

Direct-manipulation editors for math

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Outline

- introduction
- behavior examples
- (mis)behavior summary
- back to text
- proposals
- final remarks

How it all started

We wanted to

- design a direct-manipulation editor for structured content (math)

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We ended up

- studying the behavior of existing editors
 - inserting
 - deleting
 - selecting
 - navigating

Tested software

1. **Amaya** version 8.2 <http://www.w3.org/Amaya/>
2. **FrameMaker** by Adobe, version 7
<http://www.adobe.com/products/framemaker/main.html>
3. **MathType** by Design Science, version 5.2
<http://www.mathtype.com/en/products/mathtype/>.
4. **Scientific WorkPlace** by MacKichan Software, version 5
<http://www.mackichan.com/products/swp.html>
5. **LyX** version 1.3.4 <http://www.lyx.org/>.
6. **Mathematica** by Wolfram, version 5.
<http://www.wolfram.com/products/mathematica/index.html>
7. **T_EXmacs** version 1.0.1.23 <http://www.texmacs.org/>

Model-based editors

- **structured** document model vs **flat** document model
- **well-formed** document: typed nodes
- **slots** represent missing parts
- **node** and **index** identify the **edit point**
- editing operations **rearrange** the document model

Direct-manipulation

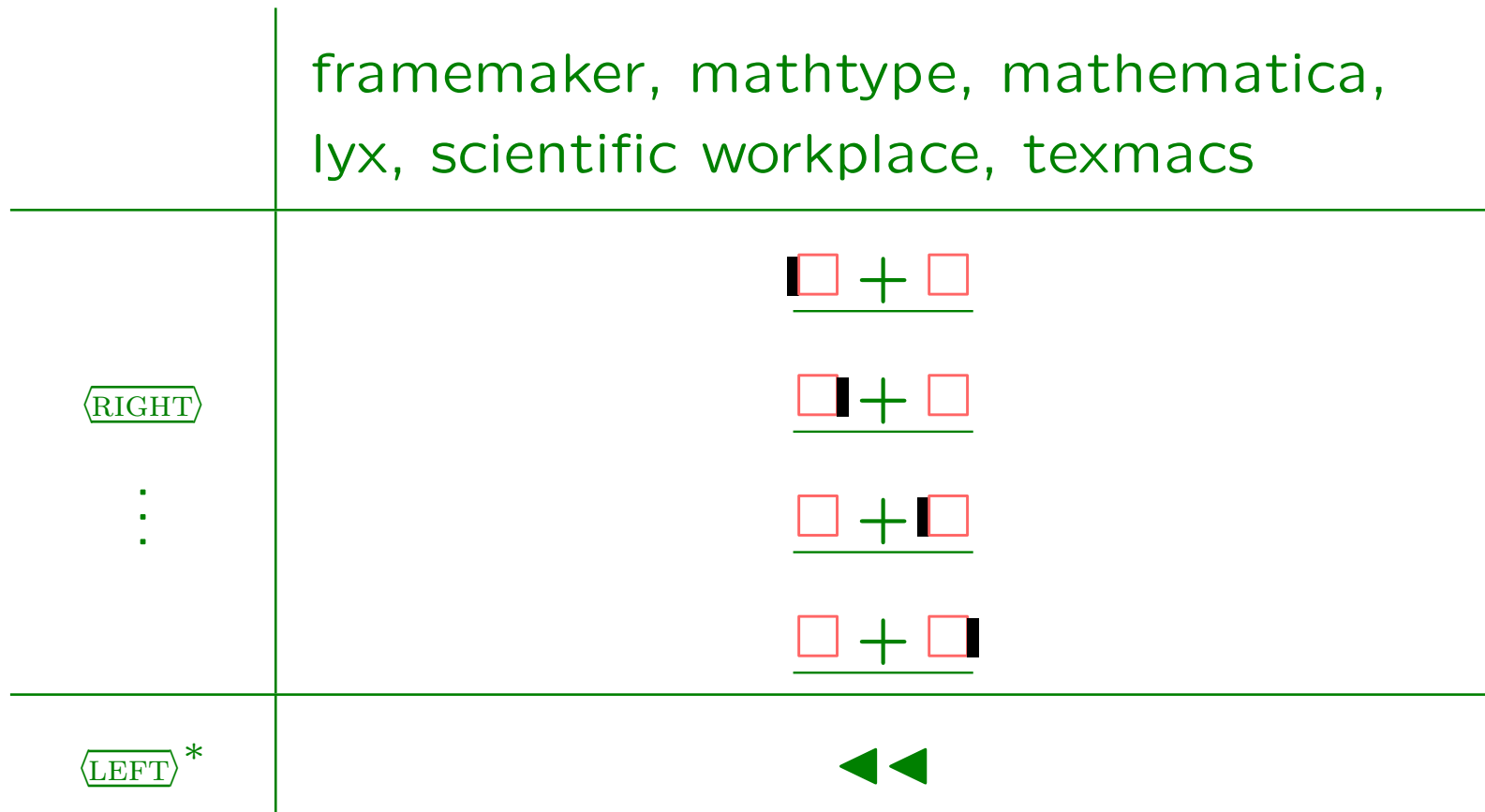
- the document model is presented as **mathematical notation** in a view
- **gap** between the information in the model and the information displayed
- various ways to present slots: \square , $?$, ...
- **focus** and **caret (cursor)** present the edit point:

$\square + \underline{\square} \square$

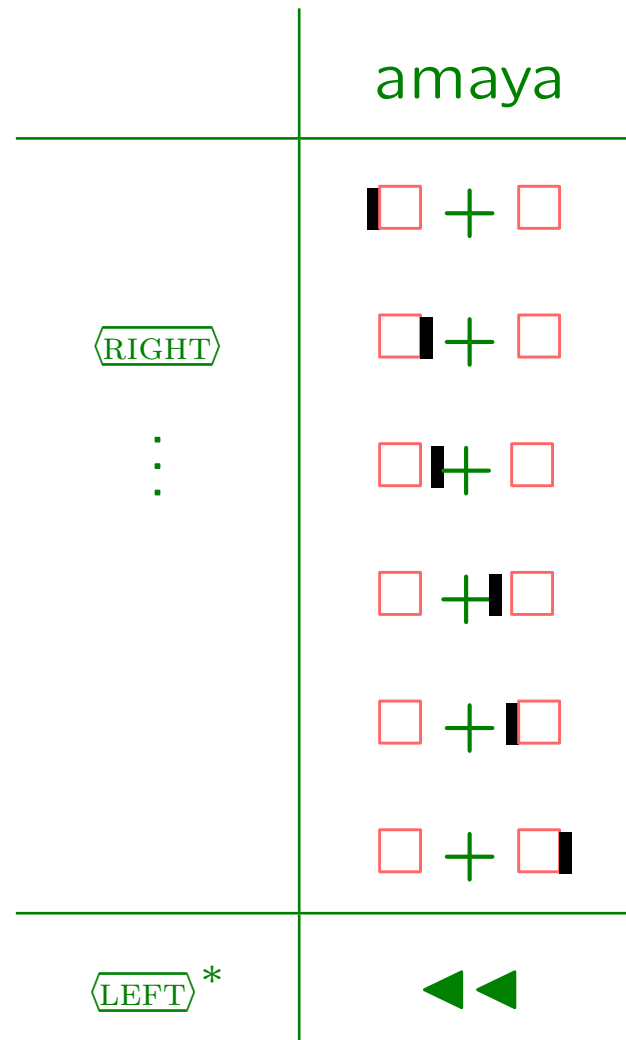
let's try them...

A promising start. . .

framemaker, mathtype, mathematica,
lyx, scientific workplace, texmacs



... except for...



Scripts

	amaya, mathematica	framemaker		lyx	mathtype	scientific workplace	texmacs
<div style="border: 1px solid green; padding: 2px; display: inline-block;">RIGHT</div> ⋮							
<div style="border: 1px solid green; padding: 2px; display: inline-block;">LEFT*</div>							

Fractions

	amaya, mathematica	framemaker	lyx	mathtype	scientific workplace	texmacs
<div style="border: 1px solid black; padding: 2px; display: inline-block;">RIGHT</div> ⋮						
<div style="border: 1px solid black; padding: 2px; display: inline-block;">LEFT</div> ⋮						

Roots

	amaya	framemaker	lyx, texmacs	mathematica	mathtype	scientific workplace
RIGHT						
⋮						
⋮						
⋮						
⋮						
⋮						
LEFT						
⋮						
⋮						
⋮						

Navigating slots

Usually with the  key, not always.

- cycling **all** the slots
- cycling **some** slots
- moving to the **next** slot
- cycling the **children** of the node
- doing nothing

One or **two** edit points per slot?

Editing











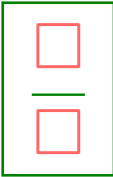
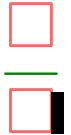



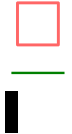
- inserting always works at the bottom level (model leaves)
- constrained vs unconstrained
- templates

$$\square_1 + \blacksquare \Rightarrow \square_1 + \frac{\square_2}{\square_3}$$

- overlays

$$\square_1 + \underline{\square_2} \blacksquare \Rightarrow \square_1 + \frac{\square_2}{\square_3}$$

Deleting

	amaya	framemaker	lyx	mathematica	math	typetex	macs
							
BKSP							
BKSP							

Identified issues

- exposed model
- mixed behaviors: model-oriented, geometric
- wrong feedback level: insufficient for unpredictable behaviors, overwhelming when not informative
- lack of reversibility
- unpredictable behaviors
- lack of dedicated views

(almost) plain text

Why should we take it as a good example?

- convergence
- structure
- context (math occurs within text, and sometimes text occurs within math)

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- **structure**
- **context** (math occurs within text, and sometimes text occurs within math)

Summary of plain text editors:

- **atomic** basic actions (movement, deletion, insertion)
- **geometric, unconstrained** operations (movement, selection) on the default view
- **reversible, predictable** behaviors

(almost) plain text: exceptions

- **boundary actions:** use common sense (and the model)

There is a silence where hath been no sound,

There is a silence where no sound may be,█

█In the cold grave -- under the deep, deep sea,

- **edit point clashing:** be deterministic

There is a █silence where hath been no sound,

There is a silence where no sound may be,

In the cold grave -- under the deep, deep sea,

- **impossible moves:** be reversible

There is a silence where hath been no sound,█

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In the cold grave -- under the deep, deep sea,█

Proposal

Edit points:

- give useful feedback depending on the view
- no less, no more

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Slots:

- make them **visible**
- make them **easily accessible**
- implement restricted forms of **model navigation** in the default view (`itexmac`)
- allow customization of **visit order**

Proposal

Geometric navigation:

- move the caret to the geometrically **closest** edit point
- move along the **leaves** of the model
- be **predictable** (and thus **reversible**)
- make the movement worth the action

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Model navigation:

- provide a dedicated view
- provide appropriate operations only

Concluding remarks

- qualitative evaluation: plenty of room for improvement
- qualitative evaluation: no winner
- one more reason why WYSIWYG is not popular?
- lack of bibliography

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What next?

- collaboration with AbiWord team
- quantitative evaluation