Mathematical Expressions and HTML

Lui Kwan Ho, Chow Kwan Wai and Lau Yiu Chung

Advised by
Prof. Fangzhen LIN

INTRODUCTION

During the development of technology, there are more and more methods for describing mathematical notations. These methods aim at integrating mathematical formulae into World Wide Web pages. The goal of this project is to find out an easy, fast, and inexpensive way to display mathematical formulas on web pages. Our project will focus on the following steps:

1. To identify and evaluate the current approaches in displaying mathematical expressions on web pages;
2. To analyze the advantages and disadvantages of each approach;
3. To pinpoint the best available approach (MathJax), and enhance its usability.

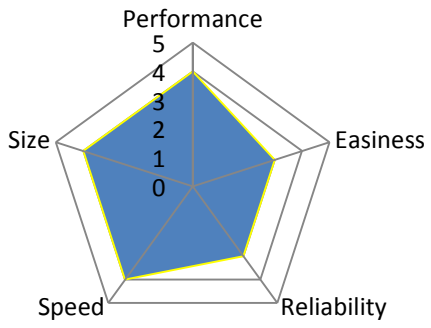
Finally, a website with user-friendly interface will be created to display mathematical formulas using MathJax.

OVERVIEW

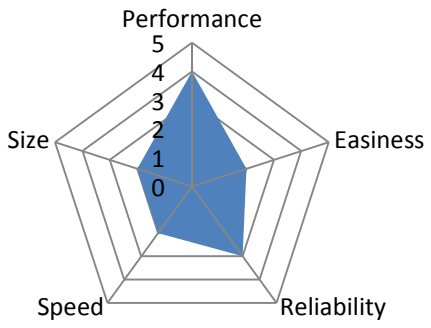
1) **Mathematical Markup Language (MathML)**
   An application of XML for representing mathematical formula in web page
2) **Fancy HTML with Cascading Style Sheets (CSS)**
   The language for describing the presentation of web pages, including colors, layout, and fonts
3) **Image**
   including raster graphics and vector graphics
4) **LaTeX**
   A document markup language and document preparation system for the TeX typesetting program.
5) **MathJax**
   An open-source JavaScript display engine for LaTeX and MathML that works in all modern browsers

COMPARISON BETWEEN DIFFERENT APPROACHES

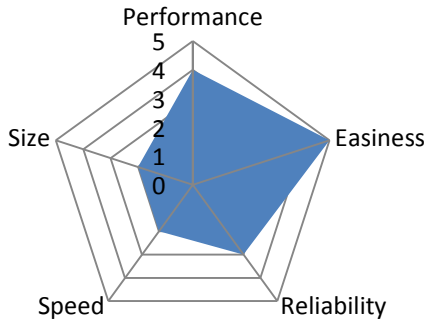
MathML



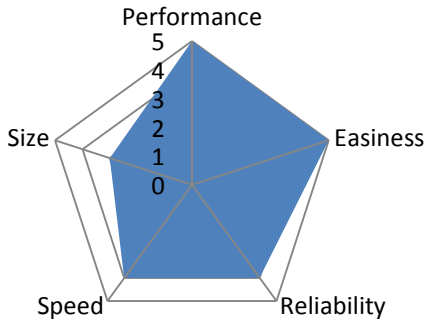
Fancy HTML with CSS



Image



LaTex (MathJax)



---------- MATHJAX – THE BEST APPROACH ----------

MathJax is an open-source JavaScript display engine for LaTeX and MathML that works in all modern browsers. MathJax uses web-based fonts to produce high-quality typesetting that scales and prints at full resolution.

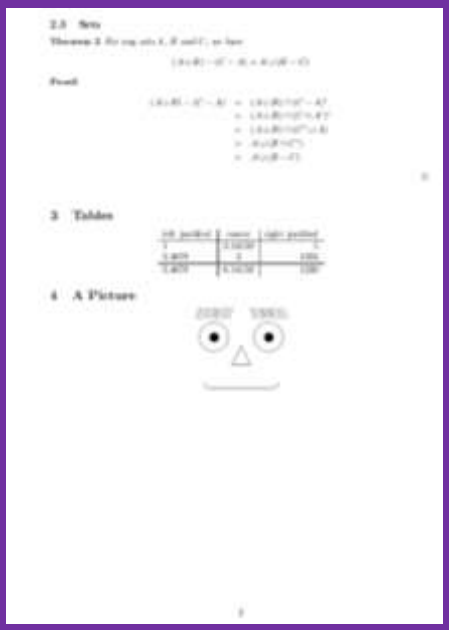
Examples of math rendered by MathJax

$$f(a) = \frac{1}{2\pi i} \oint_\gamma \frac{f(z)}{z-a}\, dz$$

Strength:

- It has a satisfying result by having excellent rendering quality across all the browsers.
- It requires no specific installation for the visitors
- It can input math using LaTeX command which is not nested and complicated.
- It supports using MathML and LaTeX markup that increase its usability and the range of users.

---------- Improving MathJax (1) ----------



Some LaTeX commands were not supported by MathJax, for example the commands for documentation and layout. To solve the problem, Pandoc / JaxEdit / Tex4ht with MathJax were used to convert LaTeX file to webpage.

	TeX4ht	Pandoc	JaxEdit
Online Convert	NO	NO	YES
Correct Display	YES	NO (No typesetting)	NO
Support LaTeX Documentation Commands	YES	SOME	Only support 18 commands
Math Commands output format	Image / MathML	LaTeX	LaTeX
Output Files	Multiple files includes CSS, Image, html, etc.	One html file	NO
Overall Performance	**NORMAL**	**GOOD**	**BAD**

---------- Improving MathJax (2) ----------

MathJax usually used different fonts to indicate the function and its variables. For example, the fonts of 'sech' should be different with the font of 'x' shown in figure 1. However, the hyperbolic secant function showed by MathJax was actually shown in the style of figure 2. It is because MathJax did not support the hyperbolic secant function.

$\operatorname{sech} x$

Figure 1

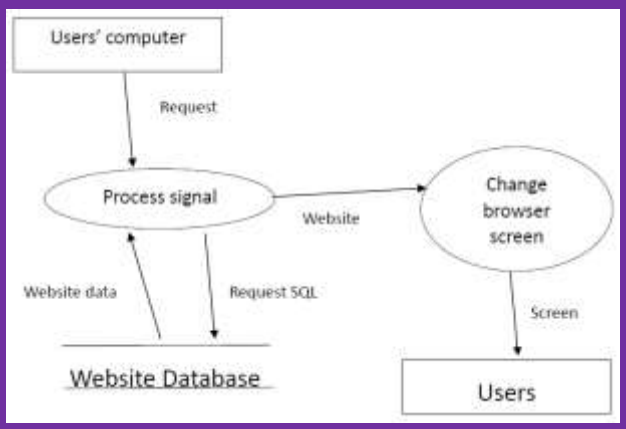
sech x

Figure 2

After we improved the library (local.js) of MathJax, several commands shown in the list were supported by MathJax now.

sech x	csch x
arccot x	arccsc x
arcsec x	arccsch x
arcsinh x	arccosh x
arctanh x	arccoth x
arcsech x	**R** (Real Number)
α	**N** (Natural Number)

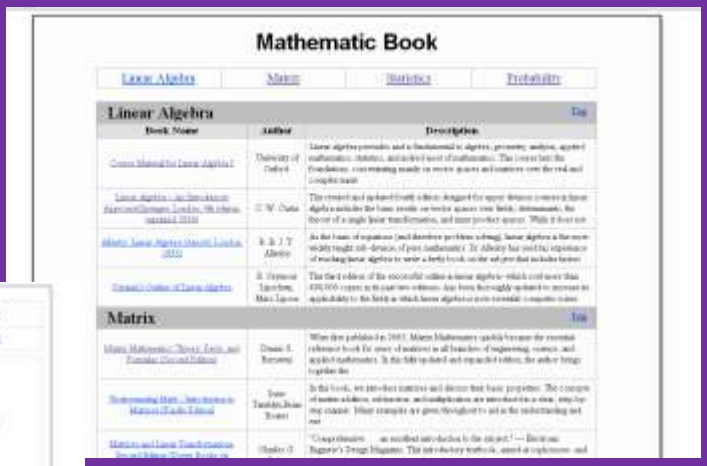
---------- THE WEBSITE ----------

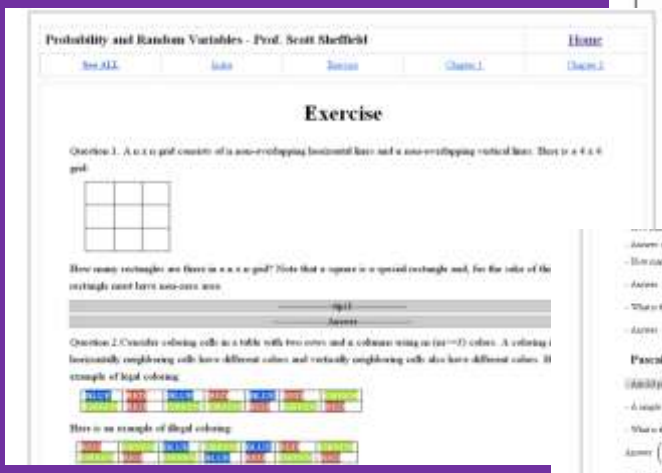


The formulas on the webpage were rendered by MathJax. To let students learn mathematics by themselves. The mathematics books and the exercises were provided by the website. Not only answer, but also tips for the problems were provided to students so that they can understand logic flow of the problem.

The homepage of the website ➡

Exercise on the webpage ⬇





The formulas on the webpage were rendered by MathJax. ➡