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# √ A Visual Formula Editor for LibreOffice Math

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

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# √ 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:

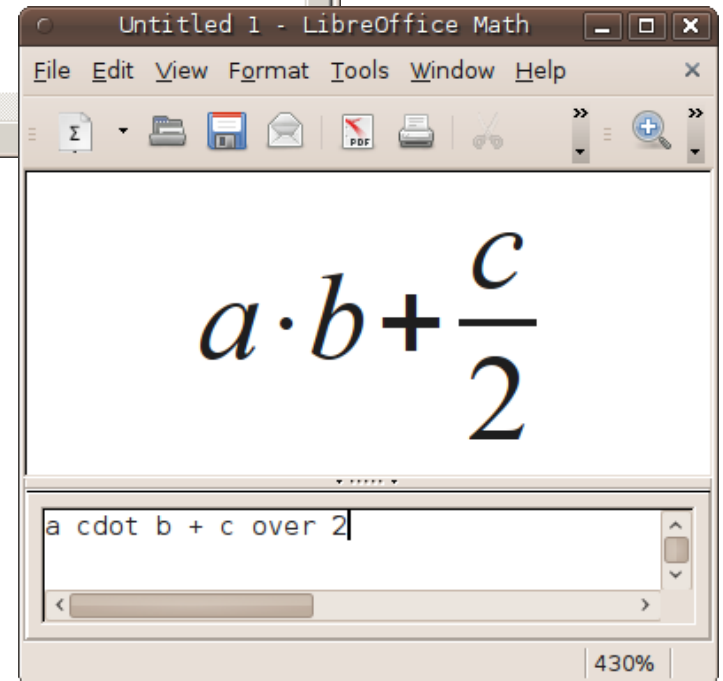
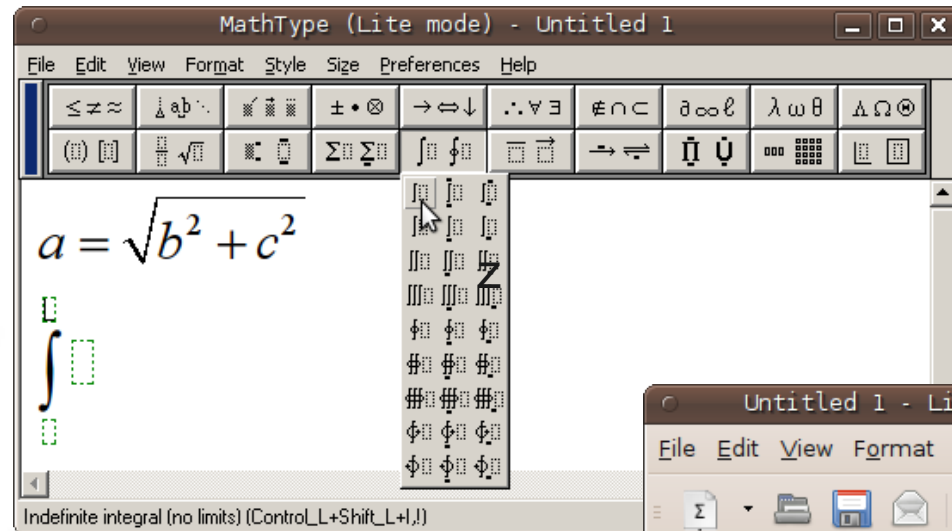
- MathType
- Microsoft Office Word
- MathCad
- LyX
- TexMacs
- KFormula

...

**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

$$a \cdot b + \frac{c}{2}$$

The top-level line, with these elements:

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

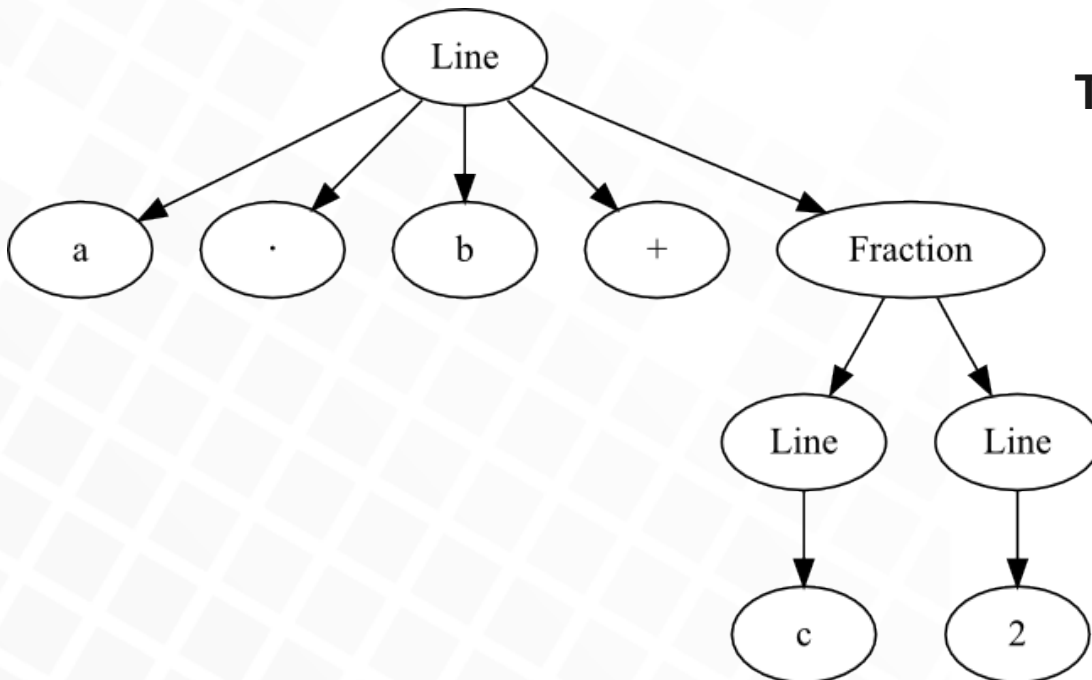
**Definition 2:** A line consists of elements, and each elements may have sub lines.

The numerator line, with this element:

$$[c]$$

The denominator line, with this element:

$$[2]$$



# √ Movement in lines

Consider **right** movement from this position:

$$a \cdot b \left| + \frac{c}{2} \right.$$

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

$$a \cdot b \left| + \left| \frac{c}{2} \right. \right.$$

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

$$a \cdot b + \left| \frac{c}{2} \right.$$

**Inside the subline** right movement can continue:

$$a \cdot b + \left| \frac{c}{2} \right.$$

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

$$a \cdot b + \frac{c}{2} \left| \right.$$

# √ Consistent selections

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

$$a \cdot b \left| + \right| \frac{c}{2} \rightarrow a \cdot b \left| + \right| \frac{c}{2}$$

$$a \cdot b \left| + \right| \frac{c}{2} \rightarrow a \cdot b \left| + \right| \frac{c}{2}$$

$$a \cdot b \left| + \right| \frac{c}{2} \rightarrow a \cdot b \left| + \right| \frac{c}{2}$$

$$a \cdot b + \left| \frac{c}{2} \right| \rightarrow a \cdot b + \left| \frac{c}{2} \right|$$

Selections needs to be **consistent**, imagine a selection like this.

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

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

# √ Natural shortcuts

Slash '/' for fraction:

$$\frac{c}{2}$$

(, { or [ for a pair of scalable brackets:

$$\left(\frac{c}{2}\right)$$

Enter-key for new lines or rows, depending on context:

$a$   
 $b$

(New toplevel line)

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

(New row in matrix)

Caret '^' for create superscripting:

$$a^2$$

Underscore '\_' for subscripting:

$$a_i$$

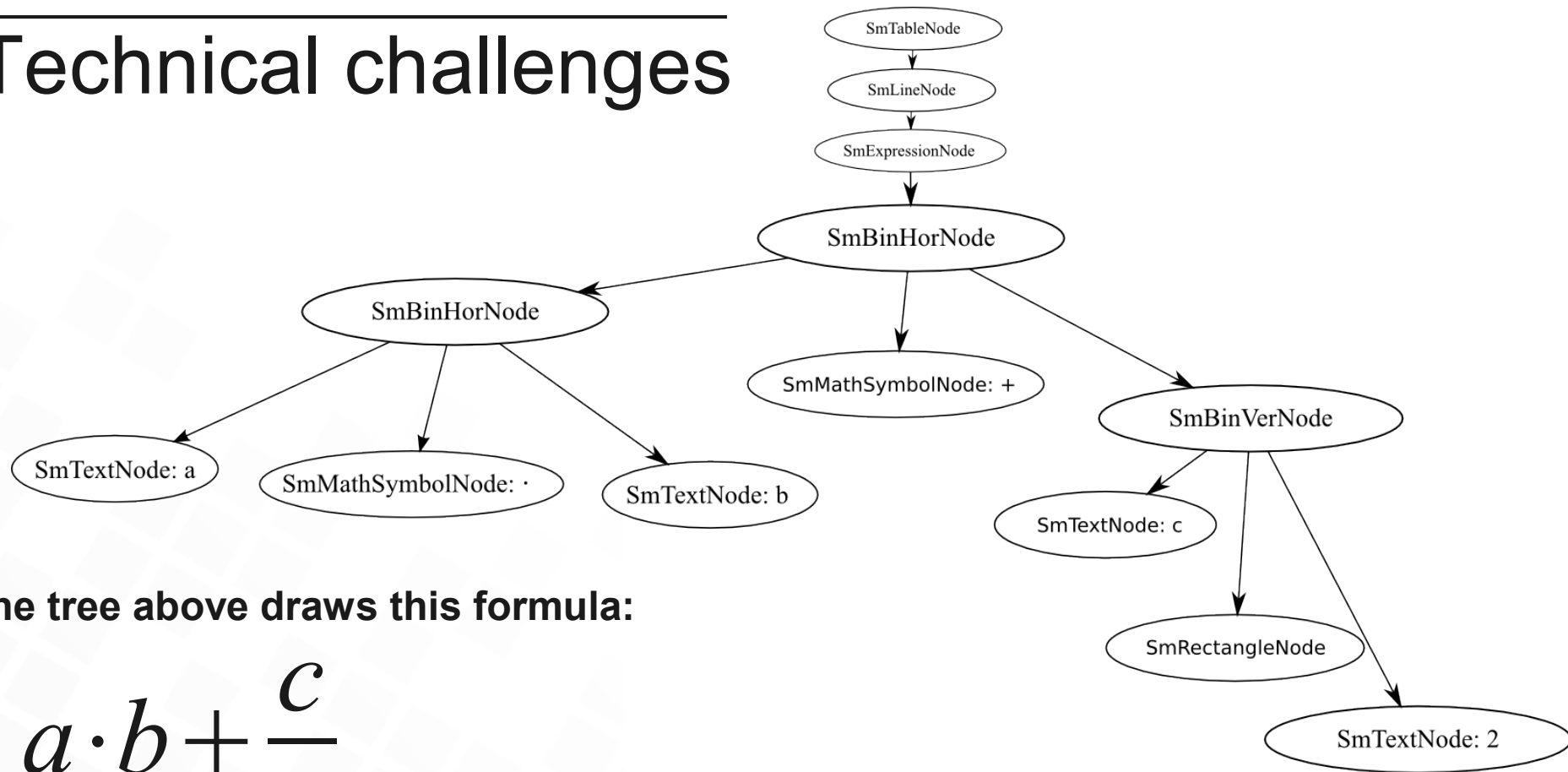
Asterisk '\*' for cdot:

$$a \cdot b$$

Exclamation '!' mark for factorial:

$$a!$$

# √ Technical challenges



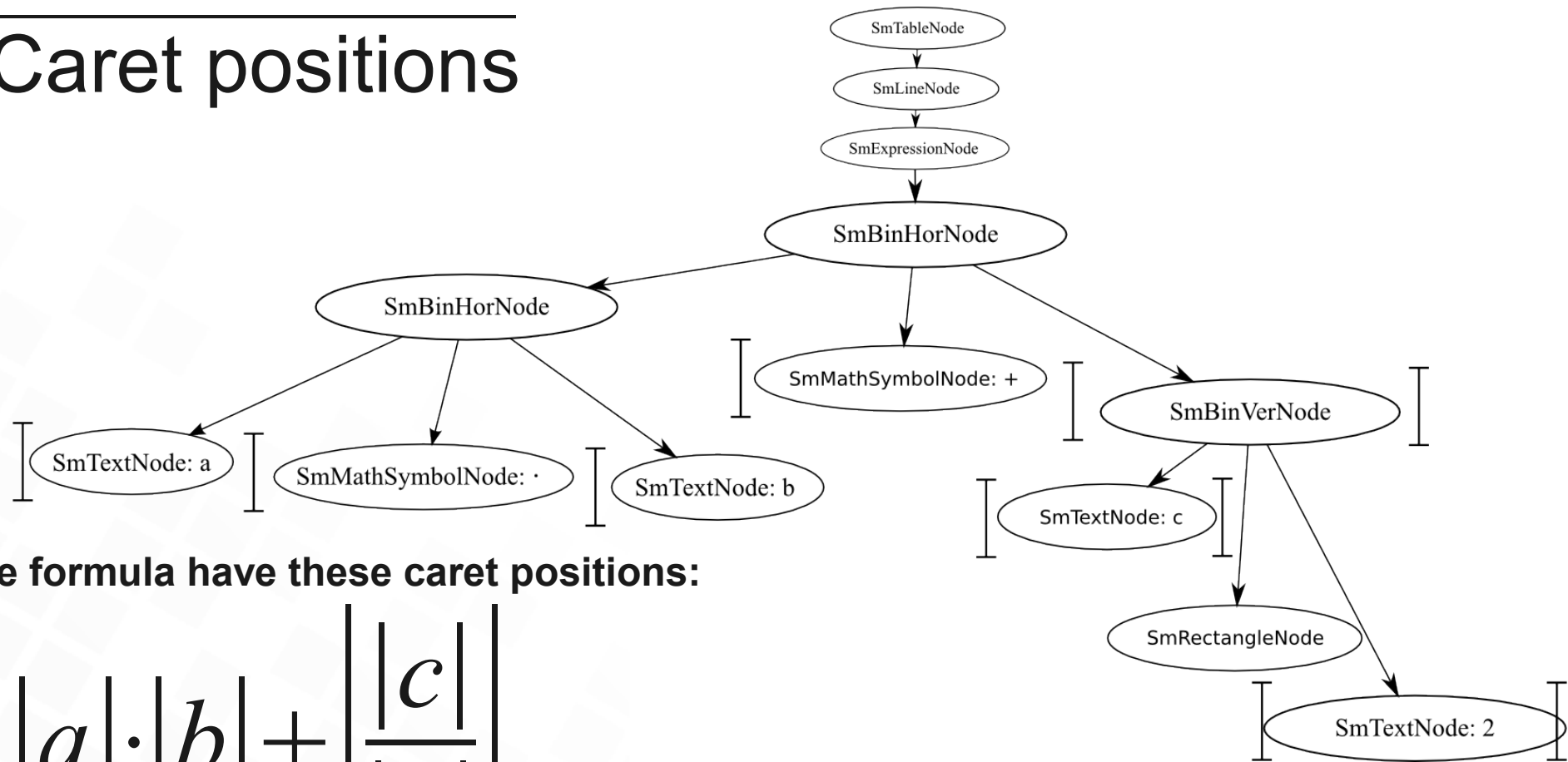
The tree above draws this formula:

$$a \cdot b + \frac{c}{2}$$

- What is caret position?
- How do we find the next caret position in any direction?
- How do we edit this?



# √Caret positions

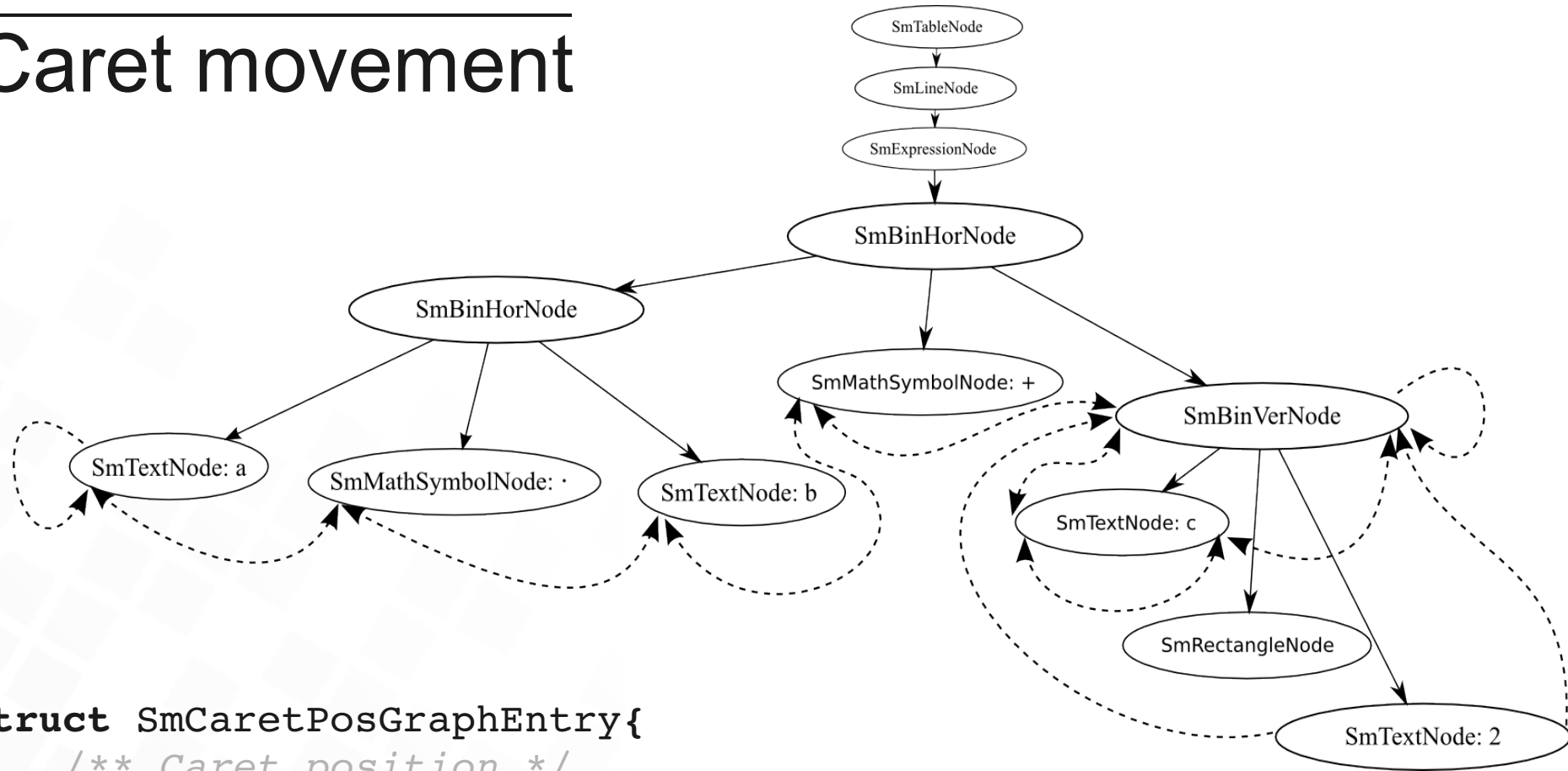


The formula have these caret positions:

$$|a| \cdot |b| + \frac{|c|}{|2|}$$

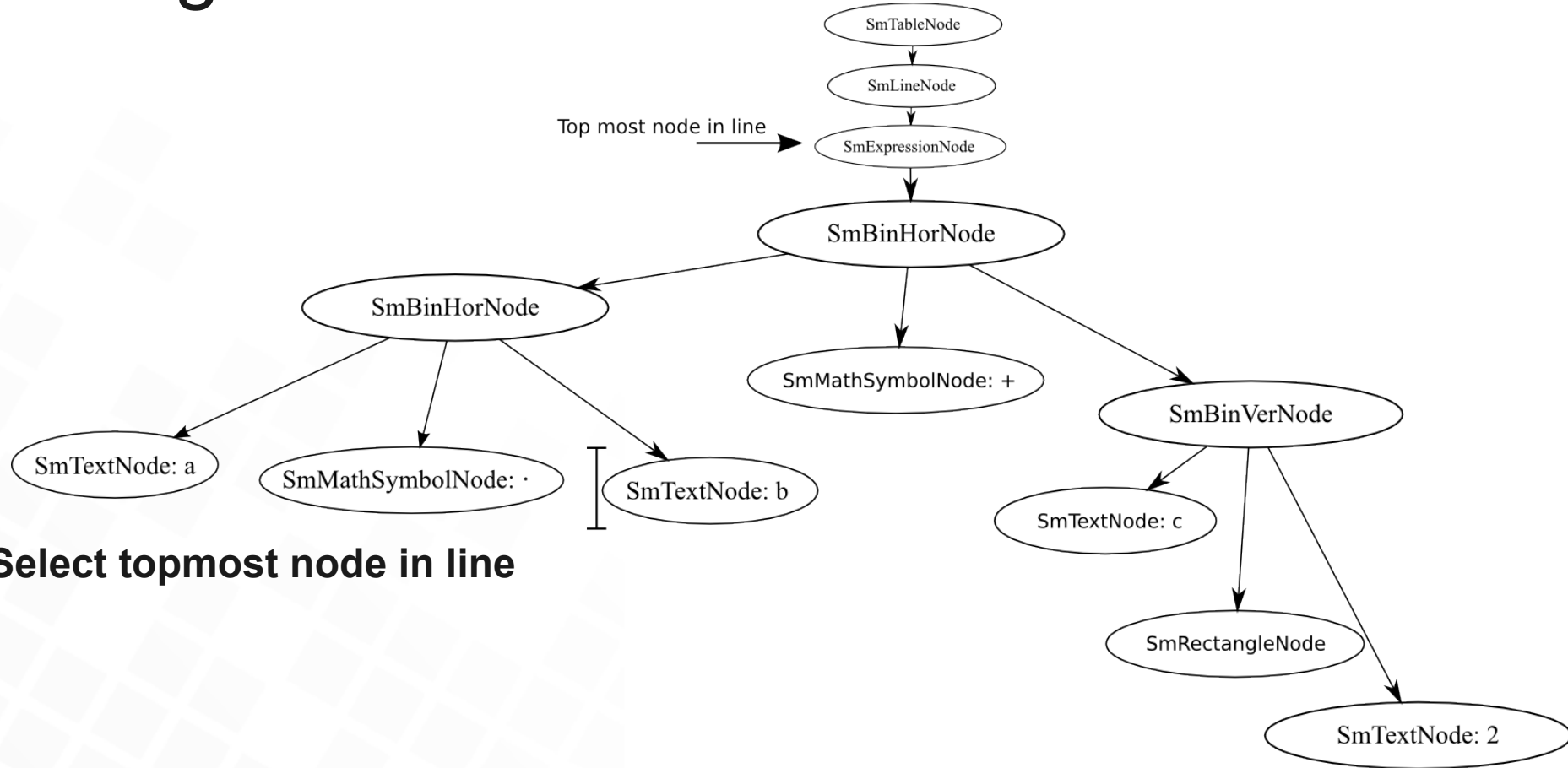
```
struct SmCaretPos{  
    /** Selected node */  
    SmNode* pSelectedNode;  
    /** Index within the selected node */  
    int Index;  
};
```

# √Caret movement

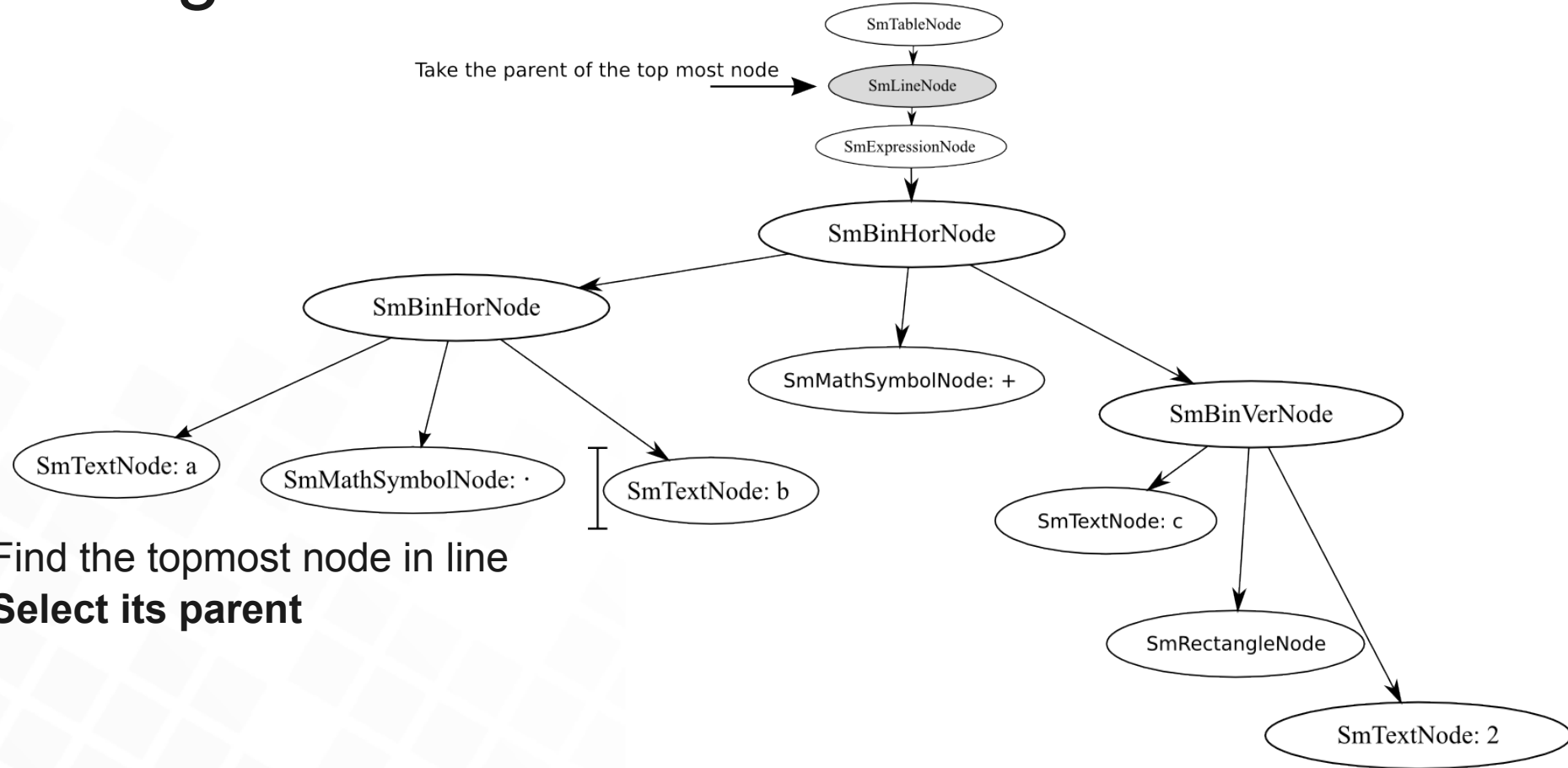


```
struct SmCaretPosGraphEntry{  
    /** Caret position */  
    SmCaretPos CaretPos;  
    /** Entry to the left visually */  
    SmCaretPosGraphEntry* Left;  
    /** Entry to the right visually */  
    SmCaretPosGraphEntry* Right;  
};
```

# √ Editing a formula

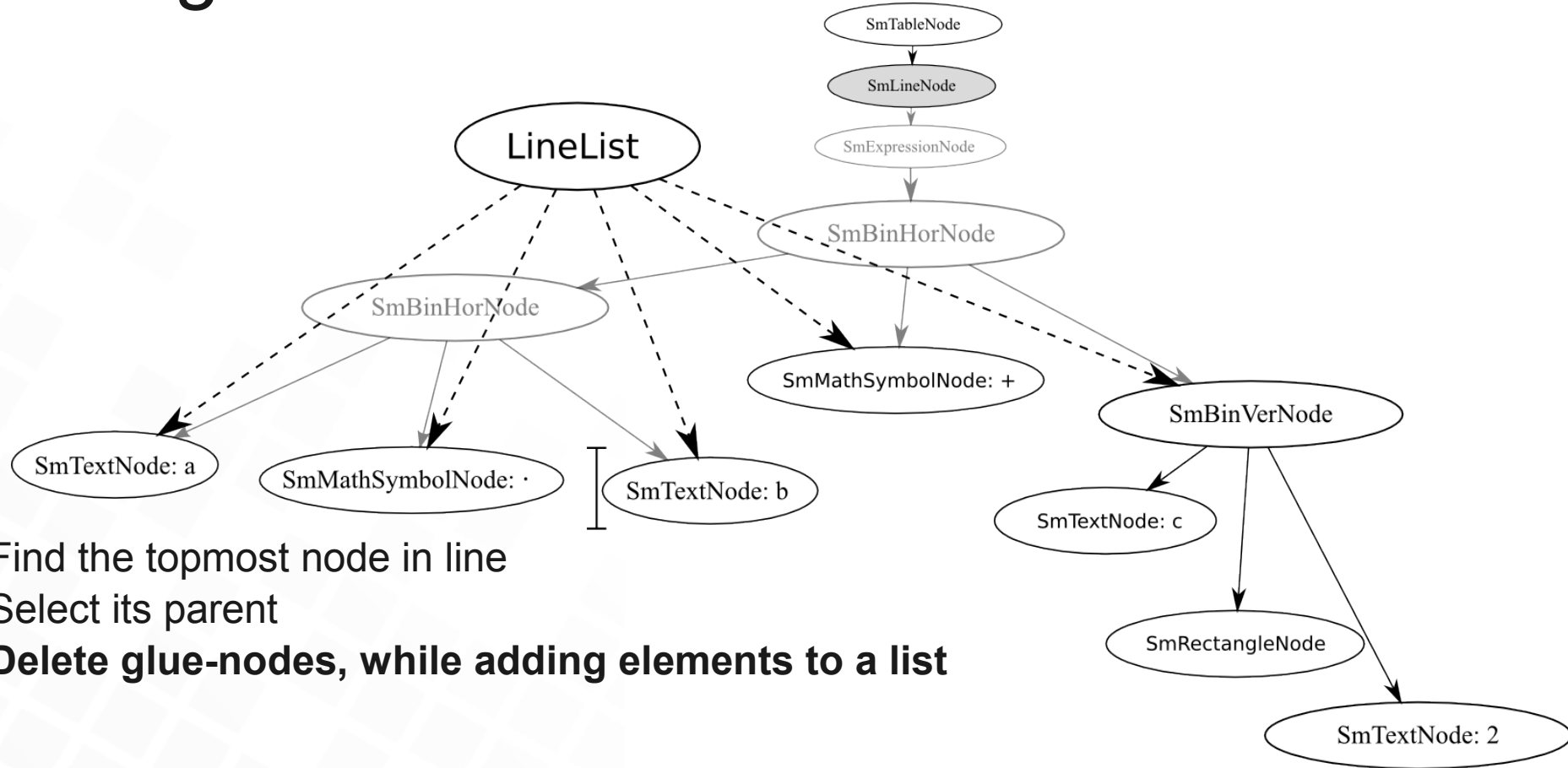


# √ Editing a formula



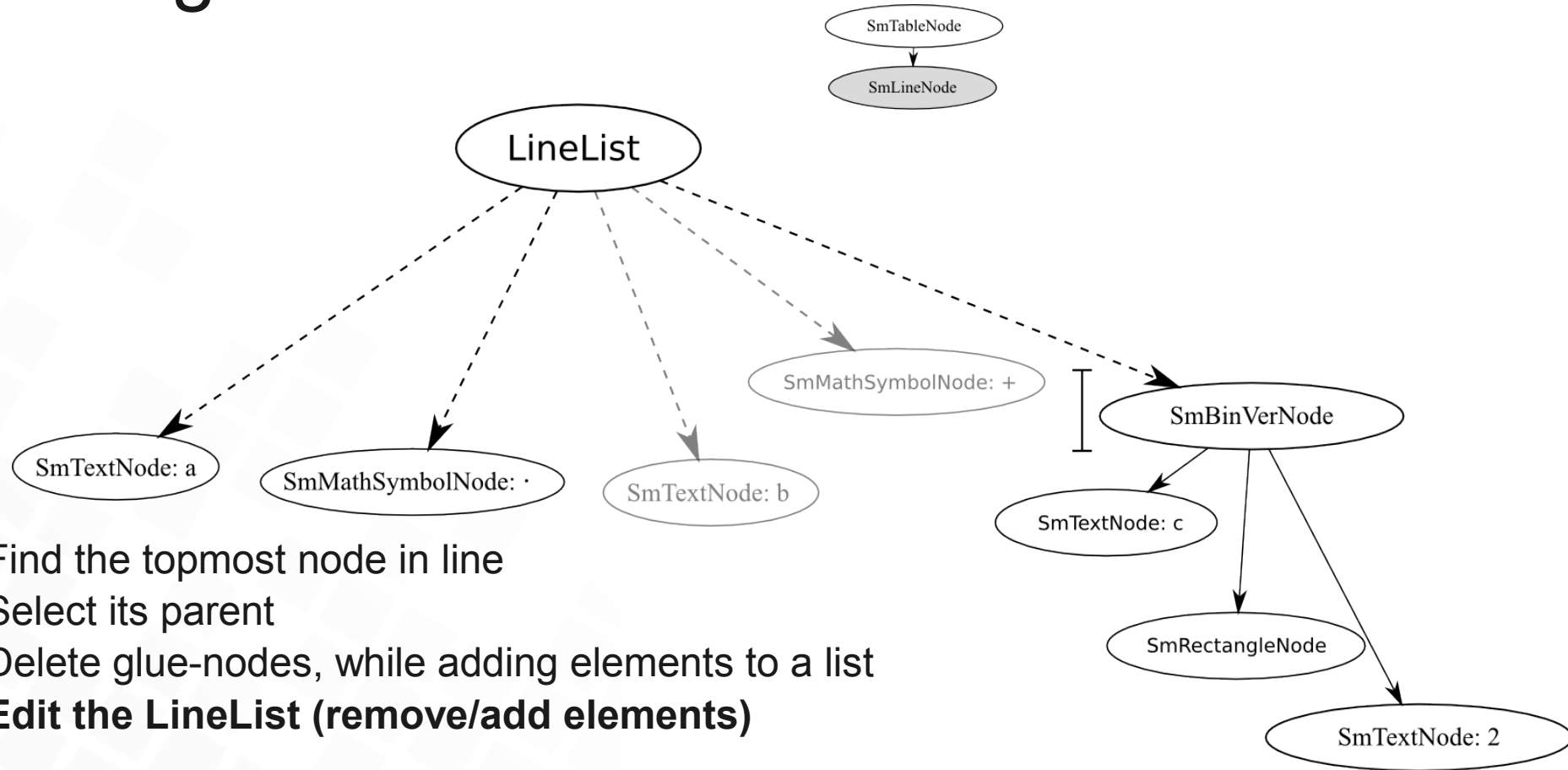
- Find the topmost node in line
- **Select its parent**

# √ Editing a formula

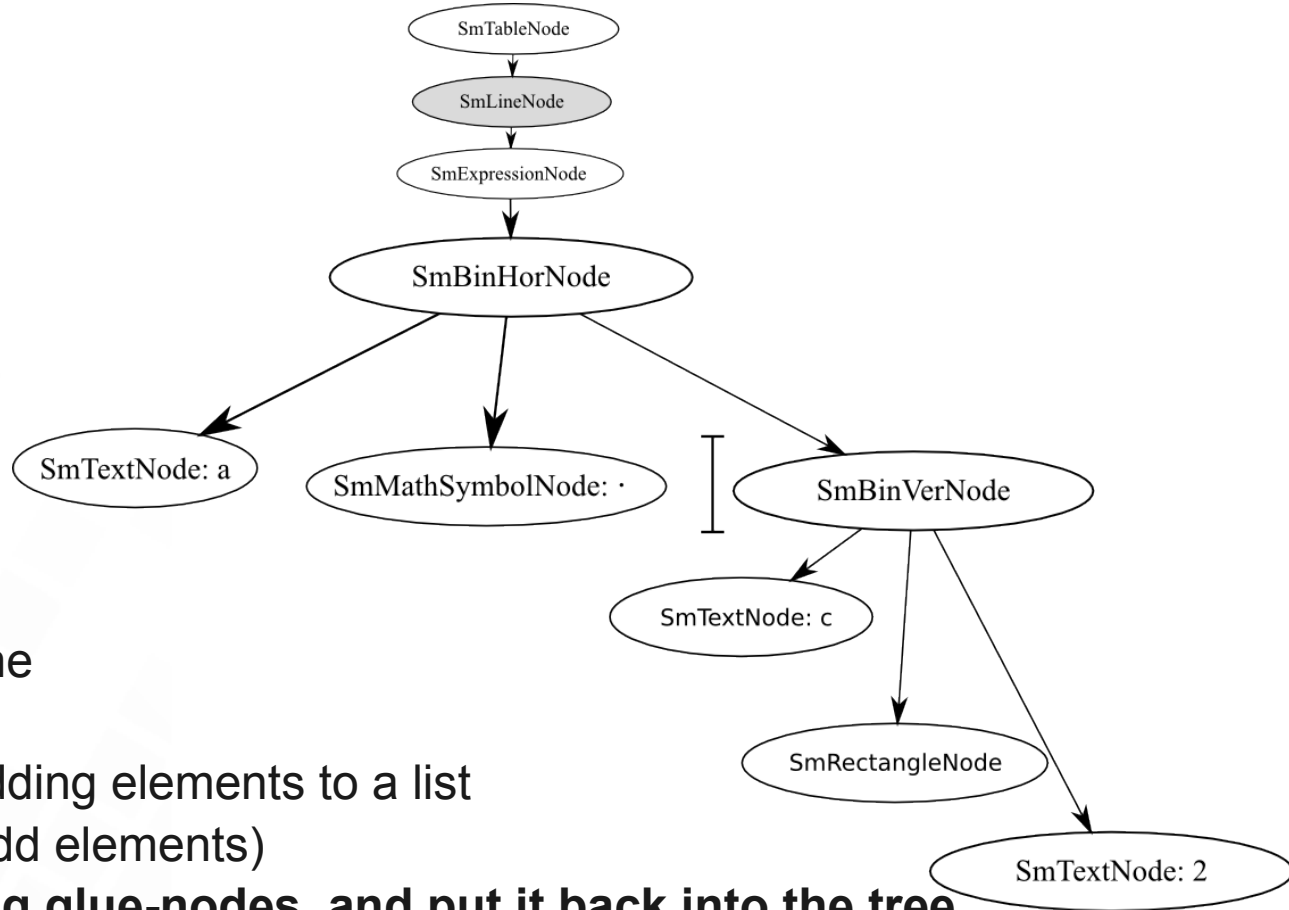


- Find the topmost node in line
- Select its parent
- **Delete glue-nodes, while adding elements to a list**

# √ Editing a formula



# √ 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

# $\sqrt{\hspace{1.5cm}}$ Demonstration





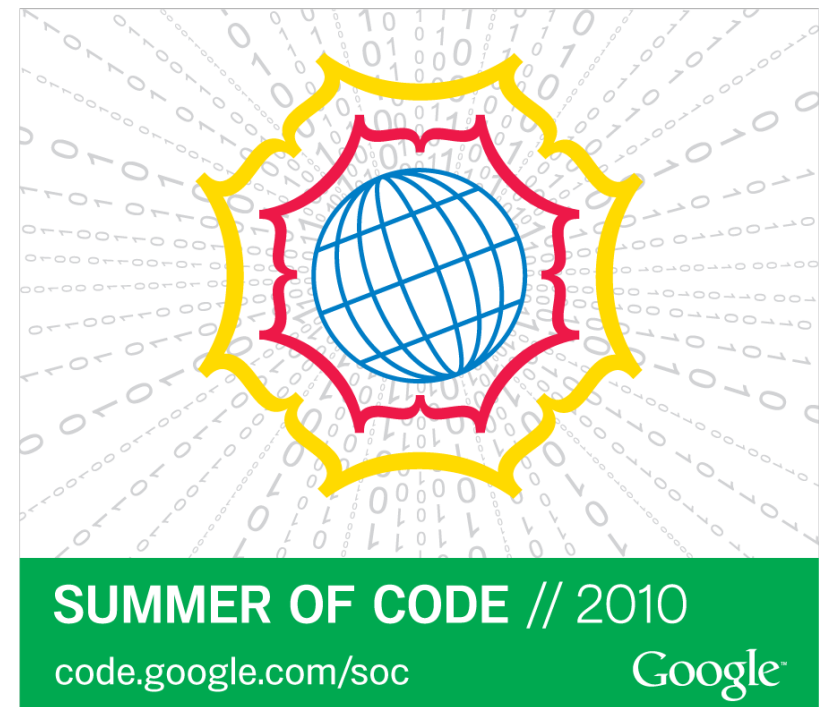
# √ Future work

- **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 [Fridrich Strba](#).

# √ The End

*- Feel free to interrupt with questions, if any...*

```
...  
return 0;
```

```
}
```

