MathML without Plugins using VML

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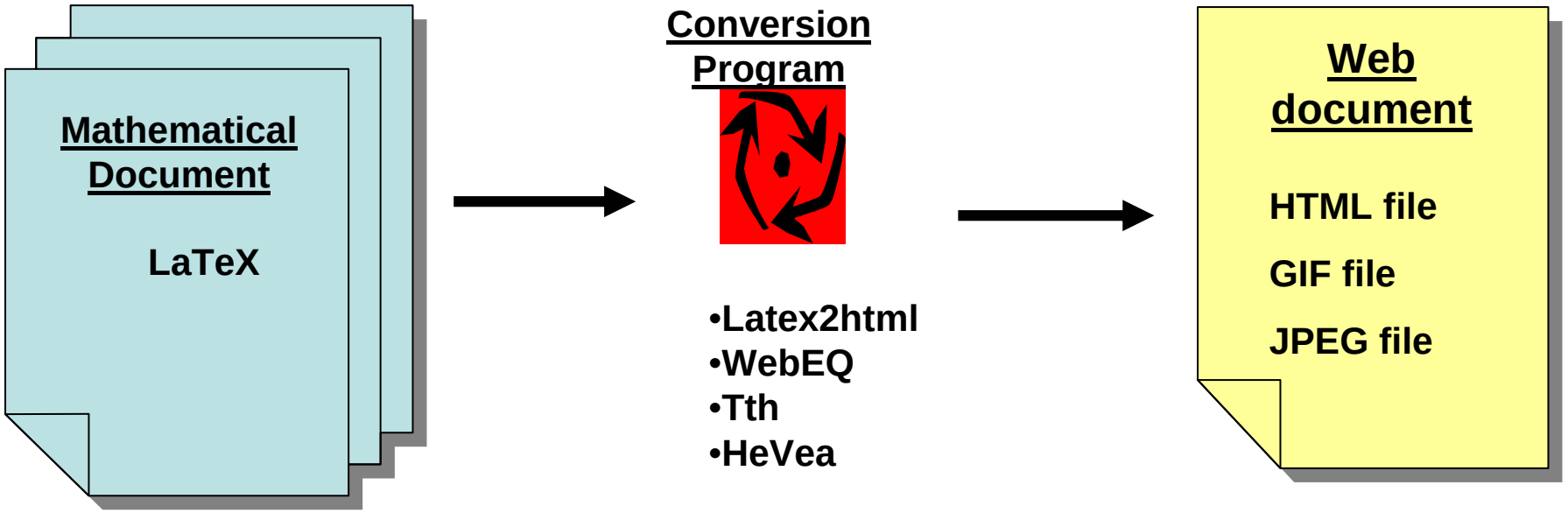
Outline

- Introduction
  - Standard way to view math on the Web
  - MathML
  - Vector Graphics
- Project Objective
- Design
- Deployment
- Conclusion

Introduction

- Standard way to view math on the Web



Disadvantages of existing results

- **Graphic file**

  (GIF or JPEG file)
  - Generates big sized file
  - Slow to load
  - Difficult to maintain
- **HTML**
  - Small size
  - Bad quality
  - Bad alignment

GIF FILE
1.71 KB

$$\sqrt{x} + \sqrt{\frac{x}{2}} + \sqrt[3]{\frac{2+\mu}{\sqrt{x}}}$$

HTML

√x + √(x/2) + 3√((2+μ)/√x)

MathML

- An XML based mark-up language for displaying math on the Web
- There are ways to convert Latex to MathML
- Only few Web browsers natively support it (Amaya, Mozilla)
- Popular browsers need Plugins to view it

Advantages of Vector Graphic

- Plain text format
- Scalable
- Zoomable
- Searchable and selectable text
- Scripting and animation
- True XML

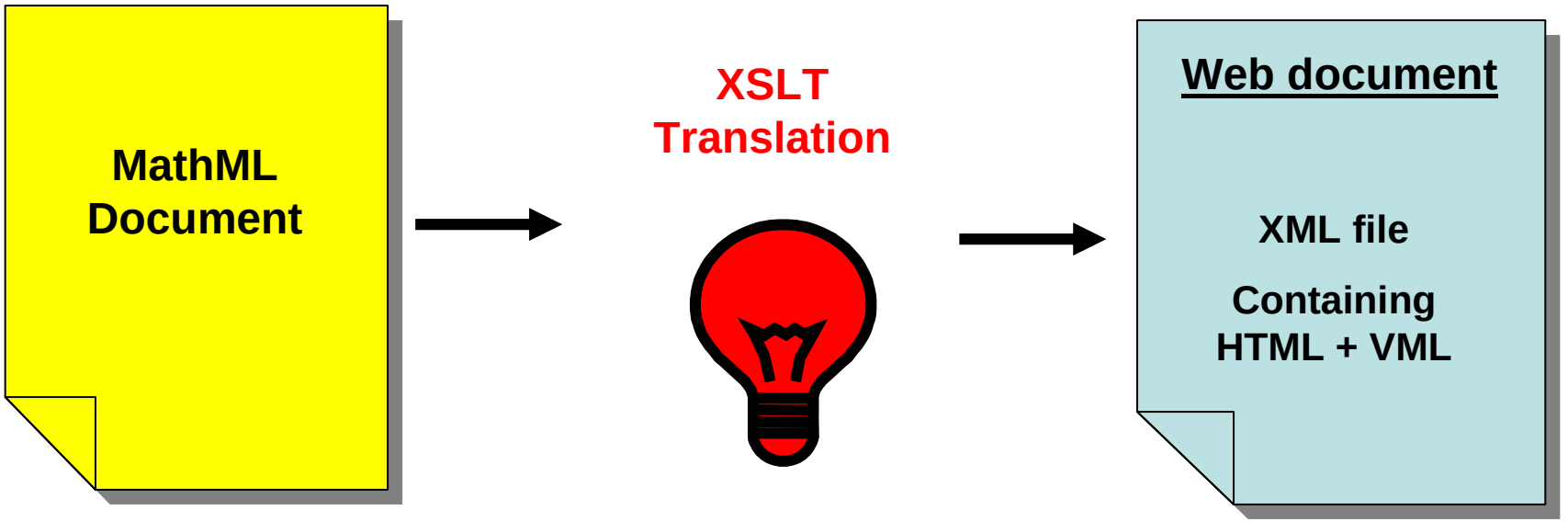
Vector Graphic Markup Language

- VML –Vector graphic Markup Language
  - Natively supported by Internet Explorer
- SVG – Scalable Vector Graphics
  - Standard vector graphic markup language by W3C

Reasons for choosing VML over SVG for this project

- VML can be viewed by Internet Explorer without using any Plugins
- Even though, SVG is an international standard language, it is not yet supported by any of the popular browsers
- VML’s capabilities are sufficient to draw mathematical expressions.

Project objective



XSLT

- e**X**tensible **S**tylesheet **L**anguage **T**ransformations
- Convert XML files that contains MathML to XML file containing HTML and VML
- Internet Explorer supports XSLT
- soon will be, available on the majority of desktop browsers

Design

- MathML
  - **Content Markup:** concerned with the semantics of mathematics.
  - **Presentation Markup:** concerned with the rendering of mathematics.
  - EG. X + Y

Content Markup

```
<apply>
  <plus>
    <ci> X </ci>
    <ci> Y </ci>
  </plus>
</apply>
```

Presentation Markup

```
<mi>X</mi>
<mo>+</mo>
<mi>Y</mi>
```

Continued

- This project translates only MathML Presentation Markup.
- Most software application programs generate the MathML in Presentation Markup.
- MathML Content2Presentation Transformation is able to translate content markup expressions into presentation markup expressions automatically.
- Content2Presentation gives a very precise translation.

MathML Presentation Markup

- The presentation elements are divided into two main groups:
  - Token elements group

    <mi> Identifier, E.g. X, Y, A, B

    <mo> Operator, E.g.+, -, =, >, <

    <mn> Number, E.g.1, 10, 999.0093

    E.g. A+2

    <mi>A</mi>

    <mo>+</mo>

    <mn>2</mn>

MathML Presentation Markup

- **Layout element group:**

  <msub> Subscript, E.g. $a_1 \quad a_2 \quad a_3$

  <msqrt> Square root, E.g. $\sqrt{4\,ac}$

  – E.g. Syntax for root element : <mroot> base index </mroot>

```
<mroot>
   <mrow>
     <mn>4</mn>
     <mi>a</mi>
     <mi>c</mi>
   </mrow>
   <mi>x</mi>
</mroot>
```

$\sqrt[x]{4\,ac}$

MathML Presentation Mode

Category	Tag	Description
Token Elements:	<mi>	identifier
	<mn>	number
	<mo>	operator, fence, or separator
	<mtext>	text
	<mspace/>	space
General Layout:	<ms>	string literal
	<mrow>	group any number of sub-expressions
	<mfrac>	form a fraction from two sub-expressions
	<msqrt>	form a square root sign
	<mroot>	form a radical with specified index
	<mstyle>	style change
	<merror>	enclose a syntax error message
	<mpadded>	adjust space around content
	<mphantom>	make content invisible but preserve its size
	<mfenced>	surround content with a pair of fences
	<mrow>	group any number of sub-expressions
	<mfrac>	form a fraction from two sub-expressions
	<msqrt>	form a square root sign
Scripts and Limits:	<msub>	attach a subscript to a base
	<msubsup>	attach a subscript-superscript pair to a base
	<munder>	attach an underscript to a base
	<mover>	attach an overscript to a base
	<munderover>	attach an underscript-overscript pair to a base
	<mmultiscripts>	attach prescripts and tensor indices to a base
Tables:	<mtable>	form a table structure
	<mtr>	Form a row in a table
	<mtd>	form a column in a table
	<mlabeledtr>	form a row with label
	<malignmark/>	set group alignment
	<malignmark/>	set element alignment
Actions:	<maction>	set HTML actions to a sub-expression

XSLT Structure

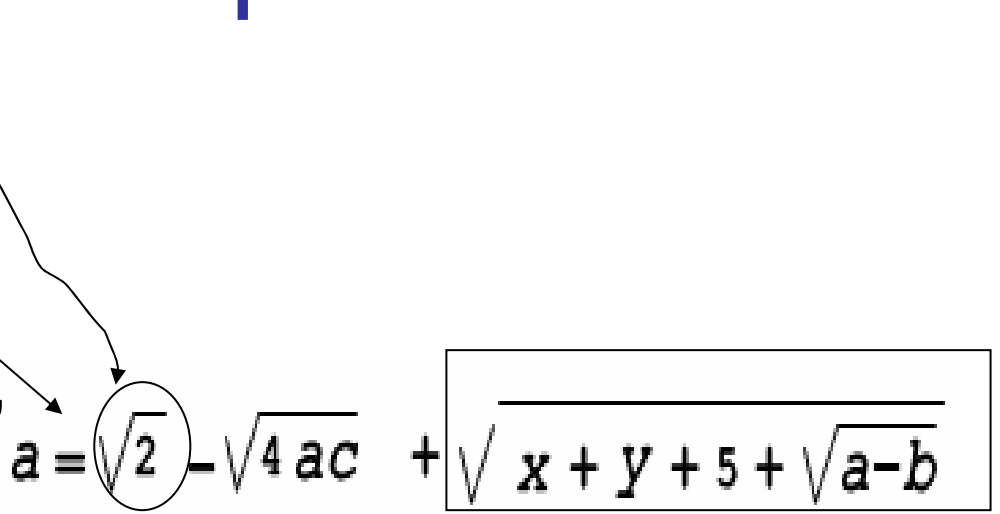
- Tree structure
- XPath
  - Enables you to refer to specific sections of XML document
- Weakness of XSLT
  - Did not provide For-loop, find max or min, etc.
  - Difficult to change the value within the same functions

Design Model

- Hierarchy value passing design
- Table design
- Vector graphic design
- MathML design

Example

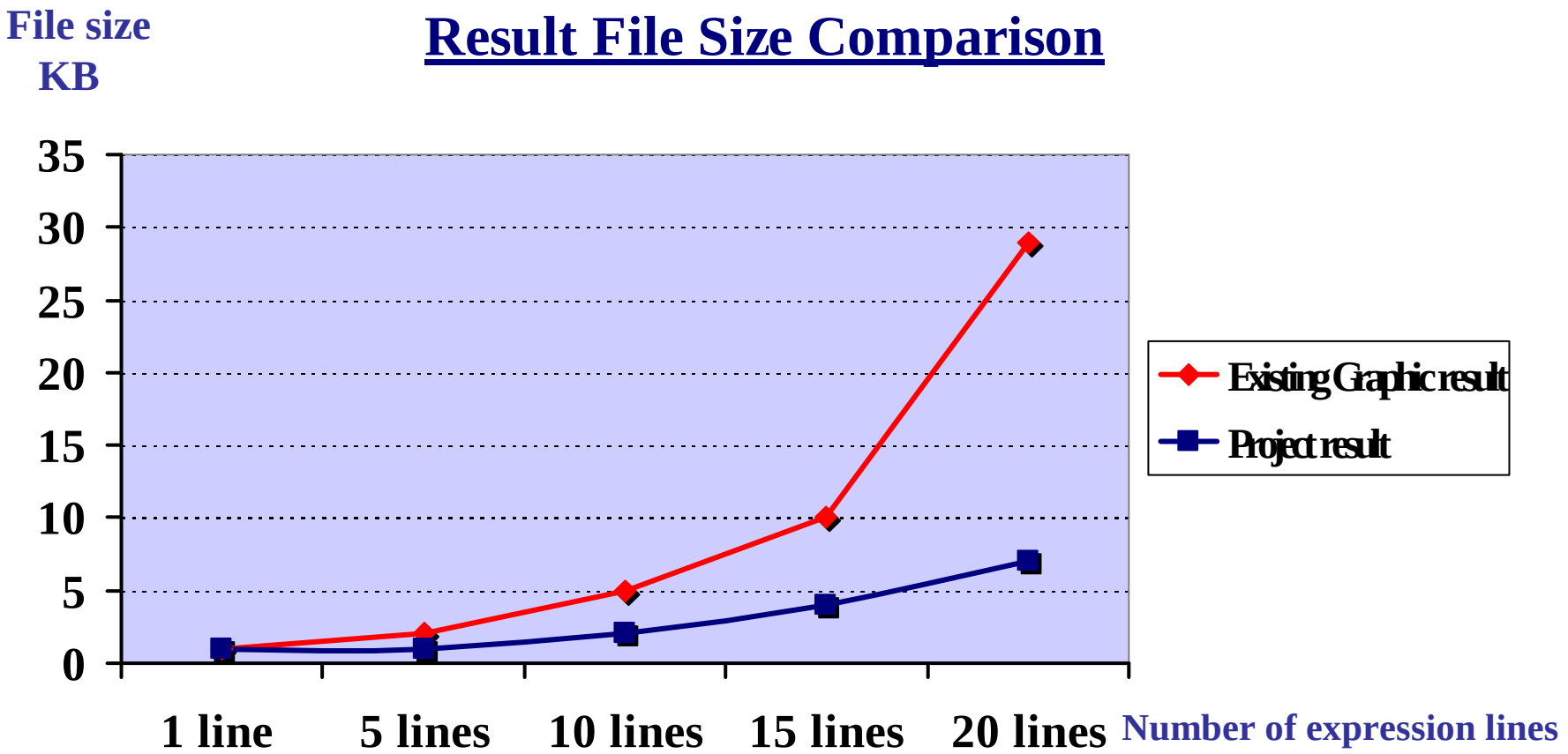
```
<math>
    <mi>a</mi>
    <mo>=</mo>

    <msqrt>
      <mn>2</mn>
    </msqrt>

    <mo>-</mo>

    <msqrt>
      <mrow>
            <mn>4</mn>
            <mi>a</mi>
            <mi>c</mi>
      </mrow>
    </msqrt>

    <mo> + </mo>

    <msqrt>
     <mrow>

            <mi>x</mi>
            <mo>+</mo>
            <mi>y</mi>
            <mo>+</mo>
            <mn>5</mn>
            <mo>+</mo>

            <msqrt>
                <mrow>
                    <mi>a</mi>
                    <mo>-</mo>
                    <mi>b</mi>
                </mrow>
            </msqrt>
     </mrow>
    </msqrt>

</math>
```



Translation Simulation

$$a = \sqrt{2} - \sqrt{4ac} + \sqrt{x + y + 5 + \sqrt{a-b}}$$

Deployment


Result File Size Comparison
File size
KB
35
30
25
20
15
10
5
0
1 line
5 lines
10 lines
15 lines
20 lines
Number of expression lines
Existing Graphic result
Project result

Conclusion

- Using this approach, Mathematical expressions can be rendered on the Web without using any type of Plugins.
- Generate much smaller result file than the conventional way that uses image file such as Bitmapped or GIF or JPEG format.
- Better rendering result than those displaying the result using plain HTML.