

Authoring of Semantic Mathematical Content for Learning on the Web



**Vortrag zur Dissertationsprüfung,
Universität des Saarlandes, 30. Juli 2012**

**Paul Libbrecht
paul@hoplahup.net**

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Outline

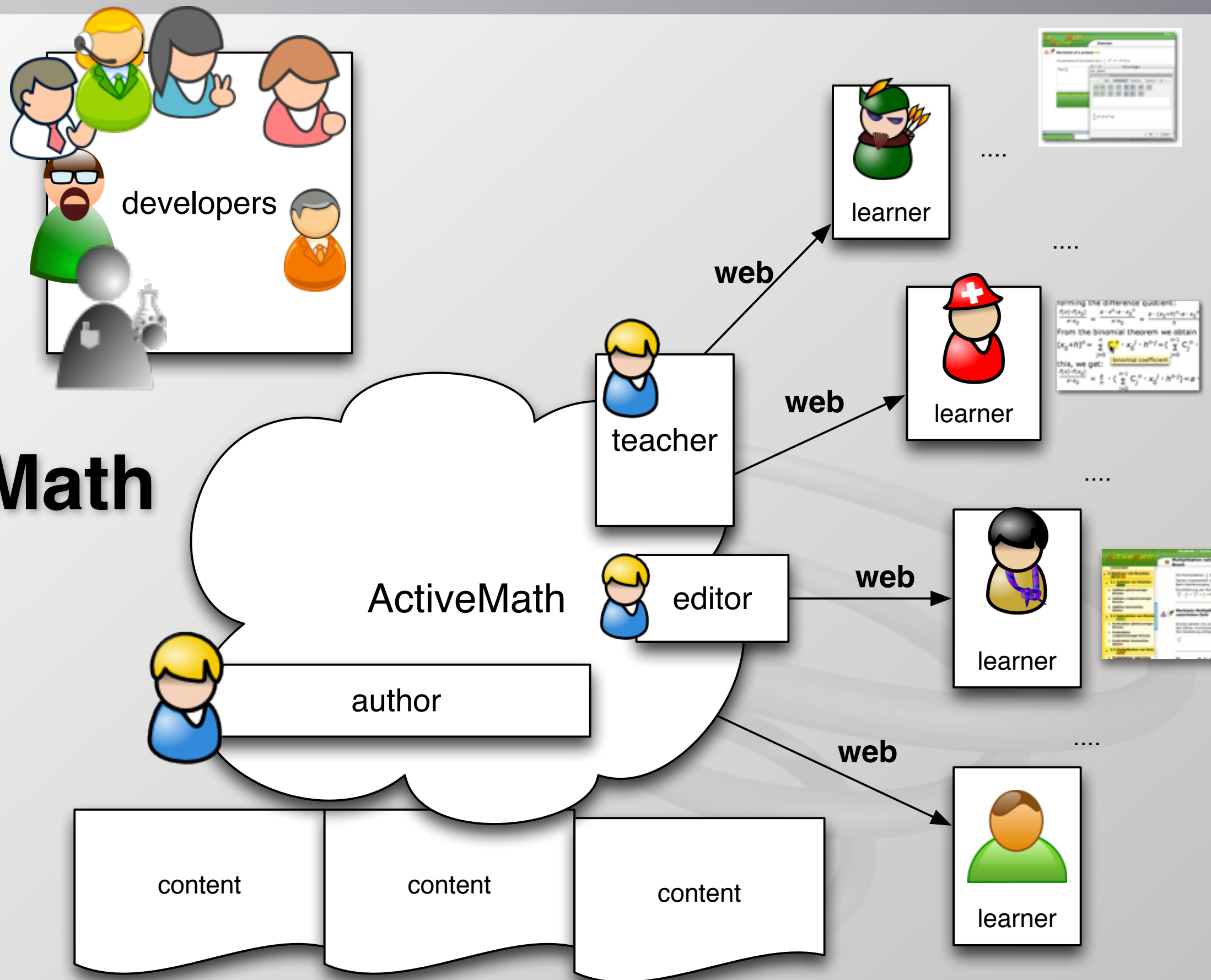
- mission: authoring for ActiveMath
- related work
- my contribution
 - WYCIWYG
 - facilitating the input
 - storage & search
 - case studies
- summary
- future work

Outline

- **mission: authoring for ActiveMath**
- related work
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The Mission

Roles in ActiveMath



Role in Act

From the binomial theorem we obtain

$$(x_2 + h)^n = \sum_{j=0}^n \binom{n}{j} x_2^j h^{n-j} = \sum_{j=0}^{n-1} \binom{n-1}{j} x_2^j h + \dots$$

this, we get:

$$\frac{f(x_2 + h) - f(x_2)}{h} = \frac{1}{h} \cdot \left(\sum_{j=0}^{n-1} \binom{n-1}{j} x_2^j h^{n-j} \right) = \dots$$

The Mission



Roles in ActiveM

forming the difference quotient:

$$\frac{f(x)-f(x_0)}{x-x_0} = \frac{a \cdot x^n - a \cdot x_0^n}{x-x_0} = \frac{a \cdot (x_0+h)^n - a \cdot x_0^n}{h}$$

From the binomial theorem we obtain

$$(x_0+h)^n = \sum_{j=0}^n C_j^n \cdot x_0^j \cdot h^{n-j} = \left(\sum_{j=0}^{n-1} C_j^n \cdot \right.$$

binomial coefficient

this, we get:

$$\frac{f(x)-f(x_0)}{x-x_0} = \frac{a}{h} \cdot \left(\sum_{j=0}^{n-1} C_j^n \cdot x_0^j \cdot h^{n-j} \right) = a \cdot$$

The Mission



ActiveMath

Hauptseite | Suchen | Notizen | Mein Profil | Werkzeuge | Drucken | Abmelden | Hilfe

Multiplikation natürlicher Zahlen mit einem Bruch 22/54

umwandeln

2 Rechnen mit Brüchen

2.1 Addition von Brüchen

2.2 Subtraktion von Brüchen

2.3 Multiplikation von Brüchen

Multiplikation natürlicher

Die Multiplikation $\frac{2}{3} \cdot 6$ ergibt einen Scheinbruch von $\frac{12}{3}$, der in 4 Ganze umgewandelt wird .
Beim Rechenvorgang $\frac{2}{3} \cdot 6$ besteht die Möglichkeit, vor der Durchführung der Multiplikation zu kürzen .

$$\frac{2 \cdot 6}{3} : \frac{3}{3} = \frac{2 \cdot 2}{1} = \frac{4}{1} = 4$$

Merksatz Multiplikation von Brüchen mit einer natürlichen Zahl

Brüche werden mit einer natürlichen Zahl multipliziert, indem man den Zähler multipliziert und den Nenner unverändert lässt .
Die Darstellung erfolgt auf dem Bruchstrich :

$$\frac{1 \cdot 3}{4}$$

finding the difference quotient:

$$\frac{f(x) - f(x_0)}{x - x_0} = \frac{a \cdot x^n + b \cdot x^{n-1} + \dots + c - (a \cdot x_0^n + b \cdot x_0^{n-1} + \dots + c)}{x - x_0}$$

From the binomial theorem we obtain

$$(x_0 + h)^n = \sum_{j=0}^n \binom{n}{j} x_0^{n-j} h^j = \left(\sum_{j=0}^{n-1} \binom{n}{j} x_0^{n-j} h^j \right) + x_0^n$$

this, we get:

$$\frac{f(x) - f(x_0)}{x - x_0} = \frac{a \cdot \left(\sum_{j=0}^{n-1} \binom{n}{j} x_0^{n-j} h^j \right) + b \cdot \left(\sum_{j=0}^{n-1} \binom{n}{j} x_0^{n-j} h^j \right) + \dots + c - (a \cdot x_0^n + b \cdot x_0^{n-1} + \dots + c)}{h}$$

learner

ActiveMath Content



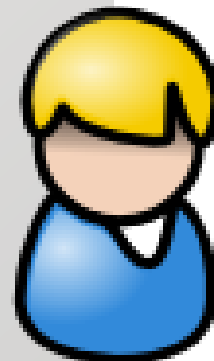
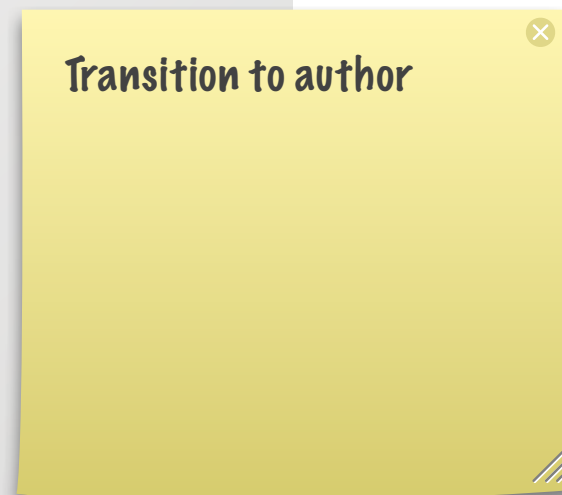
Transition to author

The Mission

ActiveMath Content



a set of items

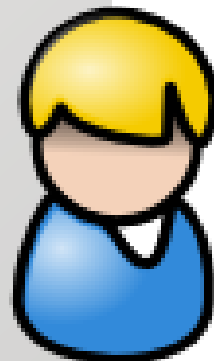
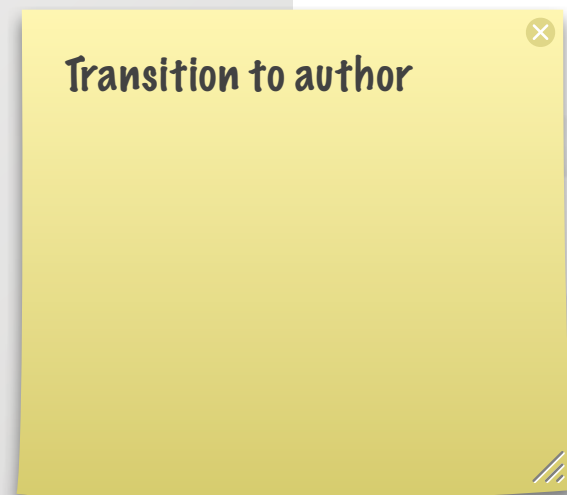


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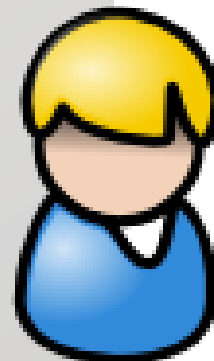
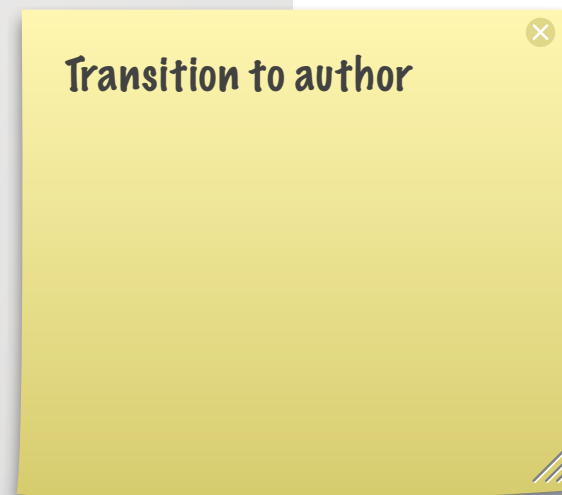


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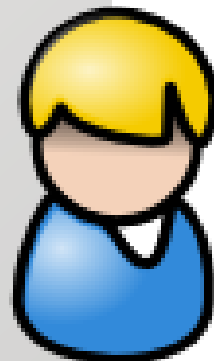
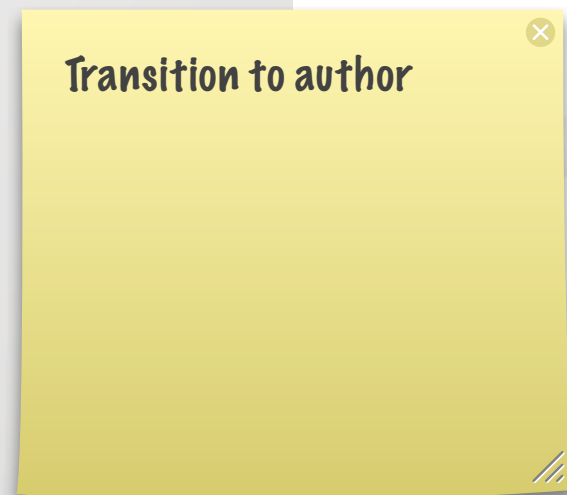


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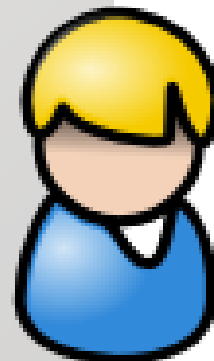
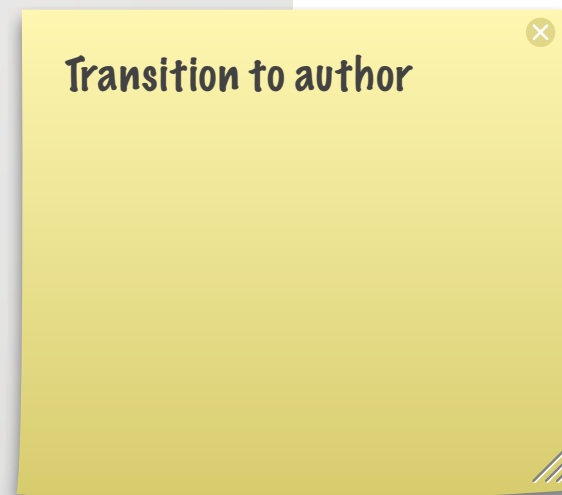


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ActiveMath Content



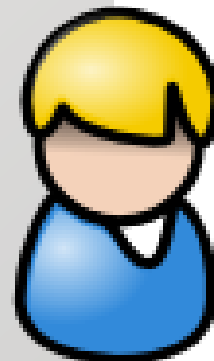
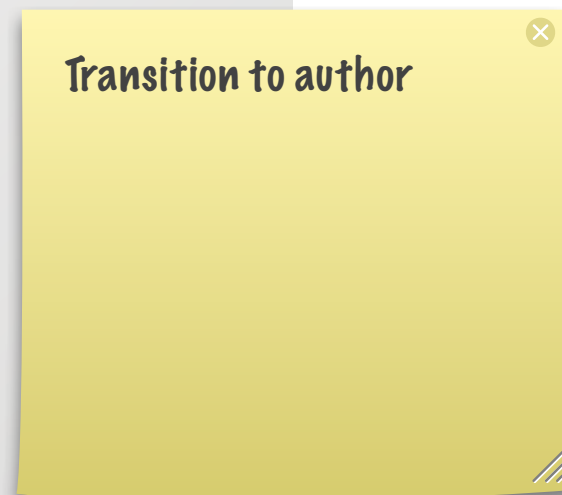
a set of items



ActiveMath Content



a set of items



The Mission

ActiveMath Content



a set of items

```
<example id="ex1_ab_group"
```

```
<CMP>
```

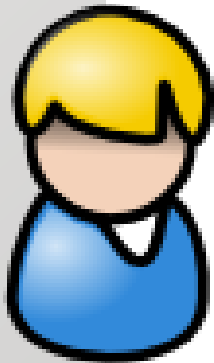
Z
R

are all examples for
but also e.g., the set of all maps
since these maps can be added and su

Transition to author

, , , and are all examples for abelian groups ,
 , , and

with text,



ActiveMath Content

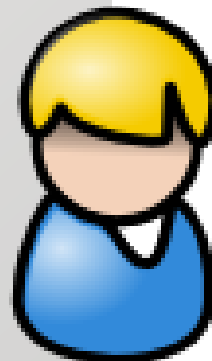


a set of items

Transition to author

$\mathbb{Z}$, $\mathbb{Q}$, $\mathbb{R}$, and $\mathbb{C}$ are all examples for abelian groups ,
 $(f + g)(x) = f(x) + g(x)$, $(f - g)(x) = f(x) - g(x)$, and

with text,
with formulæ



```
<example id="ex1_ab_group"
```

```
<CMP>
```

```
<OMOBJ><OMS cd="setname1" name="Z" /
```

```
<OMOBJ><OMS cd="setname1" name="R" /
```

```
are all examples for <textref xref=
```

```
but also e.g., the set of all maps <
```

```
since these maps can be added and su
```

```
<OMOBJ>
```

```
<OMA>
```

```
<OMS cd="relation1" name="eq" />
```

```
<OMA>
```

```
<OMA>
```

```
<OMS cd="arith1" name="plus" />
```

```
<OMV name="f" />
```

```
<OMV name="g" />
```

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</OMA>
```

```
<OMV name="x" />
```

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</OMA>
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<OMA>
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```
<OMS cd="arith1" name="plus" />
```

```
<OMA>
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```
<OMV name="f" />
```

```
<OMV name="x" />
```

```
</OMA>
```

```
<OMA>
```

The Mission

ActiveMath Content



a set of items

with annotations
with relations

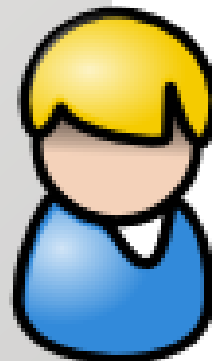


Examples for abelian groups ★★

Transition to author

$\mathbb{Z}$, $\mathbb{Q}$, $\mathbb{R}$, and $\mathbb{C}$ are all examples for abelian groups,
 $(f + g)(x) = f(x) + g(x)$, $(f - g)(x) = f(x) - g(x)$, and

with text,
with formulæ



```
<example id="ex1_ab_group"
```

```
  <ref xref="functions_symbols/fun
  <ref xref="functions_symbols/zer
</relation>
  <learningcontext value="university
  <difficulty value="medium" />
</extradata>
</metadata>
```

```
<CMP>
```

```
  <OMOBJ><OMS cd="setname1" name="Z" />
```

```
  <OMOBJ><OMS cd="setname1" name="R" />
```

```
are all examples for <textref xref=
```

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```
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```

```
<OMOBJ>
```

```
  <OMA>
```

```
    <OMS cd="relation1" name="eq" />
```

```
  <OMA>
```

```
    <OMA>
```

```
      <OMS cd="arith1" name="plus" />
```

```
      <OMV name="f" />
```

```
      <OMV name="g" />
```

```
    </OMA>
```

```
    <OMV name="x" />
```

```
  </OMA>
```

```
  <OMA>
```

```
    <OMS cd="arith1" name="plus" />
```

```
  <OMA>
```

```
    <OMV name="f" />
```

```
    <OMV name="x" />
```

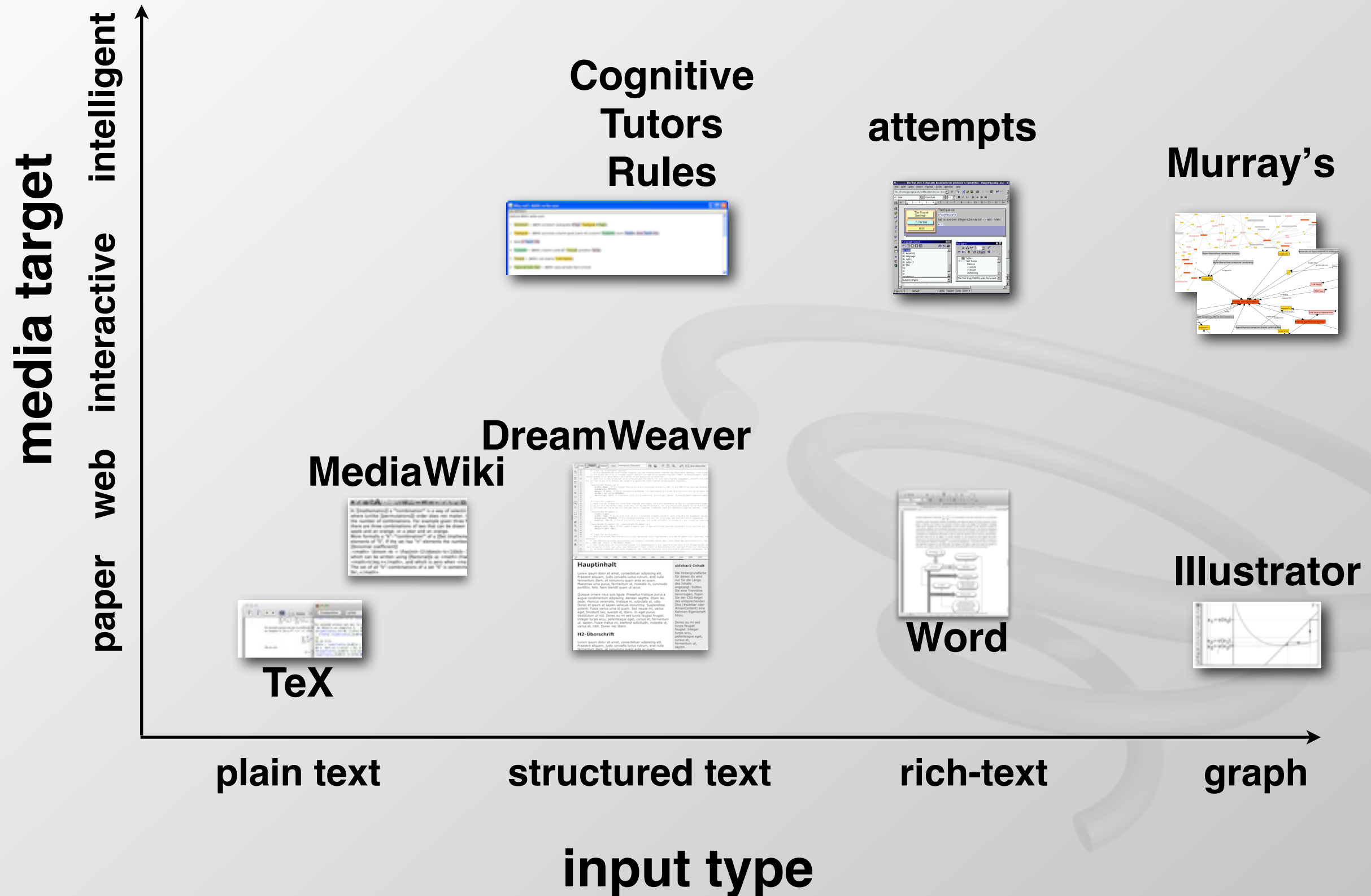
```
  </OMA>
```

```
<OMA>
```

Outline

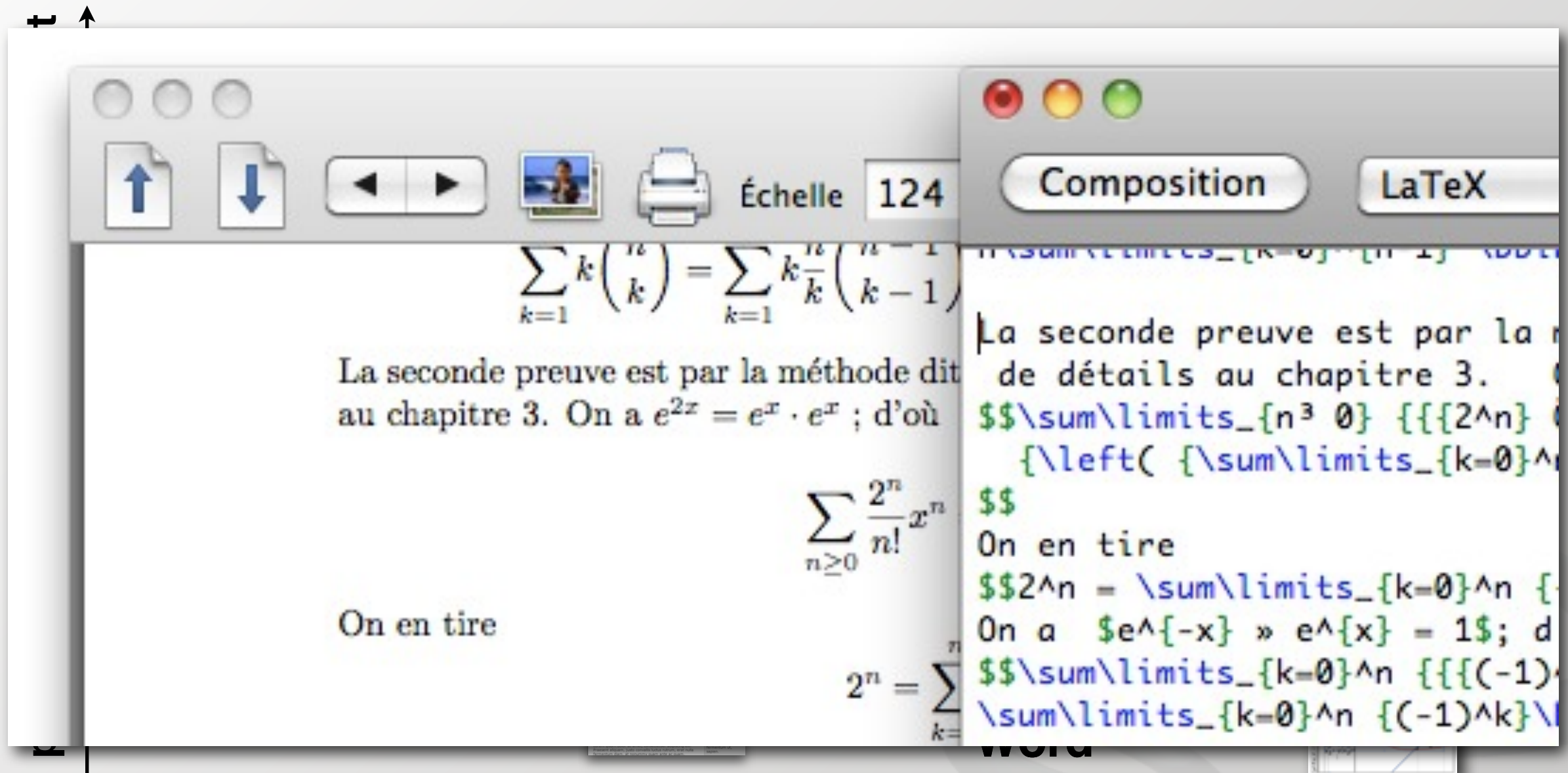
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Authoring Tools



Authoring Tools TeXshop

media target



plain text

structured text

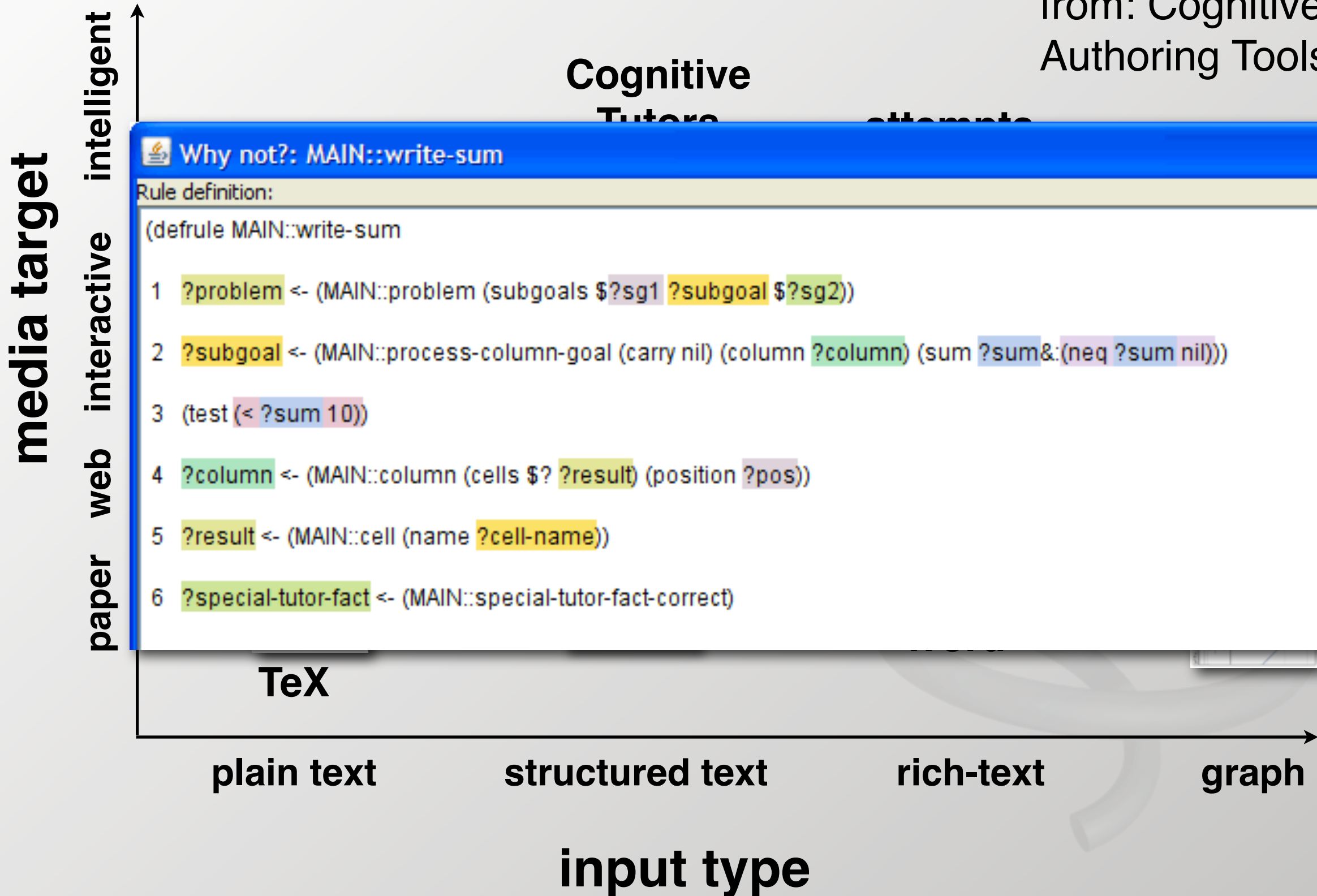
rich-text

graph

input type

Authoring Tools: CTAT Rules

from: Cognitive Tutors' Authoring Tools' Tutorial



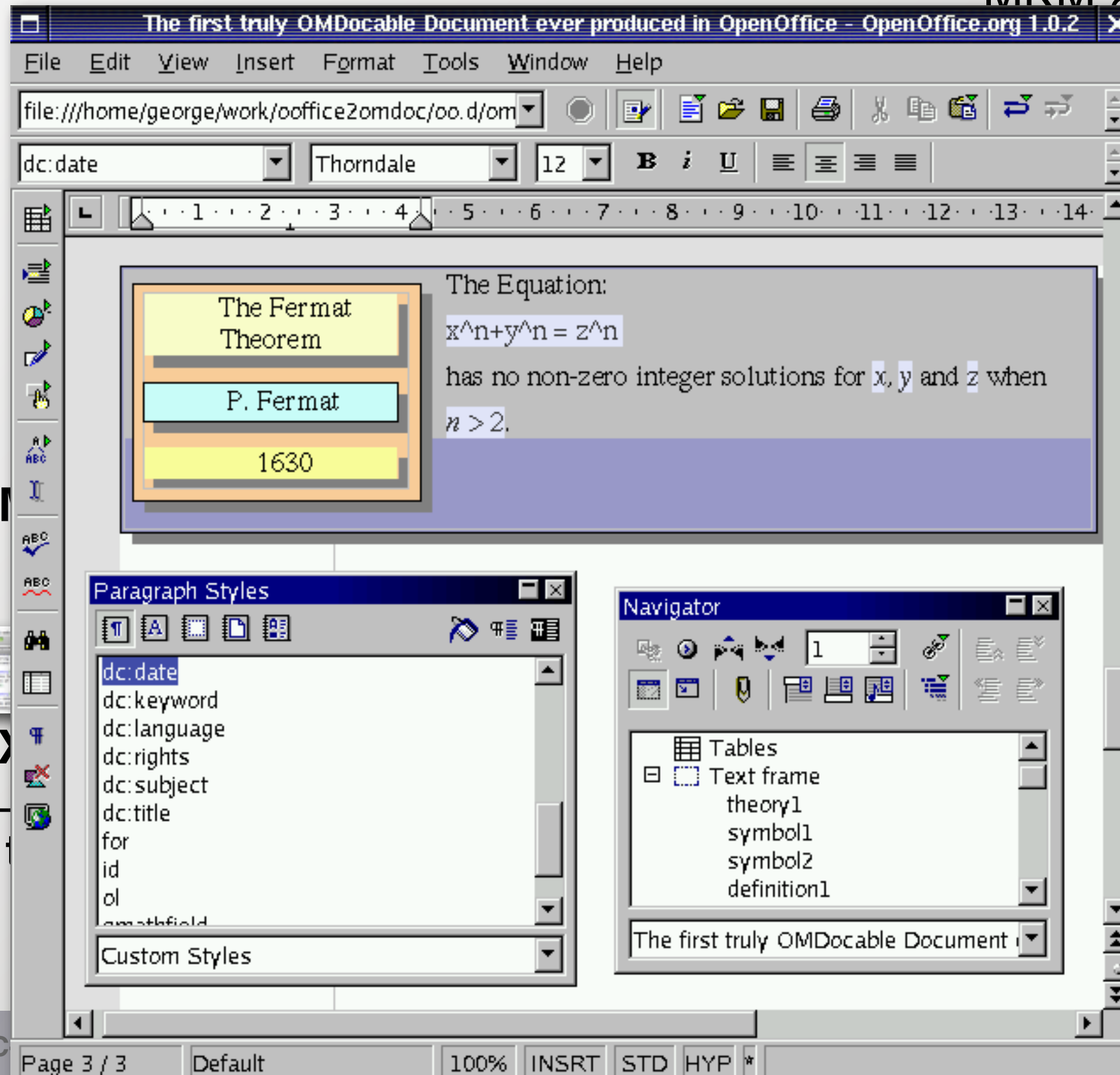
Authoring Tools: Word Proc.

from: Goguadze
Gonzalez-Palomo
MKM 2003

media target

paper web interactive intelligent

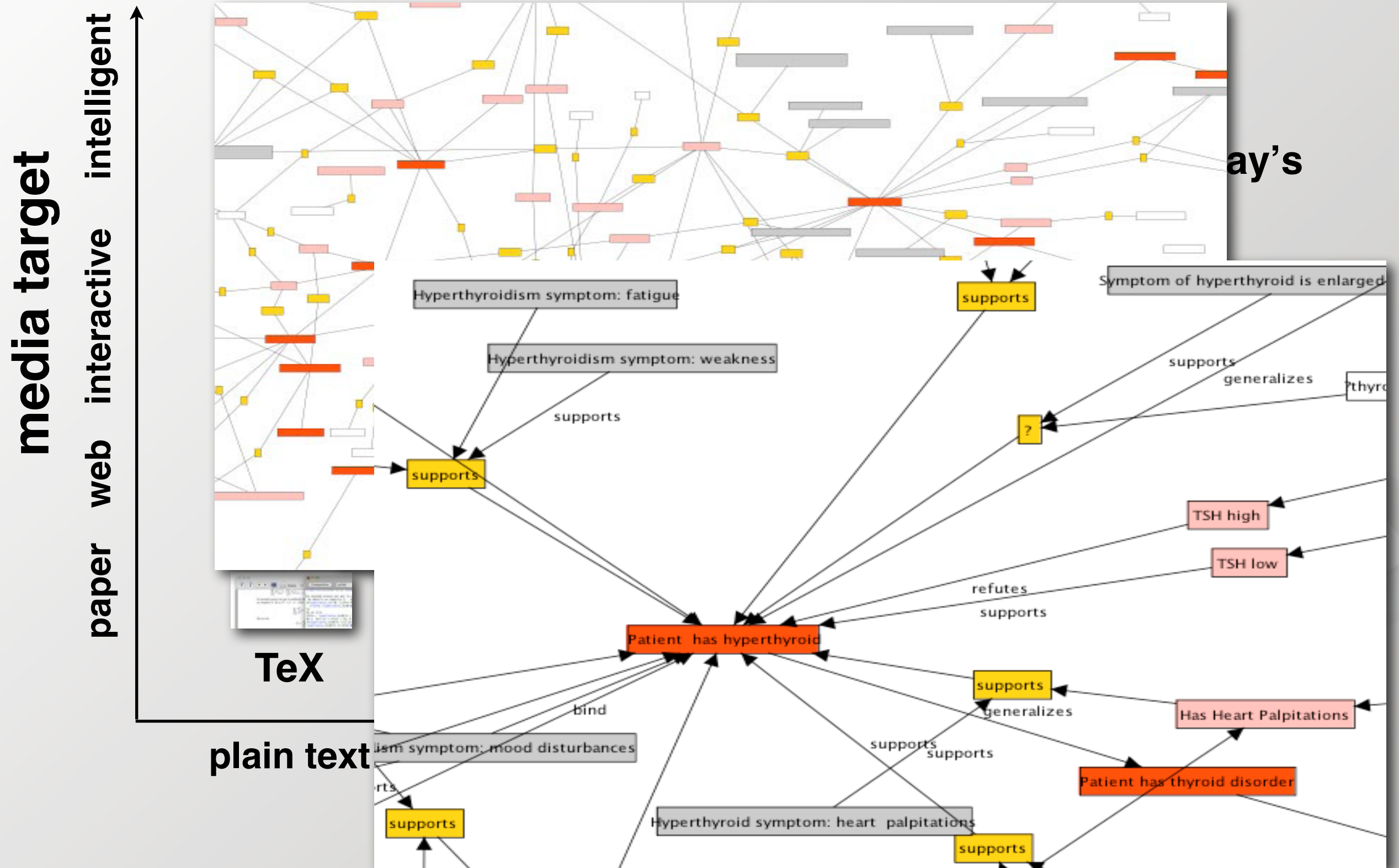
Text
plain



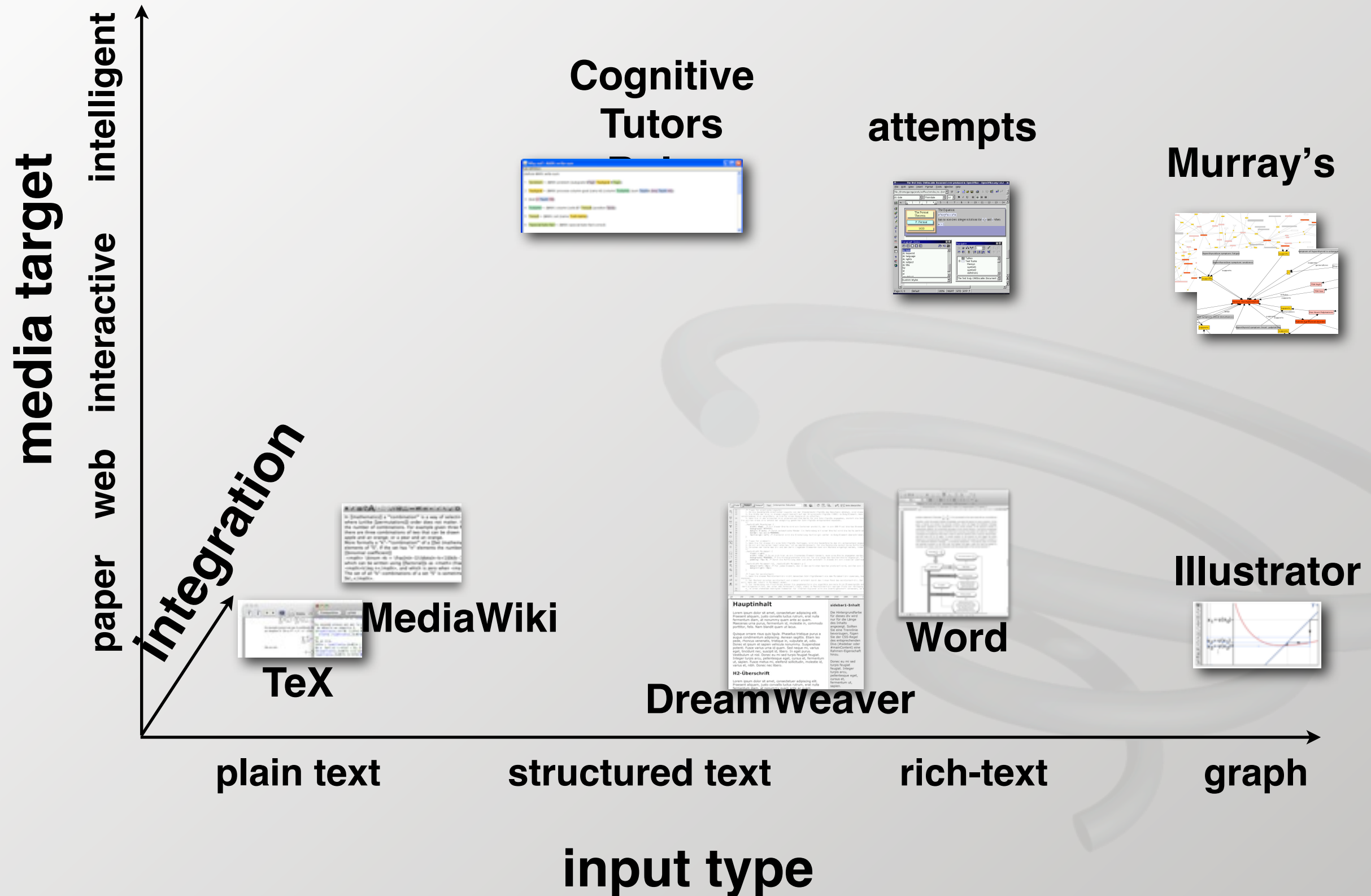
Authoring Tools

from: Murray, Woolf, Marshall
Lessons learned... ITS 2004

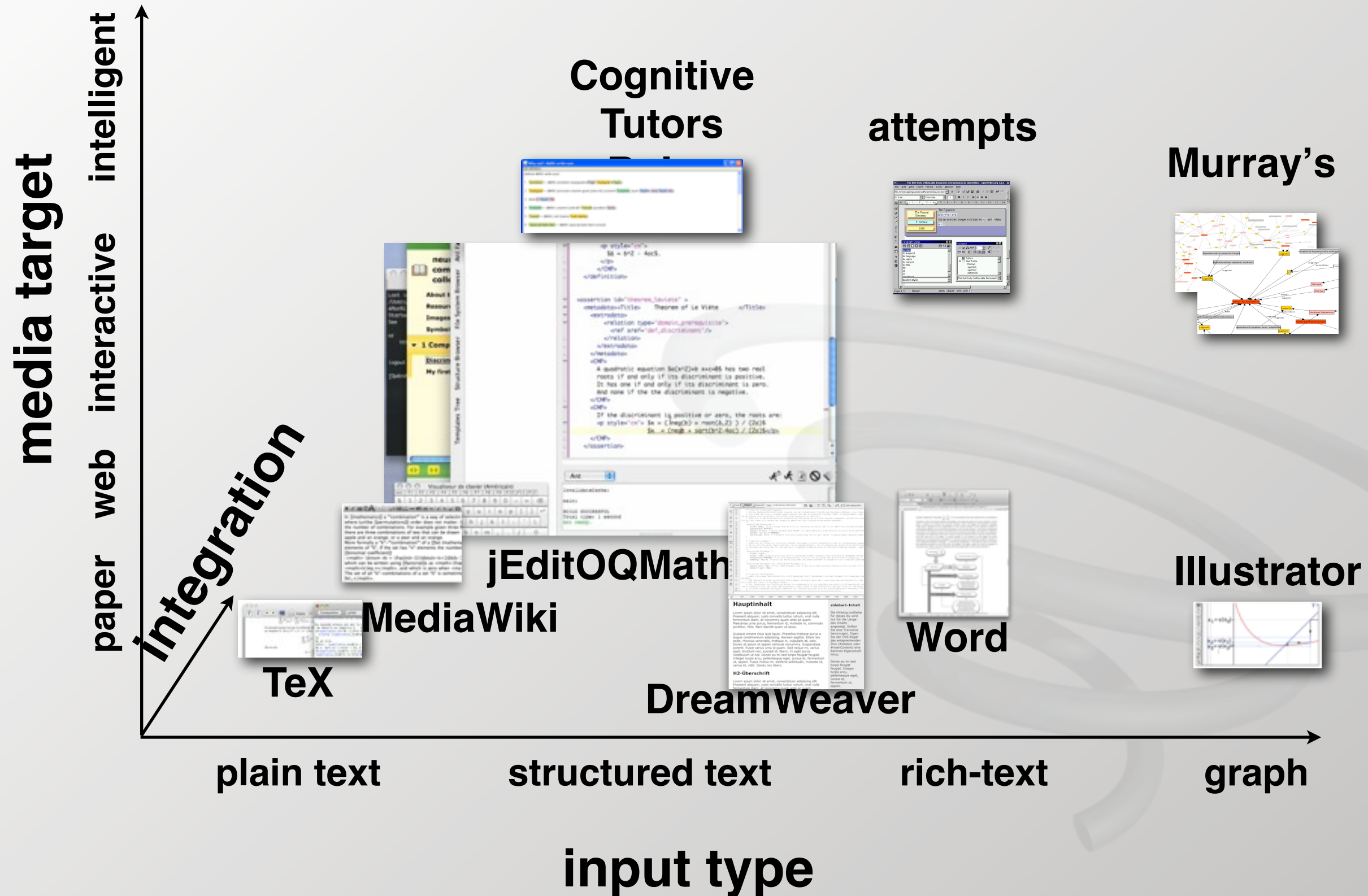
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Authoring Tools



Authoring Tools



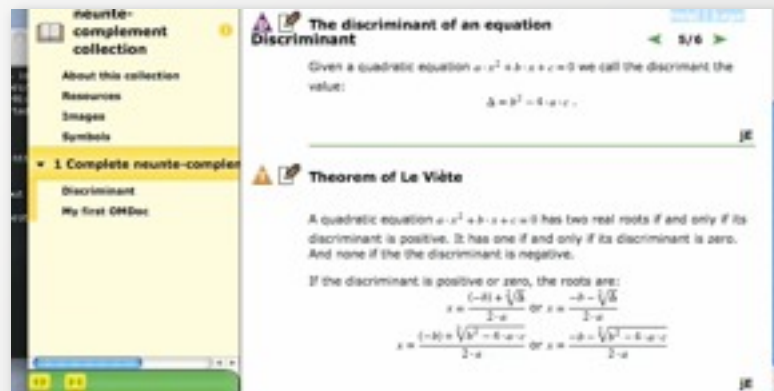
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The Core Paradigm: WYCIWYG

What You Check is What You Get

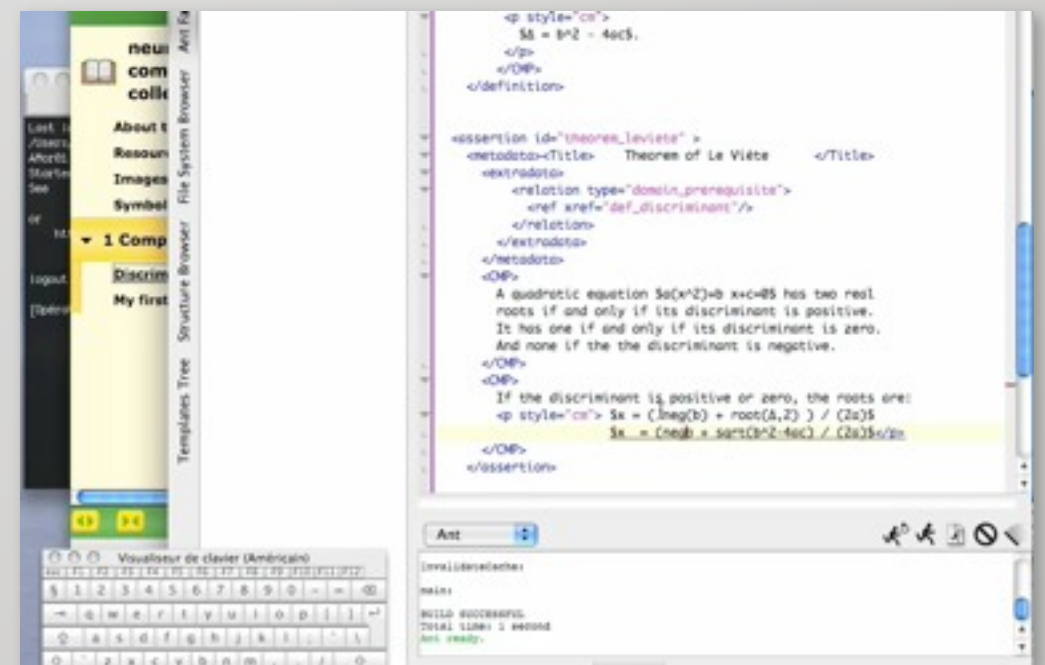
check



enhance

get

build



The Core Paradigm: WYCIWYG

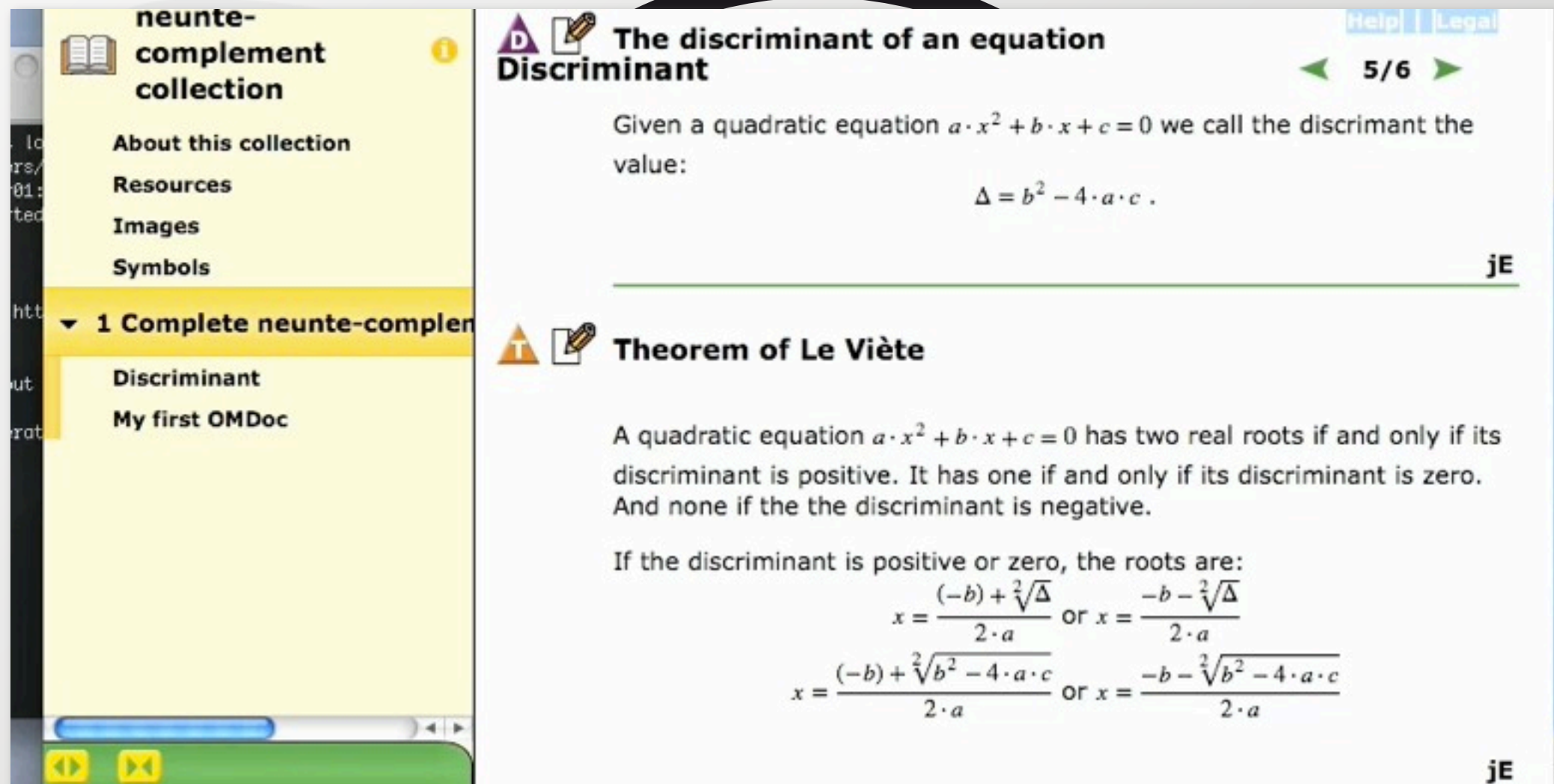
What You Check is What You Get

check

input
structured
text

The screenshot displays a web-based authoring tool interface. On the left, a sidebar contains a 'neunte-complement collection' and a 'Theorem of' section. The main editor area shows a document with structured text, including a definition of the discriminant and a theorem by Viète. The text is enclosed in XML-like tags such as `<p style="cm">`, `<math>`, `</math>`, `</p>`, `</CMP>`, `</definition>`, `<assertion id="theorem_leviette">`, `<metadata>`, `<extradata>`, `<relation type="domain_prerequisite">`, `<ref xref="def_discriminant"/>`, `</relation>`, `</extradata>`, `</metadata>`, `<CMP>`, and `</assertion>`. A terminal window at the bottom right shows the output of an Ant build process, indicating a successful build with the message 'BUILD SUCCESSFUL' and 'Ant ready.'.

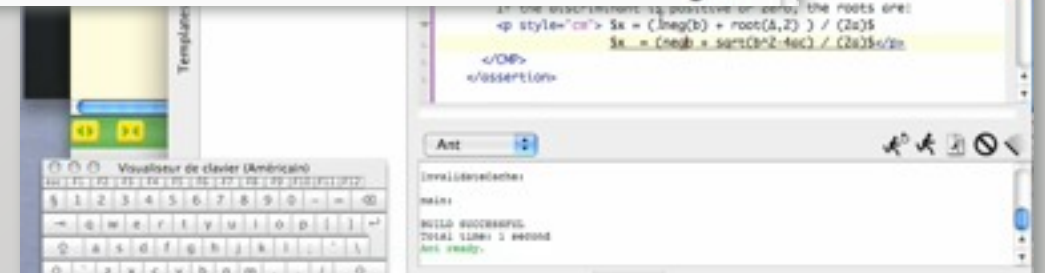
What You Check is What You Get check



The screenshot shows a web interface for a 'neunte-complement collection'. The left sidebar lists 'About this collection', 'Resources', 'Images', and 'Symbols'. The main content area is titled 'The discriminant of an equation' and 'Discriminant'. It explains that for a quadratic equation $a \cdot x^2 + b \cdot x + c = 0$, the discriminant is $\Delta = b^2 - 4 \cdot a \cdot c$. Below this, the 'Theorem of Le Viète' is presented, stating that a quadratic equation has two real roots if and only if its discriminant is positive, one root if zero, and none if negative. The roots are given by the formulas: $x = \frac{(-b) \pm \sqrt{\Delta}}{2 \cdot a}$ or $x = \frac{-b \pm \sqrt{b^2 - 4 \cdot a \cdot c}}{2 \cdot a}$. The interface includes a 'Help' link, a 'Legal' link, and a '5/6' page indicator.

check in
realistic ActiveMath

build

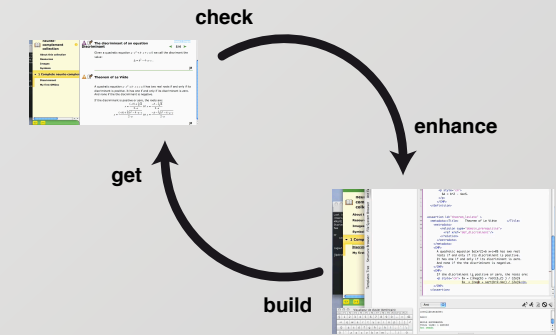


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Supported Text Edition

- the source is a structured text
 - tree like, elements, texts, attributes
 - formulæ in compact format
 - kept readable at all times
- lots of XML editing support
- help to get started:
 - tutorials with exact texts
 - copy and paste of formulæ from many places:
 - some TeX
 - Wikipedia, Planet Math, MathML
 - smart paste



Task cont-1: Add first content and see it

The goal of this task is to perform a first content modification and see the content updated in one's ActiveMath. This is half a sanity test.

Prerequisite
create-a-collection

Applications That Should be Running
JediOOMath, ActiveMath, web-browser

Task description

- go to JediOOMath, in the file first.logmath
- find a CMP element, for example the hello-world axiom
- inside this element, between and type a rare word or two (say, Möbius)
- let us add a few exotic characters as well: type the sequence of letters $\Delta e i l$ followed by C ; (edit > expand-abbreviation). You should see a capital delta letter, a triangle.
- save (press C-S or press the pencil toolbar-button)
- validation happens, verify there's nothing to complain about in the status bar ("XML parsing complete, 0 error(s)").
 - if not, you have introduced illegal characters or at illegal places, undo a few times then re-insert without "<" and ">"
- open the AntFam tab (the top tab on the left-side-bar of the Jedi window)
- inside there, find an item called "fancy-surfaces collection, ActiveMath build file". If there is no listed build yet, press the "+" button and locate the build.xml file of your collection first.
- double click this item, or click it once then click the running man
 - (we are compiling and publishing, more about this in build-process)
- see the operation happening in the "console", ensure it says "build successful"
- go to your browser, open / http://localhost:8080/
- see your collection's automatic book, open it, see your text and the Delta there
- click the search link in the top tool menu
- type one of the rare words
- see the title of the hello-world axiom, click it and see the same

Content Modifications and Previews (cont) up Task cont-2: add-search-see: add an item, find it, see it >

The shape of the triangle is determined by the lengths of the side also be derived from the lengths of the sides. By Heron's formula

$$T = \sqrt{s(s-a)(s-b)(s-c)}$$

where $s = \frac{a+b+c}{2}$ is the semiperimeter, or half of the triangle's

Three equivalent ways of writing Heron's formula are

$$T = \frac{1}{4} \sqrt{(a^2 + b^2 + c^2)^2 - 2(a^4 + b^4 + c^4)}$$

```
<assertion id="heron-formula">
  <metadata><Title> The Formula of Heron </Title>
</metadata>
<CMP>Given the length $a$, $b$, and $c$ of a triangle,
computed with the formula of Heron:
  <p style="text-align: center;">

$$S_{\Delta ABC} = \frac{1}{4} \sqrt{((a^2 + b^2 + c^2)^2 - 2(a^4 + b^4 + c^4))}$$

  </p>
</CMP>
</assertion>
```

The Formula of Heron

Given the length a , b , and c of a triangle, its area A can be computed with the formula of Heron:

$$A = \frac{1}{4} \sqrt{(a^2 + b^2 + c^2)^2 - 2(a^4 + b^4 + c^4)}$$

Highlight of the thesis

Supported T

- the source
 - tree like, el
 - formulæ in
 - kept readal
- lots of XML
- help to get
 - tutorials wi
 - copy and p
 - some TeX
 - Wikipedi
- smart paste

Task cont-1: Add first content and see it

The goal of this task is to perform a first content modification and see the content updated in one's ActiveMath. This is half a sanity test.

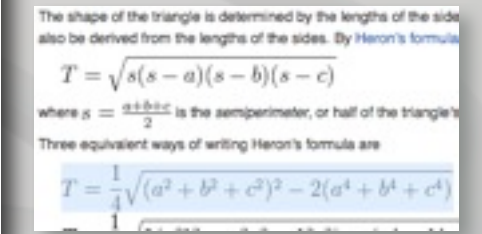
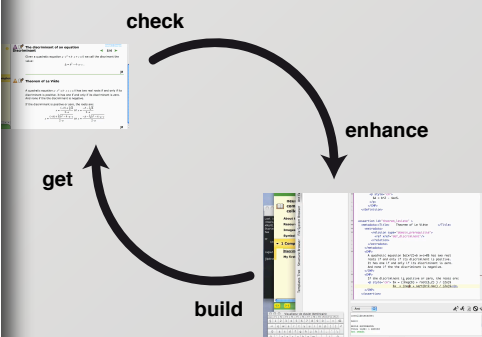
Prerequisite
create-a-collection

Applications That Should be Running
jEditOQMath, ActiveMath, web-browser

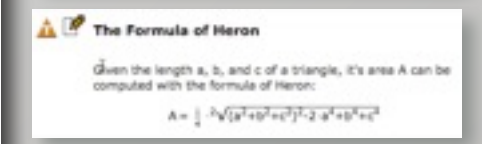
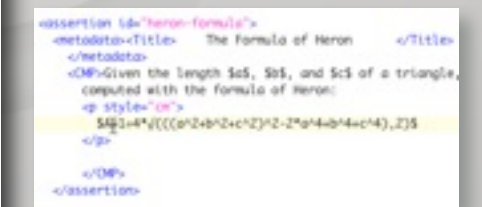
Task description

- go to jEditOQMath, in the file first.oqmath
- find a CMP element, for example the hello-world axiom
- inside this element, between and type a rare word or two (say, Möbius)
- let us add a few a exotic characters as well: type the sequence of letters D e l t a followed by C-; (edit > expand-abbreviation). You should see a capital delta letter, a triangle.
- save (press C-S or press the pencil toolbar-button)
- validation happens, verify there's nothing to complain about in the status bar ("XML parsing complete, 0 error(s)").
 - if not, you have introduced illegal characters or at illegal places, undo a few times then re-insert without "<", "&" and ">".
- open the AntFarm tab (the top tab on the left-side-bar of the jEdit window)
- inside there, find an item called "fancy-surfaces collection, ActiveMath build file". If there is no listed build yet, press the "+" button and locate the build.xml file of your collection first.
- double click this item, or click it once then click the running man
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- see the title of the hello-world axiom, click it and see the same

◀ Content Modifications and Previews (cont) up Task cont-2: add-search-see: add an item, find it, see it ▶



laces:



The shape of the triangle is determined by the lengths of the sides. It can also be derived from the lengths of the sides. By Heron's formula

$$T = \sqrt{s(s - a)(s - b)(s - c)}$$

where $s = \frac{a+b+c}{2}$ is the *semiperimeter*, or half of the triangle's

Three equivalent ways of writing Heron's formula are

$$T = \frac{1}{4} \sqrt{(a^2 + b^2 + c^2)^2 - 2(a^4 + b^4 + c^4)}$$

```
<assertion id="heron-formula">
  <metadata><Title>    The Formula of Heron    </Title>
  </metadata>
  <CMP>Given the length $a$, $b$, and $c$ of a triangle,
    computed with the formula of Heron:
    <p style="cm">
      $A=\frac{1}{4}*\sqrt{(((a^2+b^2+c^2)^2-2*a^4+b^4+c^4),2)}$
    </p>
  </CMP>
</assertion>
```

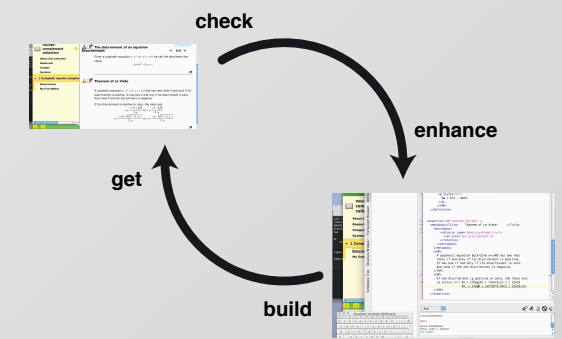
- Wiki




The Formula of Heron

Given the length a, b, and c of a triangle, it's area A can be computed with the formula of Heron:

$$A = \frac{1}{4} \cdot \sqrt{(a^2+b^2+c^2)^2-2 \cdot a^4+b^4+c^4}$$



Task cont-1: Add first content and see it

The goal of this task is to perform a first content modification and see the content updated in one's ActiveMath. This is half a sanity test.

Prerequisite
create-a-collection

Applications That Should be Running
JEditQMath, ActiveMath, web-browser

Task description

- go to JEditQMath, in the file first.oqmath
- find a CMP element, for example the hello-world axiom
- inside this element, between and type a rare word or two (say, Möbius)
- let us add a few a exotic characters as well: type the sequence of letters D e l t a followed by C-; (edit > expand-abbreviation). You should see a capital delta letter, a triangle.
- save (press C-S or press the pencil toolbar-button)
- validation happens, verify there's nothing to complain about in the status bar ("XML parsing complete, 0 error(s)")
 - if not, you have introduced illegal characters or at illegal places, undo a few times then re-insert without "<", "&" and ">".
- open the AntFarm tab (the top tab on the left-side-bar of the JEdit window)
- inside there, find an item called "fancy-surfaces collection, ActiveMath build file". If there is no listed build yet, press the "+" button and locate the build.xml file of your collection first.
- double click this item, or click it once then click the running man
 - (we are compiling and publishing, more about this in build-process)
- see the operation happening in the "console", ensure it says "build successful"
- go to your browser, open / http://localhost:8080/
- see your collection's automatic book, open it, see your text and the Delta there
- click the search link in the top tool menu
- type one of the rare words
- see the title of the hello-world axiom, click it and see the same

< Content Modifications and Previews (cont)
 <
 up

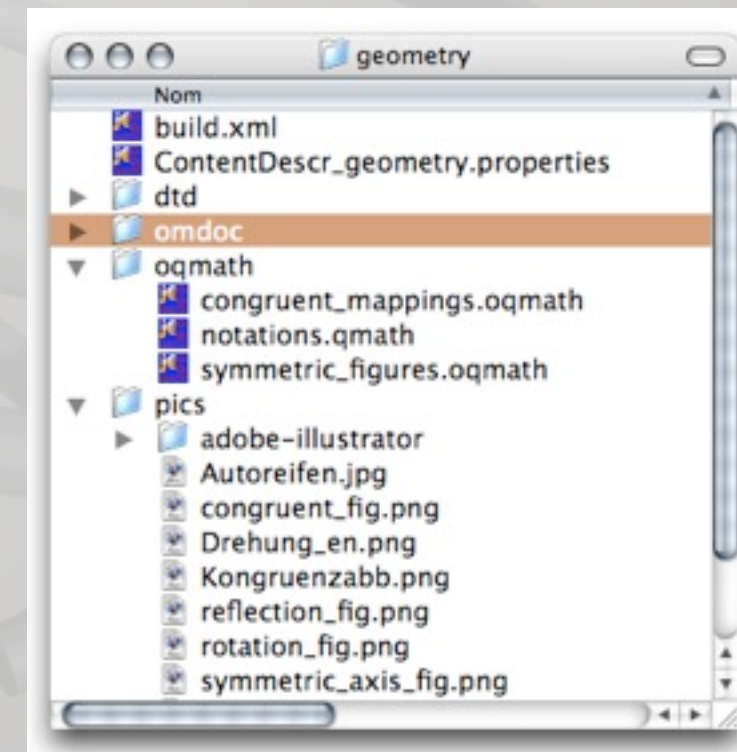
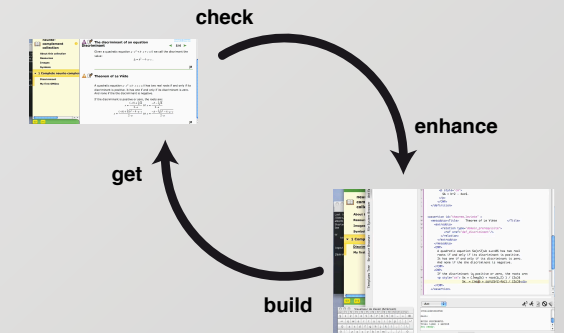
Task cont-2: add-search-see: add an item, find it, see it >

Outline

- mission: authoring for ActiveMath
- related work
- my contribution
 - WYCIWYG
 - facilitating the input
 - **storage & search**
 - case studies
- summary
- future work

Content Storage

- authors create files
- the files are indexed
 - ActiveMath can serve the content items
- short build cycles:
 - need to check now!
 - ready to serve high-performance
- files are in collections
 - authors know what is where
 - directory with simple organization
 - can be shared



Collections for Re-use of Content



Search

- a tool for learners and authors
- search for text, attributes, formulæ
- display content items, find seen places

The screenshot displays the ActiveMath Search interface. The top header features the 'ActiveMath' logo and navigation links for 'Print' and 'Help'. Below the header, the 'ActiveMath Search' section includes tabs for 'simple', 'advanced' (selected), and 'history'. The search criteria are defined as: 'Search for "derivation, type: Theorem or Assertion, [formula]" (English) (among all items) 30 objects found'. The search results list includes items such as 'The derivative of polynomials', 'The derivative of power functions', and 'The derivative functions of the hyperbolic functions'. The detailed view for 'The derivative of polynomials' is shown, including the text: 'Let $n \in \mathbb{N}^+$ and f be a real (or complex) polynomial of degree n in x , defined by $y = f(x) = a_n \cdot x^n + \dots + a_2 \cdot x^2 + a_1 \cdot x + a_0$, with real (or complex) numbers a_j . Then the derivative function of f is a real (or complex) polynomial of degree $n-1$ in x , given by'.

ActiveMath Search

simple advanced history

Search for "derivation, type: Theorem or Assertion, [formula]" (English) (among all items) 30 objects found

Search for items...

which contain the text contain approximate words derivation

which... are of type Theorem or Assertion

which contain the formula x^2

+ -

☒ all criteria

in language English

search New Search

back

The derivative of polynomials

Let $n \in \mathbb{N}^+$ and f be a real (or complex) polynomial of degree n in x , defined by

$$y = f(x) = a_n \cdot x^n + \dots + a_2 \cdot x^2 + a_1 \cdot x + a_0,$$

with real (or complex) numbers a_j . Then the derivative function of f is a real (or complex) polynomial of degree $n-1$ in x , given by

Search

- a tool for learners and authors
- search for text, attributes, formulæ
- display content items, find places
- how does it work?
 - an *index* notes occurrences of each word
 - ranking through:
 - precision to query (title, stemming)
 - desirability for learner
 - formulæ are made into phrases



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presentation
Arithmetic exercise
Let us assume
 $a+b=k$



Search

- a tool for learners and authors
 - search for terms
 - display content
- OQMath*
- `<title>Arithmetic exercise</title>`
- `<CMP>Let us assume  $a+b=k$ .</CMP>`
- presentation*
- Arithmetic exercise**
- Let us assume
 $a+b=k$
- how does it work?
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presentation

Arithmetic exercise

Let us assume

$$a+b=k$$

OQMath

<title>Arithmetic exercise</title>

<CMP>Let us assume $a+b=k$.</CMP>

OMDoc

- how content is structured
- an internal representation
- rank of terms
- presentation
- display
- formatting

<title>Arithmetic exercise</title>

<CMP>Let us assume

<OMOBJ><OMA> <OMS cd=relation1 name=eq/>

<OMA><OMS cd=arith1 name=plus/>

<OMV name=a/><OMV name=b/>

</OMA>

<OMV name=k/>

</OMA>

.</CMP>

Search

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- search for terms
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presentation
Arithmetic exercise
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OQMath

<title>Arithmetic exercise</title>
<CMP>Let us assume $a+b=k$.</CMP>

indexed tokens

title-en: arithmet exercis
text-en: let us assum _(_0 _OMS_relation1/eq
_(_1 _OMS_arith1/plus _OMV_a _OMV_b _)_1 _OMV_k _)_0
phonetic-en: LT AS ASM

- pre <OMA><OMA name=arith name=plus>
- de <OMV name=a/><OMV name=b/>
- form </OMA>
<OMV name=k/>
</OMA>
.</CMP>

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query
arithmetic

name=eq/>
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</OMA>
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</CMP>

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query
arithmetic

query
asume

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</OMA>
</CMP>

query
arithmetic

query
asume

query
 $a+b$

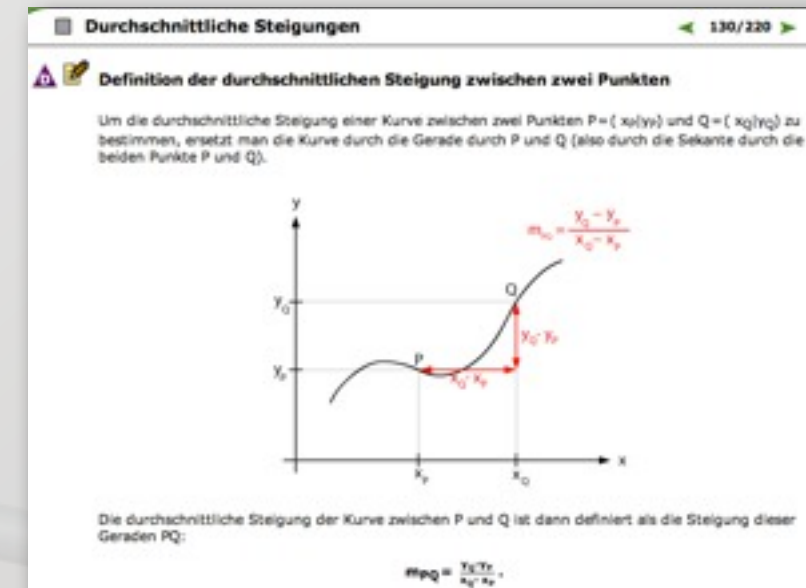
query
 $? = k$

Outline

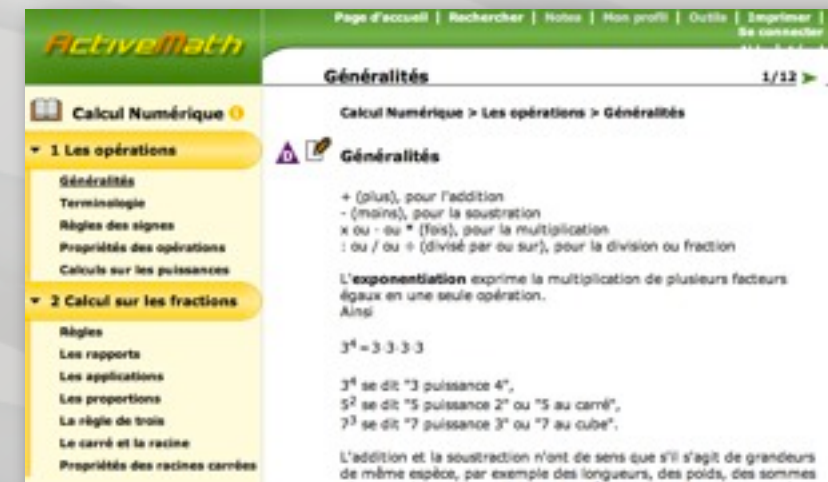
- mission: authoring for ActiveMath
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 - WYCIWYG
 - facilitating the input
 - storage & search
 - **case studies**
- summary
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Case studies: Authors' Achievements

- no formal experiment
- but long *coaching* of authors
- e.g. Christian
 - mathematician, TeX-guy
 - strong organization of content
- e.g. Adrien
 - young developer,
 - full self-learner from tasks
- meeting intelligent features...
- tool used by ~50 authors
- who created ~20000 items



400 pages



20 pages

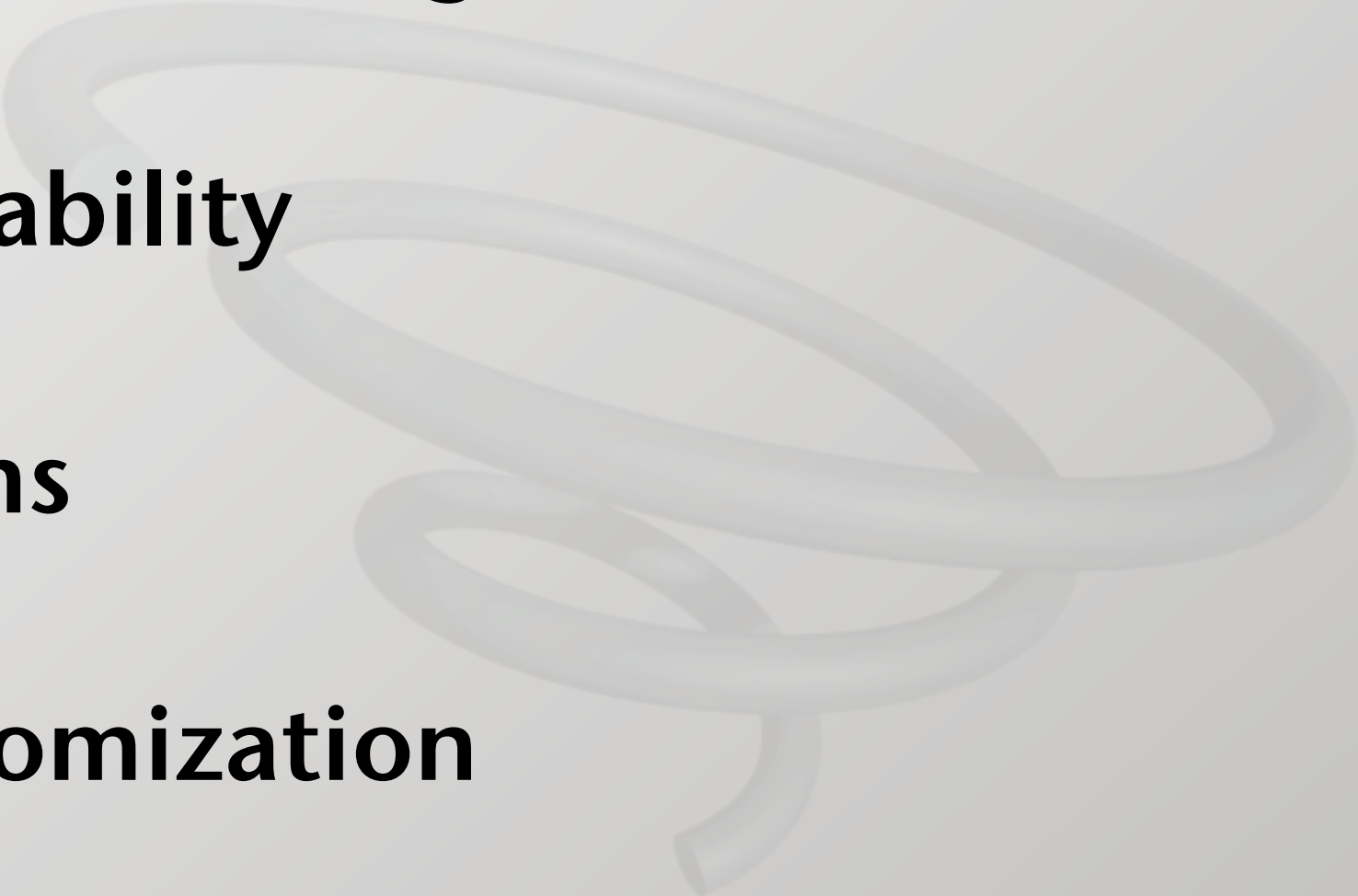
Lessons Learned

- **task descriptions**
 - no imprecision allowed
 - effective to jumpstart
- **tangible authoring crucial**
 - all: utility of features only if it works
 - far-away expectations ignored
 - short attempt cycles to grasp meaning
- **freedom to organize sources**
 - author-*important* information at visible places
 - inheritance model

Features of an authoring tool (Murray 2003)

- **visual editing and rapid testing**
- **flexible opportunistic design**
- **modularity, re-usability**
- **familiar paradigms**
- **scriptability, customization**

Features of an authoring tool

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- **scriptability, customization**
 - *source text editing, configurable notations*

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Future work

- **visual tool**
 - remember: *easy input but hard management*
 - architecture and component to be re-used
 - reload, search, CnP, ...
- **fuzzy math search**
 - normalization and rewriting systems exist
 - should x^2-1 match $(x-1)(x+1)$?
- **testable intelligent components**
 - as easy as a WYCIWYG cycle
 - restart course-planning with same user-model



thank you.

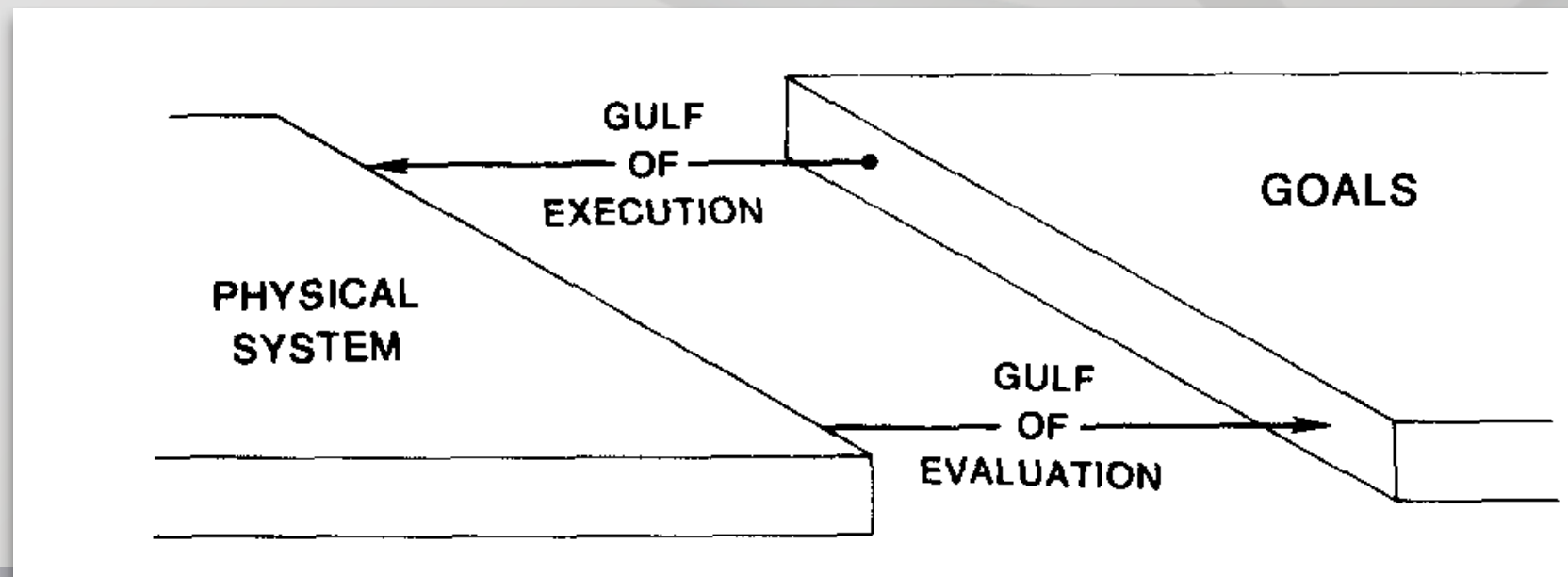
supplementary

Editing XML Source is not Easy

- **text source editing:**
 - is common and for all skill-levels
 - can be exchanged in emails, etc
 - is versioning-system friendly
- **XML editing:**
 - is much better supported than many other languages (e.g. QMath or wiki)
 - can be kept readable (read: OMDoc book)
 - multiple editors, standardized validation

Direct Manipulation

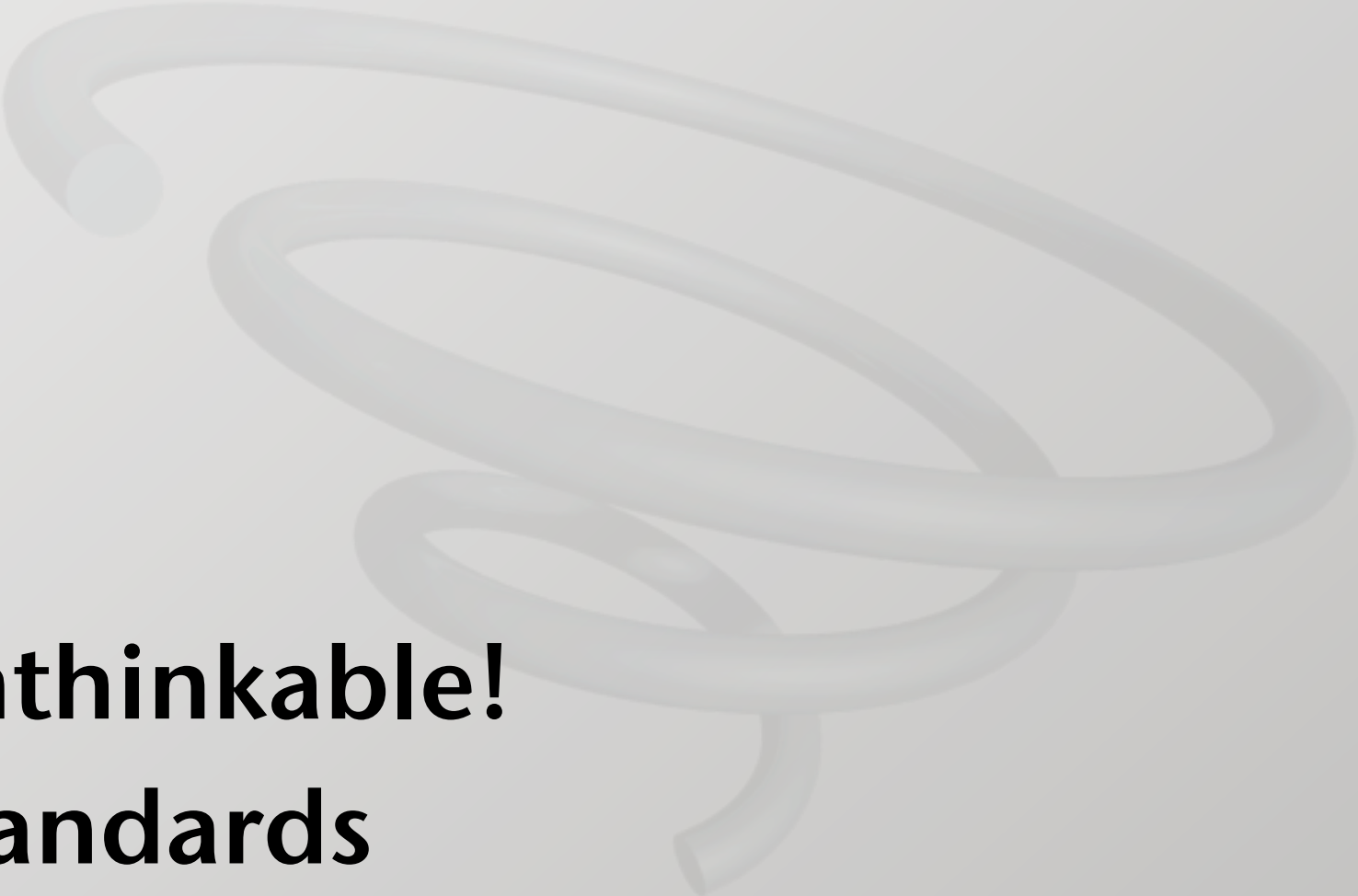
- Easy?
 - *look at direction manipulation*
 - he formulated „against programming“
 - but a more detailed analysis (Fröhlich 1996)
 - Visualisation of output data seems critical to the benefits of direct manipulation
 - Visualisation of input data may be less important
- Gulf of evaluation



Storage Performance

- **focus: fast serving**
 - beyond 2000 queries/second
- **indexing may take time:**
 - LeAM_calculus: old CPU, ~20 minutes
 - new CPU: ~2 minutes
 - 1000 books? ~15 hours
 - comparable to big deployments
- **focus for authors: fast reload**
 - only reloads changed files
 - motto: keep files small

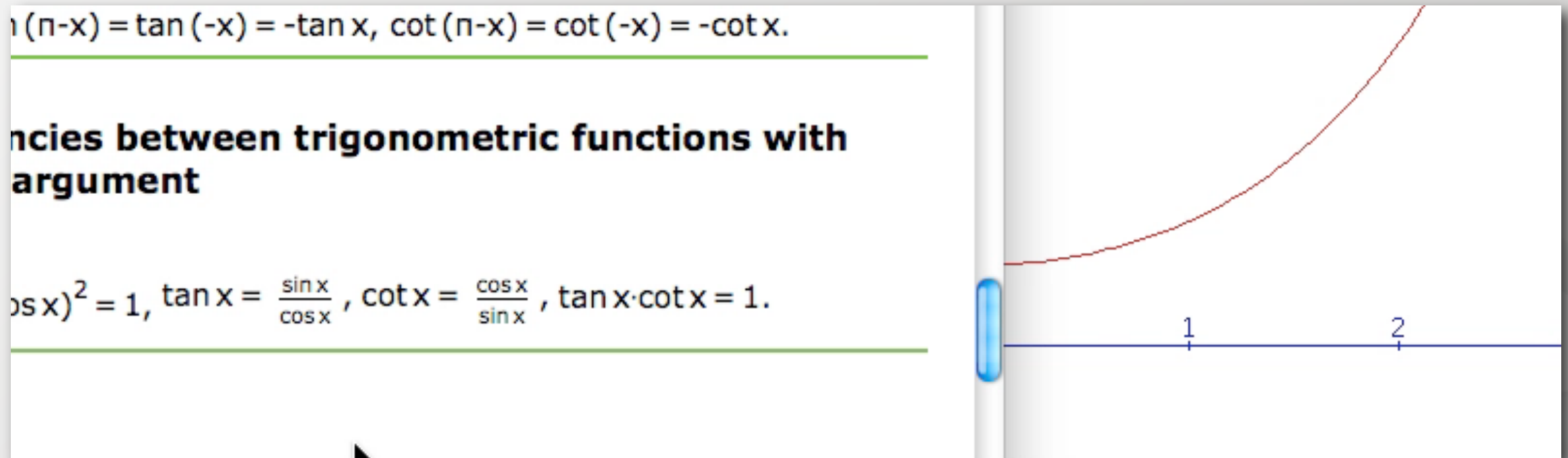
Copy and Paste for Learners

- for students as well
 - based on drag-and-drop of links
- 
- evaluation: unthinkable!
 - conclusion: standards

also in this thesis

Copy and Paste for Learners

- for students as well
- based on drag-and-drop of links



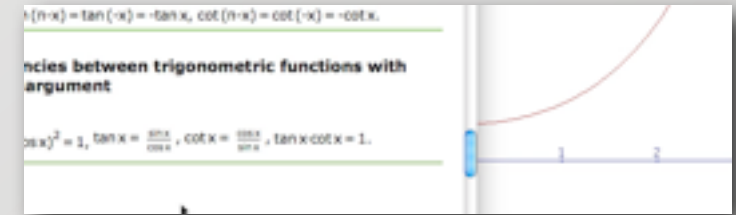
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 - observe discrepancies
 - MicroSoft - DesSci: simili-agreement
 - MathML 3 chapter 6
 - IETF mailing-list: name clipboard flavors

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Authoring for Artificial Intelligence

- in ActiveMath, AI includes:
 - Belief Network Model as the learner-model
 - authors should try to simulate
 - Hierarchical Task Network Planner
 - authors should make sure the course generation delivers sensible courses
 - CAS-evaluation of exercises
 - authors should anticipate answers and make sure evaluation works
 - ranking of search
 - anticipate queries and verify

Authoring for Artificial Intelligence

- approach thus far:
 - limit to knowledge-explanation
 - ==> too theoretical
 - obtain strategies by (strict) interviews
- contribution:
 - limit size of metadata input by inheritance
- future: testable intelligence
 - introspectable user-model
 - reporting course-generation
 - ...

Search Test Suite

- objective:
 - raise utility of the search engine
 - precision: «low-amount of noise»
 - recall: «percentage rightly found»
- created by domain experts
- with books they know well

verbindungs-gesetz	0,5	1,0	*	0.083333336	1,0
assoziativ-gesetz Bruchrechnung	0,0	NaN	*	0,0	0,0
Zehnerbruch	1,0	1,0	*	0.16666667	1,0
Bruch in Dezimalzahl	0,5	1,0	*	0.083333336	1,0
bruch in dezimalzahl umwandeln	1,0	1,0	*	0.25	1,0
periode	1,0	1,0	*	0,05	1,0

logarithmische

☒ ... La dérivée de la fonction cotangente

☐ ... La dérivée de la fonction tangente

☒ ... Définition de la fonction logarithmique naturelle

☐ ... La dérivée de la fonction cotangente

Missing:

Evaluate

page 1 de 8 ▶

(généraliser la requête à tous les éléments)

	2006 LeAM English	2009 SchulM	2010 SchulM	2010 LeAM Spanish	2010 Kassel
precision	93 %	12 %	53 %	79 %	78 %
recall	63 %	81 %	85 %	87 %	84 %