A Visual Formula Editor for LibreOffice Math

- Presentation of a GSoC Project by Jonas Finnemann Jensen.
Presentation outline

• What is visual formula editing?
• How should the editor work?
  • Movement in lines
  • Consistent selections
  • Natural shortcuts
• Technical challenges
  • Caret positions
  • Caret movement
• Editing a formula
• Demonstration of the hack
• Future work
• The Google summer of code experience
• The End.

Warning: Contains boring technical details.
What is visual formula editing?

Visual formula editors:
- MathType
- Microsoft Office Word
- MathCad
- LyX
- TexMacs
- KFormula
...

**Definition 1:** A visual formula editor provides a WYSIWYG interface which doesn't require knowledge of the underlying format.

Is visual formula editors better?
- *My little sister says so, but she's not very smart... :)*
How should the editor work?

The formula below have three lines

\[ a \cdot b + \frac{c}{2} \]

**Definition 2:** A line consists of elements, and each elements may have sub lines.

The top-level line, with these elements:

\[ [a], [\cdot], [b], [+] \]

The numerator line, with this element:

\[ c \]

The denominator line, with this element:

\[ \frac{c}{2} \]

\[ 2 \]
Consider **right** movement from this position:

\[ a \cdot b + \frac{c}{2} \]

Movement to the **right** will select the next element in the line:

\[ a \cdot b + \frac{c}{2} \]

Further right movement, **moves into a subline** of the fraction:

\[ a \cdot b + \frac{c}{2} \]

Inside the subline right movement can continue:

\[ a \cdot b + \frac{c}{2} \]

At the end of the subline, right movement can continue in parent line:

\[ a \cdot b + \frac{c}{2} \]
Consistent selections

Definition 3: A selection is the elements between two caret positions in the same line.

Selections need to be consistent, imagine a selection like this.

Such a selection would be hard to understand. So we don't allow them!
Natural shortcuts

Slash '/' for fraction:
\[ \frac{c}{2} \]

Caret '^' for create superscripting:
\[ a^2 \]

Underscore '_' for subscripting:
\[ a_i \]

Asterisk '*' for cdot:
\[ a \cdot b \]

Enter-key for new lines or rows, depending on context:
\[ a \]
\[ b \]

Exclamation '!' mark for factorial:
\[ a! \]

(New toplevel line)

(New row in matrix)
The tree above draws this formula:

\[ a \cdot b + \frac{c}{2} \]

- What is caret position?
- How do we find the next caret position in any direction?
- How do we edit this?
The formula have these caret positions:

\[ |a \cdot b| + \left| \frac{c}{2} \right| \]

```c
struct SmCaretPos{
    /** Selected node */
    SmNode* pSelectedNode;
    /** Index within the selected node */
    int Index;
};
```
\sqrt{\text{Caret movement}}

```
struct SmCaretPosGraphEntry{
    /** Caret position */
    SmCaretPos CaretPos;
    /** Entry to the left visually */
    SmCaretPosGraphEntry* Left;
    /** Entry to the right visually */
    SmCaretPosGraphEntry* Right;
};
```
Editing a formula

- Select topmost node in line

\[ \sqrt{a \cdot b + c} = d \]

Diagram:
- SmBinHorNode
  - SmTextNode: a
  - SmMathSymbolNode: \cdot
  - SmTextNode: b
- SmBinVerNode
  - SmTextNode: c
  - SmRectangleNode
- SmExpressionNode
  - SmTableNode
  - SmLineNode

Top most node in line
Editing a formula

- Find the topmost node in line
- Select its parent
Editing a formula

- Find the topmost node in line
- Select its parent
- **Delete glue-nodes, while adding elements to a list**
Editing a formula

- Find the topmost node in line
- Select its parent
- Delete glue-nodes, while adding elements to a list
- **Edit the LineList (remove/add elements)**
Editing a formula

- Find the topmost node in line
- Select its parent
- Delete glue-nodes, while adding elements to a list
- Edit the LineList (remove/add elements)
- **Parse the LineList creating glue-nodes, and put it back into the tree**
- Rebuild the graph of caret positions from scratch
Demonstration
√ Future work

- Alignment and font commands are ignored and discarded during visual editing.
- Needs global clipboard integration.
- Undo/redo with "UndoManager" integration.
- The formula flickers due to lack of double buffering.
- The parser merges multiple blanks into large blank node.
- Better GUI for "Formula elements" needed.
- Method for inserting a column in a matrix is missing.
- Deletion of lines and sub-/superscripts should be possible.
- Some cleanup and other minor details...

- Lots of testing...
The Google summer of code experience

In my experience GSoC is a great way to:

- Get involved in something
- Gain some practical experience
- Get some guidance
- And do something useful...

Big thanks to my mentors Eric Bechard and Fridich Strba.
The End
- Feel free to interrupt with questions, if any...

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