A MathML content markup editor on the xfy

Takayuki Kawata, **Masaaki Kataoka**, **Hiroshi Kai**,
Ehime university

Yasushi Tamura
Justsystems Co.

Contents

- Development of an authoring software for compound XML documents
  - xfy
- From a point of view of an application of the “compact computer algebra”, a MathML editor on the xfy will be proposed.
  - MathML content markup
  - Utilization of computer algebra system

Background

- Application of XML documents
  - XHTML, SVG, MathML, …
- Example of the usage
  - Web services
  - Word processors
  - e-learning management software
- Math documents
  - Several XML vocabularies in a document (Compound XML documents)
    - e.g. XHTML, MathML, SVG in a document
- Compound XML documents editor
  - WYSIWYG editors … Amaya, xfy

xfy

- XML application platform
  - Authoring compound XML
  - Performing XML based application
- Features
  - Supporting XML vocabularies
    - XHTML, SVG, MathML (presentation markup), CML, XBRL, UBL, XML for Blog, …
  - Extensible functionality
    - Editing user-defined or standard XMLs
      - plugin (developed with Java and xfy API)
      - XVCD (a script language, an extension of XSLT)

Editing math expressions on xfy

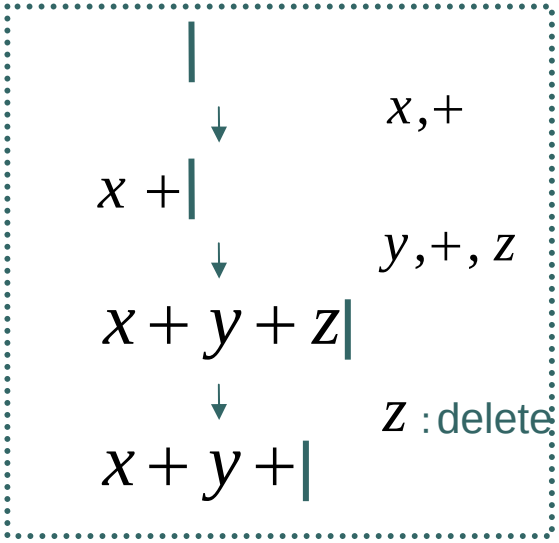
- Justsystems Co. has been providing a MathML presentation markup editor on the xfy.
- Reuse and calculation of expressions
  - Semantic and Unambiguous information for math expressions
    - OpenMath
    - MathML content markup
- In this research, we implement a MathML content markup editor plugin for xfy.

MathML editors

- Presentation markup
  - Amaya, WebEQ, xfy, …
- Content markup
  - Formulator 3.7 MathML Weaver
    - WYSIWYG Template editor
  - Integre MathML Equation Editor
    - WYSIWYG Template editor with a direct manipulation

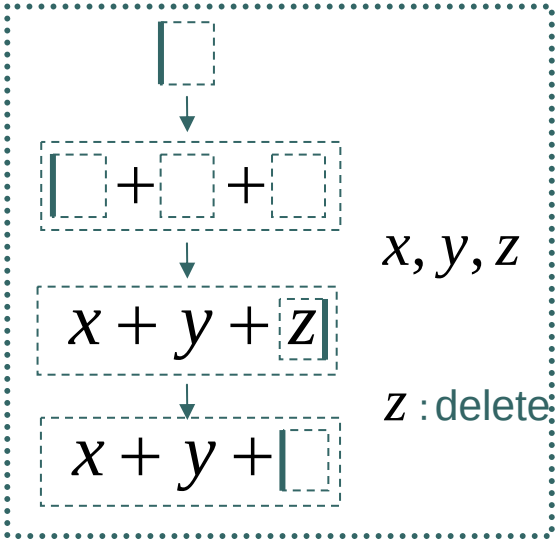
Input behavior

Direct input



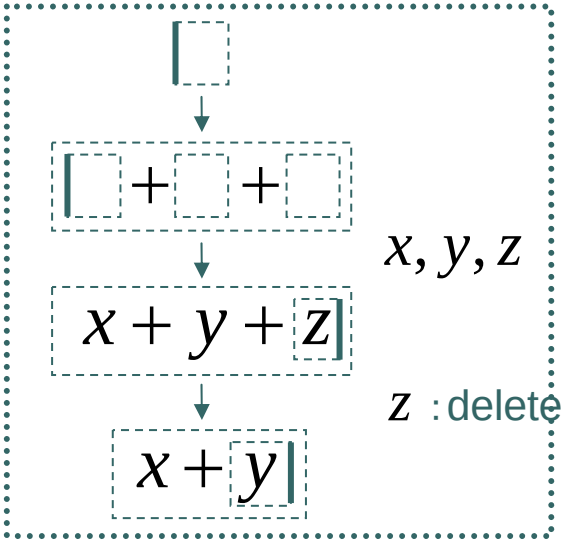
Xfy Presentation Markup Editor

Template input



Formulator 3.7 MathML Weaver

Template + Direct input

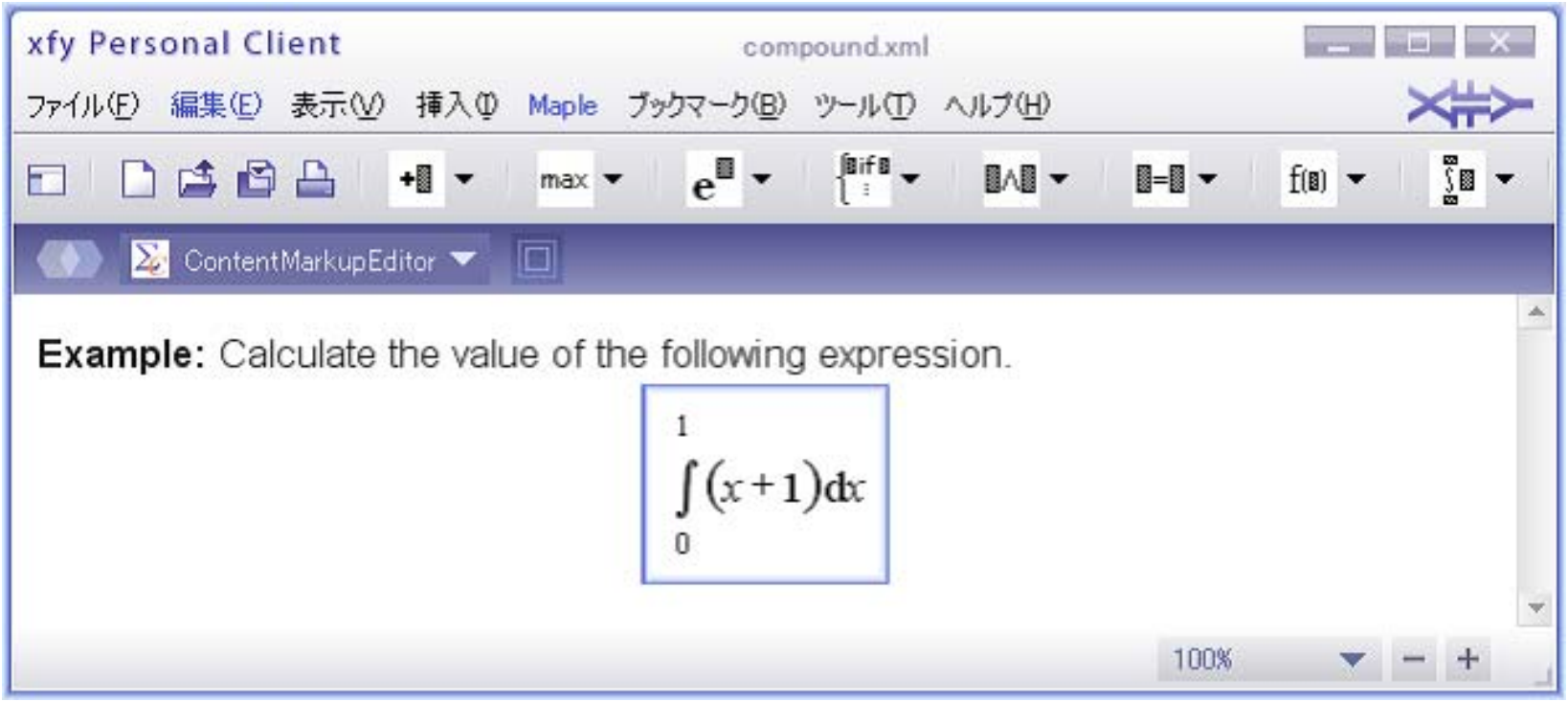


Integre MathML Equation Editor

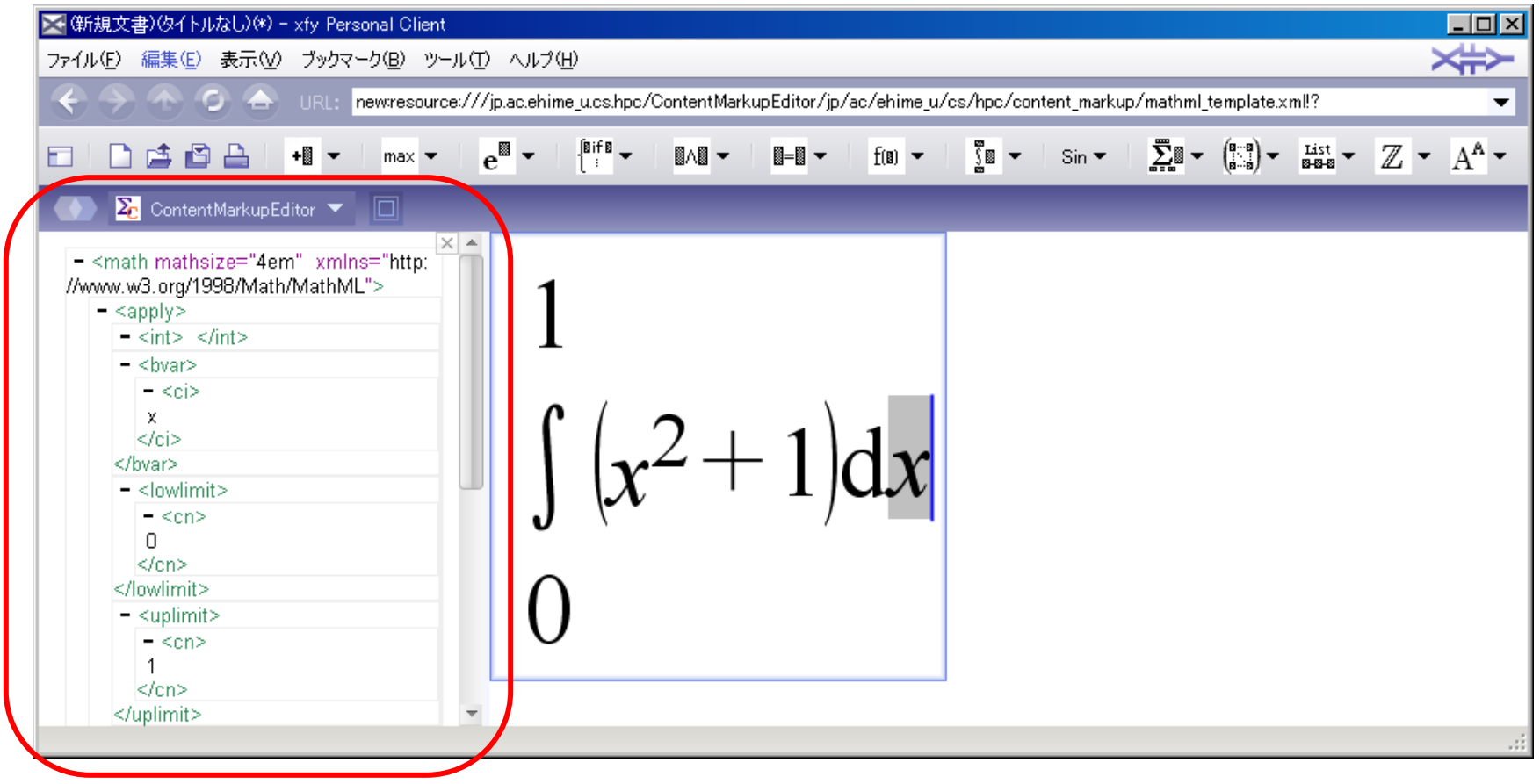
- Template editing results in a bad experience for the user.
- Expressions edited by the direct input may lack semantic information.

⇒ Our approach adopts “Template + Direct input”.

A screenshot of our editor



A screenshot of our editor



Display MathML interactively

Usability test

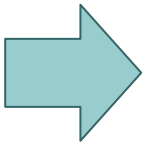
- Usability of Template and direct input of our editor
- Comparisons
  - Our editor
  - Formulator 3.7 MathML Weaver（FMW）
  - Integre MathML Equation Editor（IMEE）
  - Xfy presentation markup editor (XPME)
- Experiments
  - We defined the input cost for 10 expressions as follows:

$$\text{input cost} = \sum_{k=1}^{10} \left(\#\text{clicks}_k + \#\text{typings}_k \right)$$

  - The number of samples is 7 (undergraduate student: 5, graduate student: 2).

A hypothesis test（t-test）

- Null hypothesis（H_0）
  - The average input cost of our editor do not differ from ones of other editors.
- Alternate hypothesis（H_1）
  - The average input cost of our editor is less than ones of other editors.



One-sided test （Significance level：5%）

Results

× ・・・ large Input cost
— ・・・ no difference

Table : Average input cost

	FMW	IMEE	XPME
Our editor	-	-	×

- Compare our editor with FMW and IMEE
  - ➔ No difference about the average input cost
- Compare our editor with MathML presentation markup editor
  - ➔ Our editor has large input cost

→ We can conclude our editor is a normal editor in a sense as a content markup editor

Editing by computer algebra system

- Benefit of CAS in MathML editor
  - Validation of the input
    - Incorrect input $(x+1)^2 = x^2 + x + 1 \in Z[x]$
  - Shortcut of the input
    - When we input $x^5 + 5x^4 + 10x^3 + 10x^2 + 5x + 1$ it may be useful if we can use expansion of the polynomial $(x+1)^5$ on the editor

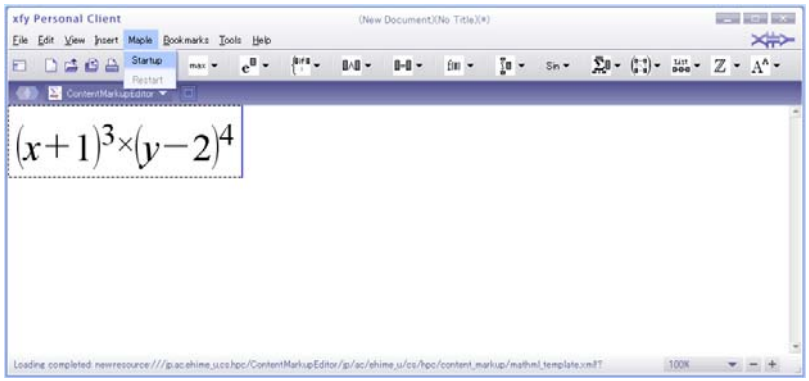
How can we access CAS from MathML editor?

- In such application of CAS, we do not need full functionalities of CAS.
- Efficient implementation and good usability (interactive inputs) are very important.
- How can we access CAS effectively ?
- A solution
  - We need to get a list of available functions for the expression and choose a function to be performed among them. (likewise the Maple context menu shown by right click on a expression)
  - Available functions are collected from
    - Computer Algebra Systems
    - Mathematical Web services
  - For the purpose, we need to have a characterization of (sub)expressions in MathML content markup.
    (This is a future work)

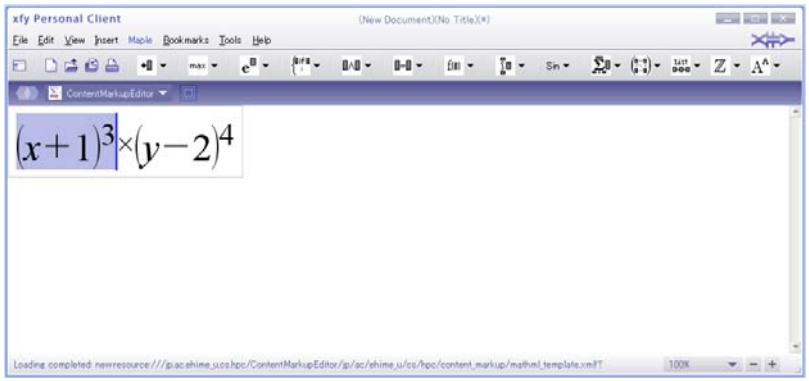
Short cut by maple

- CASs supporing MathML input/output
  - Maple, Mathematica, …
- For example, Maple has
  - MathML package
    - MathML Input, Output
  - OpenMaple
    - Maple API in C/Java/VB
- Using these Maple functionalities, it is easy to call Maple functions from the xfy MathML editor.

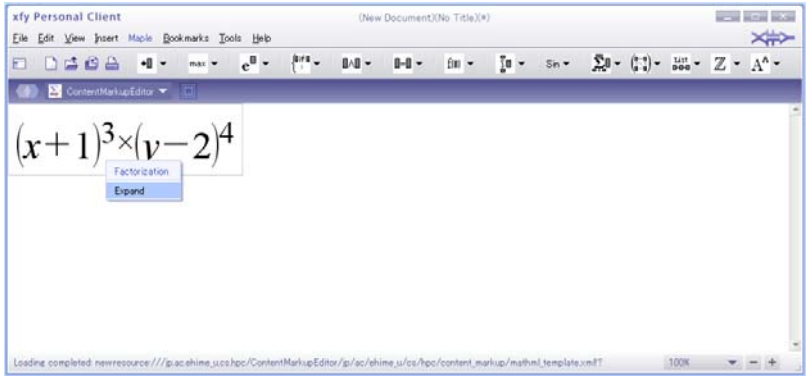
Editing of the subexpression



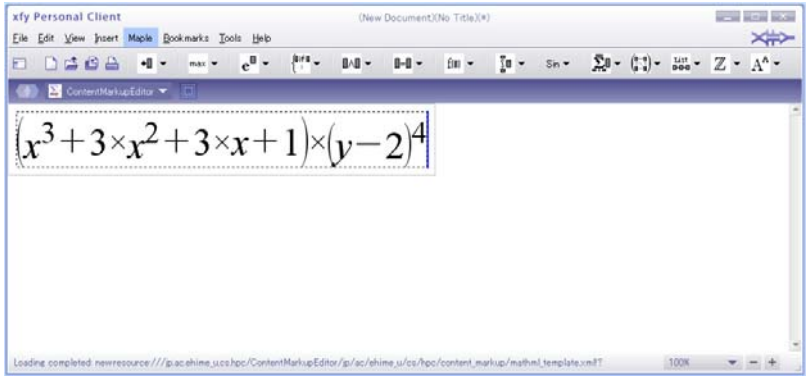
1. Input a expression



2. Mark a region to edit



3. Choose an operation



4. Obtain the result

Conclusions and future work

- From a point of view of an application of the compact computer algebra, we proposed a content markup editor
  - Editing using computer algebra system
  - Unlike the other content markup editors, our editor provides a seamless authoring environment for MathML content markup embedded in compound XML documents.
  - Our editor is normal as a content markup editor.

Conclusions and future work

- How can we improve the user-interface to provide more freely inputs to users, acting like presentation markup editors ?
- We should consider an efficient and interactive method to select operations appropriate to the subexpression to be processed.