Description

This module is written in the process of defining a couple of styles for an educational math book. The macros provide you a way to visualize steps in for instance solving equations.

The horizontal visualization is called stepchart, while the vertical alternative carries the name steptable. The vertical alternative has a special case that permits alignment on a mid symbol (in most cases a relation).

The implementation uses a combination of \TeX and \ METAPOST, and is set up in such a way that hyperlinks and alike will work okay.

Structure

The horizontal stepcharts have at most four rows: two rows of cells with each an associated row of texts. The plural elements cells and texts each have two subelements. The texts elements are put between cells.

```xml
<stepchart>
  <cells> <top> some text </top> <bot> some text </bot> </cells>
  <texts> <top> text </top> <bot> text </bot> </texts>
  <cells> <top> some text </top> <bot> some text </bot> </cells>
</stepchart>
```

```
  text
  text
  some text  some text
  some text  some text

When a singular cell element is used in combination with the plural texts, we get one row of step cells with both top and bottom texts.

```xml
<stepchart>
  <cell> some text </cell>
```
The third horizontal alternative only has singular elements, and as a result the texts are put above the step cells.

Normally, the lines go from cell to cell via a text. When you let the cell element follow by more than one text element (or their plural forms), all lines will start at the same point.
The vertical alternative (of course) looks different and permits pretty long explanations.

```
<steptable>
  <cell> cell 1 </cell>
  <text> text 1 </text>
  <cell> cell 2 </cell>
  <text> text 2 </text>
  <cell> cell 3 </cell>
</steptable>
```

When the plural element `cells` is used, three sub-elements are expected. These align around the mid element `c2`.

```
<stepalignable>
  <cells> <c1> left </c1> <c2> center </c2> <c3> right </c3> </cells>
  <text> text </text>
  <cells> <c1> lft </c1> <c2> ctr </c2> <c3> rgt </c3> </cells>
  <text> text </text>
  <cells> <c1> l </c1> <c2> c </c2> <c3> r </c3> </cells>
</stepalignable>
```
You can draw lines normally or dashes and with or without arrows in both directions. This is controlled by the `alternative` option of \setupSTEPaligntable. As an example we use this table:

\startSTEPaligntable
\cells \(2c\) \(=\) \(2a+3b\)
\text {with \(a=5\)}
\cells \(2c\) \(=\) \(10+3b\)
\text {and \(b=6\)}
\cells \(2c\) \(=\) \(10+18\)
\text {we get}
\stopSTEPaligntable

Next we show the (currently) 9 alternatives. The zero alternative draws no lines so there we can make the distance smaller.

\setupSTEPlines
[alternative=0,
 width=.5em]

\setupSTEPlines
[alternative=1]

\setupSTEPlines
[alternative=2]
\[2c = 2a + 3b\]

\[2c = 10 + 3b\]

\[2c = 10 + 18\]

with \(a = 5\)

and \(b = 6\)

\section*{Steps}

5
\setupSTEPlines [alternative=7]

\setupSTEPlines [alternative=8]

Usage

The step chart module is loaded with:

\usemodule[cell] % was step

but in the case of embedded math, you should also load the MATHML module:

\usemodule[cell,mathml]

XML example

Steps 6
Because we don't want to clutter the examples with MATHML we stick to a simple mapping:

```
\startxmlsetups xml:math:simple
  \xmlsetsetup {#1} {m} {xml:math:simple:tex}
\stopxmlsetups

\startxmlsetups xml:math:simple:tex
  \mathematics{\xmlflush{#1}}
\stopxmlsetups

\xmlregistersetup{xml:math:simple}
```

So, in the next examples the \textit{m} element contains \LaTeX\ math.

```
<stepchart>
  <cells> <top> A </top> <bot> B </bot> </cells>
  <cells> <top> one </top> <bot> five </bot> </cells>
  <texts> <top> +2 </top> <bot> -2 </bot> </texts>
  <cells> <top> two </top> <bot> four </bot> </cells>
  <texts> <top> +3 </top> <bot> -3 </bot> </texts>
  <cells> <top> three </top> <bot> three </bot> </cells>
  <texts> <top> +4 </top> <bot> -4 </bot> </texts>
  <cells> <top> four </top> <bot> two </bot> </cells>
  <texts> <top> +5 </top> <bot> -5 </bot> </texts>
  <cells> <top> five </top> <bot> one </bot> </cells>
</stepchart>
```

```
\begin{tikzpicture}
  \node (A) at (0,0) {A};
  \node (B) at (0,-2) {B};
  \node (one) at (1,0) {one};
  \node (two) at (2,0) {two};
  \node (three) at (3,0) {three};
  \node (four) at (4,0) {four};
  \node (five) at (5,0) {five};
  \node (five) at (5,-2) {five};
  \node (four) at (4,-2) {four};
  \node (three) at (3,-2) {three};
  \node (two) at (2,-2) {two};
  \node (one) at (1,-2) {one};
  \node (one) at (1,0) {one};
  \node (two) at (2,0) {two};
  \node (three) at (3,0) {three};
  \node (four) at (4,0) {four};
  \node (five) at (5,0) {five};
  \node (five) at (5,-2) {five};
  \node (four) at (4,-2) {four};
  \node (three) at (3,-2) {three};
  \node (two) at (2,-2) {two};
  \node (one) at (1,-2) {one};
  \draw[->] (A) -- (one);
  \draw[->] (one) -- (two);
  \draw[->] (two) -- (three);
  \draw[->] (three) -- (four);
  \draw[->] (four) -- (five);
  \draw[->] (five) -- (one);
  \draw[->] (A) -- (five);
  \draw[->] (five) -- (four);
  \draw[->] (four) -- (three);
  \draw[->] (three) -- (two);
  \draw[->] (two) -- (one);
  \draw[->] (one) -- (B);
\end{tikzpicture}
```

```
<stepchart>
  <cell> A </cell>
  <cell> one </cell> <text> <m> +2 </m> </text>
</stepchart>
```
<cell> two </cell> <text> <m> +3 </m> </text>
<cell> three </cell> <text> <m> +4 </m> </text>
<cell> four </cell> <text> <m> +5 </m> </text>
<cell> five </cell>
</stepchart>

<steptable>
  <cell>
    <math xmlns="mathml">
      <apply> <eq/> <ci> c </ci>
        <apply> <plus/>
          <apply> <times/> <cn> 2 </cn> <ci> a </ci> </apply>
          <apply> <times/> <cn> 3 </cn> <ci> b </ci> </apply>
        </apply>
    </math>
  </cell> with
  <text> with </text>
  <cell>
    <math xmlns="mathml">
      <apply> <eq/> <ci> a </ci> <cn> 5 </cn> </apply>
    </math>
  </cell>
  <text> and </text>
  <cell>
    <math xmlns="mathml">
      <apply> <eq/> <ci> c </ci>
        <apply> <plus/> <cn> 10 </cn>
          <apply> <times/> <cn> 3 </cn> <ci> b </ci> </apply>
        </apply>
    </math>
  </cell> and
  <cell>
    <math xmlns="mathml">
      <apply> <eq/> <ci> b </ci> <cn> 6 </cn> </apply>
    </math>
  </cell>
</steptable>
\[ c = 2a + 3b \]
\[ c = 10 + 3b \]
\[ c = 10 + 18 \]
\[ c = 28 \]

with \( a = 5 \) and \( b = 6 \), we get
\[
\begin{align*}
\text{with } a &= 5 \\
\text{and } b &= 6 \\
\text{we get}
\end{align*}
\]

\[
\begin{align*}
c &= 2a + 3b \\
c &= 10 + 3b \\
c &= 10 + 18 = 28
\end{align*}
\]

\text{\textTeX{} example}

\begin{verbatim}
\startSTEPchart
\cells {A} {B}
\cells {one} {five or more} \texts{+2}{-2}
\cells {two} {four} \texts{+3}{-3}
\cells {three} {three} \texts{+4}{-4}
\cells {four} {two} \texts{+5}{-5}
\cells {five or more} {one}
\stopSTEPchart
\end{verbatim}
\cell {A} \\
\cell {one} \text{+2} \text{+3} \text{+4} \text{+5} \\
\cell {two} \\
\cell {three} \\
\cell {four} \\
\cell {five or more} \\
\stopSTEPchart

\startSTEPchart

\cells {A} {B} \\
\cells {one} {five or more} \text{+2} \\
\cells {two} {four} \text{-3} \\
\cells {three} {three} \text{+4} \\
\cells {four} {two} \text{-5} \\
\cells {five or more} {one} \\
\stopSTEPchart

\startSTEPchart

\cell {A} \\
\cell {one} \text{+2} \\
\cell {two} \\
\cell {three} \\
\cell {four} \\
\cell {five or more} \\
\stopSTEPchart

Steps 11
Steps 12

\startSTEPchart
\cell {A}
\cell {one} \text{+2} \text{+3}
\cell {two}
\cell {three} \text{+4} \text{+5}
\cell {four}
\cell {five}
\stopSTEPchart

+2 +3 +4 +5

A one two three four five

\startSTEPchart
\cell {A}
\cell {one} \text{+2}
\cell {two} \text{+3}
\cell {three} \text{+4}
\cell {four} \text{+5}
\cell {five}
\stopSTEPchart

+3 +5

A one two three four five

\startSTEPchart
\cell {A}
\cell {one} \text{+2}
\cell {two} \text{+3}
\cell {three} \text{+4}
\cell {four} \text{+5}
\cell {five}
\stopSTEPchart
\begin{STEPtable}
\begin{tabular}{|c|}
  \hline
  $c=2a+3b$
  \\
  \hline
  $c=10+3b$
  \\
  \hline
  $c=10+18$
  \\
  \hline
  $c=28$
  \\
  \hline
\end{tabular}
\end{STEPtable}

\text{with $a=5$ and $b=6$ we get}
\begin{STEPalignatable}
\begin{alignat*}{2}
  c &= 2a + 3b \\
  c &= 10 + 3b \\
  c &= 10 + 18 \\
  c &= 28
\end{alignat*}
\end{STEPalignatable}
\[ 2c = 2a + 3b \]

with \( a = 5 \) and \( b = 6 \) we get

\[ 2c = 10 + 3b \]

we get

\[ 2c = 10 + 18 \]

and therefore

\[ 2c = 28 \]

which reduces to

\[ c = 28/2 \]

\[ c = 14 \]

Configuring

The charts and tables can have their own spacing set. Quite certainly the distances between cells will differ.

\setupSTEPcharts \setupSTEPtables
after hook for commands to execute after the table
before hook for commands to execute before the table

Both charts and tables have common settings with respect to the cells, texts and lines.

\setupSTEPcells \setupSTEPtexts

alternative the kind of shape to be drawn
backgroundcolor the background color identified by name
rulethickness the width of frame around cells
framecolor the frame color identified by name
offset the space between content and frame
style a (preferable named) style
color the color of the content

\setupSTEPlines

alternative the kind of line to draw between cells
distance the distance between lines and text
offset the shift to the right of the start of the line
height the height of the (curved) line
rulethickness the width of the lines between cells
color the line color identified by name

In \TeX, some of the settings, like style and color can be set between elements.
In XML, the settings are passed as processing instructions.

\startSTEPchart
\cell {A}
\cell {one} \text{+2}
\cell {two} \text{+3}
\start
  \setupSTEPcells[color=darkred,style=bold]
  \cell {three} \text{+4}
  \cell {four} \text{+5}
\stop
\cell {five}
\stopSTEPchart
There are a couple of alternative shapes available. The most relevant ones are:

Although it is not too wise to set up the layout in the middle of a document, for graphics one can seldom get by some local fine-tuning. Here we encounter a rather fundamental difference between \TeX and XML. In \TeX, you can easily change settings on a temporary basis by using groups. In XML on the other hand, settings are bound to a category. So, in \TeX you can do this:

\begin{verbatim}
\setupSTEPcells
   [important]
   [color=darkgreen,
      style=bold]
\startSTEPchart
\cell {A}
\cell {one} \text{+2}
\cell {two} \text{+3}
\cell [important] {three} \text{+4}
\cell [important] {four} \text{+5}
\cell {five}
\stopSTEPchart
\end{verbatim}

An XML example is:

\begin{verbatim}
\setupSTEPcells[demo-1][alternative=5]
\setupSTEPcells[demo-1][framecolor=darkred]
\setupSTEPtexts[demo-1][framecolor=darkgreen]
\setupSTEPlines[demo-1][alternative=4]
\setupSTEPtexts[demo-2][style=bold]
\end{verbatim}

This will be applied to:
<steptable class="demo-1">
    <cell> type 5 </cell>
    <text> type 6 </text>
    <cell> type 7 </cell>
    <text class="demo-2"> type 8 </text>
    <cell> type 9 </cell>
</steptable>

so that we get:

```
    type 5
    type 7
    type 9
```

You can also use processing instructions:

```
<stepchart>
    <cells> <top> some text 1 </top> <bot> some text 2 </bot> </cells>
    <?context-stepchart-directive text color darkred ?>
    <texts> <top> text 3 </top> <bot> text 4 </bot> </texts>
    <cells> <top> some text 5 </top> <bot> some text 6 </bot> </cells>
    <?context-stepchart-directive text color darkblue ?>
    <texts> <top> text 7t </top> </texts>
    <cells> <top> some text 8 </top> </cells>
</stepchart>
```
Some settings apply to the whole chart. In \TeX this is easy since we can group the whole chart including settings but in XML this is somewhat problematic. We can however fall back on basic \TeX commands but it’s probably better to use as category (class), like:

\setupSTEPtexts[demo-5][distance=3em]

So, the following works as expected:

<document>
  <?context-tex-directive start ?>
  <?context-stepchart-directive text distance 1em ?>
  <stepaligntable>
    <cells> <c1>a</c1> <c2>b</c2> <c3>c</c3> </cells>
    <text> test 1 </text>
    <cells> <c1>aa</c1> <c2>b</c2> <c3>ccc</c3> </cells>
  </stepaligntable>
  <?context-tex-directive stop ?>
  <stepaligntable>
    <cells> <c1>a</c1> <c2>b</c2> <c3>c</c3> </cells>
    <text> test 2 </text>
    <cells> <c1>aa</c1> <c2>b</c2> <c3>ccc</c3> </cells>
  </stepaligntable>
  <stepaligntable class="demo-5">
    <cells> <c1>a</c1> <c2>b</c2> <c3>c</c3> </cells>
  </stepaligntable>
</document>
<text> test 3 </text>
<cells> <c1>aa</c1> <c2>b</c2> <c3>ccc</c3> </cells>
</stepaligntable>

<document>
<?context-tex-directive start ?>
<?context-stepchart-directive cell dx 10ex ?>
<stepchart>
<cells> <top> from here </top> <bot> there </bot> </cells>
<texts> <top> to </top> <bot> to </bot> </texts>
<cells> <top> and here </top> <bot> there </bot> </cells>
</stepchart>
<?context-tex-directive stop ?>
</document>

<document>
<text>
<cells>
<top> from here </top>
<bot> there </bot>
<top> to </top>
<bot> to </bot>
<top> and here </top>
<bot> there </bot>
</cells>
</text>
</document>
<document>
  <stepchart>
    <cell> some cell </cell>
    <cell> another cell </cell> <text> a bit of text </text>
    <cell> third cell </cell> <text> more text </text>
    <cell> last cell </cell>
  </stepchart>
</document>
There is no additional documentation on this module.