cr x\cr x\cr \egroup
```



The `\tabskip` outside the alignment is an internal glue register so you can for instance use the prefix `\global`. However, in a preamble it is more a directive: the given value is stored with the cell. This means that the next code is invalid:

```
\tabskip10pt
\halign\bgroup \global\tabskip20pt\relax\aligncontent\cr x\cr x\cr \egroup
```

The parser looks at tokens in the preamble, sees the `\global` and appends it to the current pre-part of the cell's template. Then it sees a `\tabskip` and assigns the value

after it to the cell's skip. The token and its value just disappear, they are not appended to the template. Now, when the template is injected (and interpreted) this `\global` expects a variable next and in our case the `x` doesn't qualify. The next snippet however works okay:

```
\scratchcounter0
\halign\bgroup
    \global\tabskip40pt\relax\advance\scratchcounter\plusone\aligncontent
      \cr
    x:\the\scratchcounter\cr
    x:\the\scratchcounter\cr
    x:\the\scratchcounter\cr
\egroup
```

Here the `\global` is applied to the `advance` because the skip definition is *not* in the preamble.

x:1
x:2
x:3

Here is a variant:

```
\scratchcounter0
\halign\bgroup
   \global\tabskip10pt\relax\aligncontent\cr
   \advance\scratchcounter\plusone x:\the\scratchcounter\cr
   \advance\scratchcounter\plusone x:\the\scratchcounter\cr
   \advance\scratchcounter\plusone x:\the\scratchcounter\cr
\egroup
```

Again the `\global` stays and this time if ends up before the content which starts with an `\advance`.
x:1
x:2
x:3

Normally you will not need the next trickery but it shows that cells are grouped:

```
\halign\bgroup\aligncontent\cr
    1\atendofgrouped{A}\atendofgrouped{B}\cr
    2\aftergrouped  {A}\aftergrouped  {B}\cr
    3                                    \cr
```

```
\egroup
```

Maybe at some point I'll add something a bit more tuned for dealing with cells, but here is what you get with the above:
1AB
2
AB3

10 Remark

It can be that the way alignments are interfaced with respect to attributes is a bit different between LuaTEX and LuaMetaTEX but because the former is frozen (in order not to interfere with current usage patterns) this is something that we will deal with deep down in ConTEXt LMTX.

In principle we can have hooks into the rows for pre and post material but it doesn't really pay of as grouping will still interfere. So for now I decided not to add these.

10 Colofon

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LuaMetaTEX	211.0
Support	www.pragma-ade.com
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