

Accessibility Features in the new MathJax Version 3

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progressiveaccess.com



Joint work with Davide Cervone

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- ① What is MathJax?
- ② Math documents on the Web
- ③ Overview of MathJax's accessible extension
- ④ New Advanced Accessibility features
 - Multiple Rule Sets
 - Specialist Domains
 - Braille Output

What is MathJax?

- MathJax is a JavaScript library for rendering Mathematics in all browsers
- Can take \LaTeX , AsciiMath, and MathML as input
- Generates browser output, e.g. HTML/CSS, SVG
- Standard Maths rendering solution for: stackexchange, blogs, mediawiki, etc.

MathJax is the de facto rendering solution of (nearly) all Mathematics on the web (in 2016: 35 million unique daily rendering requests via CDN)

<http://www.mathjax.org>

- Common sources for Maths document:
 \LaTeX , Word, Markdown
- Translate into HTML format for the web (e.g., using pandoc at <http://pandoc.org>)
- Integrate MathJax directly from CDNjs
- Configure according to the need of your web document
- Local installations possible
- Detailed documentation available at:
<http://docs.mathjax.org>
- Large user community and support

- Inbuilt and optional accessibility features
- Selectable in context menu since MathJax v2.7
- Generally available in every page using MathJax
- Needs to be selected explicitly
- Runs on every platform with every screen reader

More details at:

[https://www.mathjax.org/
mathjax-accessibility-extensions-v1-now-available/](https://www.mathjax.org/mathjax-accessibility-extensions-v1-now-available/)

Generating Accessible Math

- Speech strings are computed with Speech Rule Engine (SRE)
- Javascript library for translating XML into Speech (markup)
- Open source library:
`github.com/zorkow/speech-rule-engine`
- Only Math speech solution in JavaScript
- Runs in browser, command line, as node module.
- Initially implemented in the context of ChromeVox
- Speech solution for: ChromeVox, MathJax, EquatIO, MathLive, Wikipedia. . .

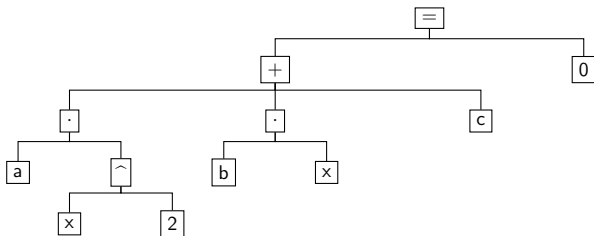
Closing the Semantic Gap

- Problem is that we have MathML as input language

$$ax^2 + bx + c = 0$$

is rewritten from its Presentation MathML representation into its semantic interpretation:

```
<math>
  <mi>a</mi>
  <msup>
    <mi>x</mi>
    <mn>2</mn>
  </msup>
  <mo>+</mo>
  <mi>b</mi>
  <mi>x</mi>
  <mo>+</mo>
  <mi>c</mi>
  <mo>=</mo>
  <mn>0</mn>
</math>
```



Integration into MathJax

- A11Y features based on Semantic Enrichment
- Speech Rule Engine derives a semantic representation
- Representation is independent of the input format
- Semantic is folded into the browser content
- Rendered without altering the visual layout
- Provides an alternative view on an expression

MathJax's AT Features

- Magnification
- Responsive Equations and Abstraction
- Highlighting
- Interactive Exploration
- Speech Generation

Magnification

- Zoom feature for single math expression
- Magnification up to 500%
- Option selectable in context menu
- Customisable trigger via mouse and keyboard actions

Aural Rendering and Highlighting

- Speech strings are computed with Speech Rule Engine (SRE)
 - special summarisation rules
 - abstraction via interactive collapse
- WAI-ARIA and CSS to implement interactive exploration
 - Speech output by updating ARIA live regions
 - Colour/contrast changes by rewriting CSS properties
- Enhanced reflow by exploiting semantic enrichment for linebreaking
- Works with all platforms, browsers, and screen readers supporting live regions

- “Walkers” allow to interactively dive into mathematical expression
- Synchronised highlighting together with aural rendering
- Use `<shift><space>` to explore expressions
- Simple navigation model using arrow keys
- Interactive collapse and expansion of sub-expressions

V3: Larger Choice of Rule Sets

- MathSpeak
 - Three different verbosity levels
 - Very strict disambiguation
- ClearSpeak (sponsored by Mozilla foundation)
 - Multitude of difference preference settings
 - Less disambiguation, more geared towards highschool and undergraduate level Math
- Nemeth Braille
- A number of specialist rules for other domains

- Provides Nemeth Braille translation in Speech Rule Engine
- Does NOT use liblouis!
- Implements translation of all the Unicode math fonts to Braille

Integration into MathJax:

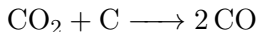
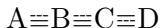
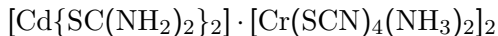
- Both speech and Braille can be exposed
 - Speech goes to screen reader
 - Nemeth goes to Braille display

Sponsored by BTAA (Big Ten Academic Alliance)

V3: Specialist Rules for Chemistry

- Semantic heuristics for speaking chemical formulas
- Based on the mhchem package

Examples:



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V3: Specialist Rules for Physics

- Semantic heuristics for physics/quantum mechanics
- Based on the braket and physics packages

Examples:

$$\begin{aligned}\langle\phi|\psi\rangle \\ \langle\phi|\mathbf{A}|\psi\rangle \\ |A\rangle = |B\rangle + |C\rangle \\ |C\rangle = (-1 + 2i)|D\rangle \\ |D\rangle = \int_{-\infty}^{\infty} e^{-x^2} |x\rangle dx\end{aligned}$$

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V3: Specialist Rules for Computer Science/Logic

- Semantic heuristics for logic and inferences
- Based on the bussproofs and eproofs packages

Examples:

$$\frac{\frac{\frac{\overline{P} \text{ Hyp}^1}{P} \quad P \rightarrow Q}{Q^2} \rightarrow_E \quad \frac{Q \rightarrow R}{R} \rightarrow_E \quad \frac{Q}{Q} \text{ Rit}^2}{\frac{Q \wedge R}{P \rightarrow Q \wedge R} \rightarrow_I^1} \wedge_I$$

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V3: Other Personalisation Aspects

- Additional Dyslexia/Dyscalculia Support
- Targeted magnification
- Highlighting and high contrast separation
 - Color selections
- Tree-colouring Example:

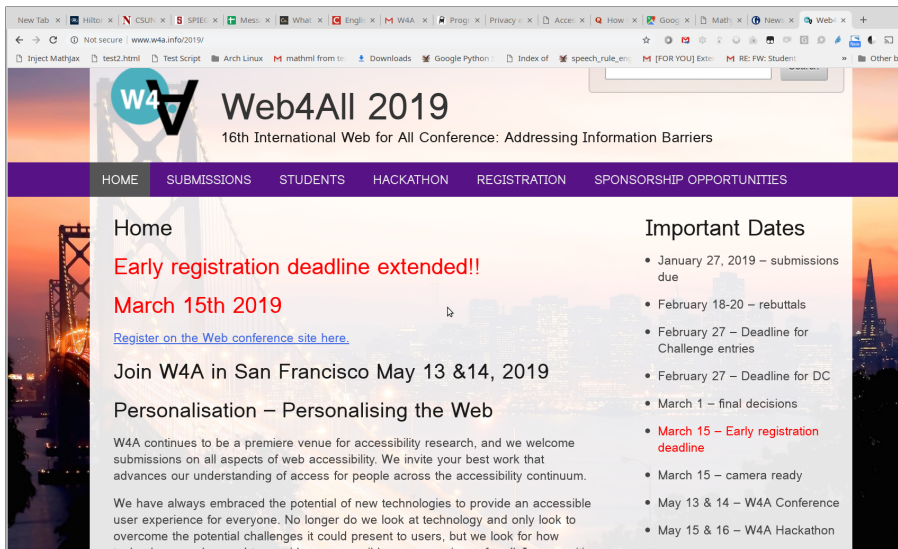
$$ax^2+bx+c=0$$

Conclusion

- Take home messages:
 - Think about moving resources to the web instead of to a platform dependent proprietary format
 - Don't throw away your \LaTeX sources
 - Don't be afraid of the command line
- MathJax Version 3 is currently in Beta-2
- Beta-3 will include new A11Y features
- Full release by the end of the year

- MathJax: mathjax.org
- MathJax v3: github.com/mathjax/mathjax-v3
- Speech Rule Engine:
github.com/zorkow/speech-rule-engine
- PanDoc: pandoc.org
- Interactive Workshop on Math and STEM Accessibility:
progressiveaccess.com/empower18

Shameless Plug: W4A

A screenshot of a web browser displaying the W4A 2019 website. The browser's address bar shows 'www.w4a.info/2019/'. The website has a purple header with the 'W4A' logo and the text 'Web4All 2019' and '16th International Web for All Conference: Addressing Information Barriers'. Below the header is a navigation bar with links: HOME, SUBMISSIONS, STUDENTS, HACKATHON, REGISTRATION, and SPONSORSHIP OPPORTUNITIES. The main content area is divided into two columns. The left column has a 'Home' section with the text 'Early registration deadline extended!!' in red, followed by 'March 15th 2019' in red, and a link 'Register on the Web conference site here.' Below this is a section titled 'Join W4A in San Francisco May 13 & 14, 2019' and 'Personalisation – Personalising the Web', followed by two paragraphs of text. The right column has a section titled 'Important Dates' followed by a list of dates and events. The background of the website features a cityscape at night with a bridge and a tall building.

New Tab x Hiltor x CSUN x SPIEGEL x Mess x What x Engl x W4A x Prog x Privacy x Acces x How x Goog x Math x New x Web x +

Not secure | www.w4a.info/2019/

Inject MathJax | test2.html | Test Script | Arch Linux | mathml from te | Downloads | Google Python | Index of | speech_rule_eng | [FOR YOU] Ext: | RE: FW: Student | Other b

W4A Web4All 2019

16th International Web for All Conference: Addressing Information Barriers

HOME SUBMISSIONS STUDENTS HACKATHON REGISTRATION SPONSORSHIP OPPORTUNITIES

Home

Early registration deadline extended!!

March 15th 2019

[Register on the Web conference site here.](#)

Join W4A in San Francisco May 13 & 14, 2019

Personalisation – Personalising the Web

W4A continues to be a premiere venue for accessibility research, and we welcome submissions on all aspects of web accessibility. We invite your best work that advances our understanding of access for people across the accessibility continuum.

We have always embraced the potential of new technologies to provide an accessible user experience for everyone. No longer do we look at technology and only look to overcome the potential challenges it could present to users, but we look for how

Important Dates

- January 27, 2019 – submissions due
- February 18-20 – rebuttals
- February 27 – Deadline for Challenge entries
- February 27 – Deadline for DC
- March 1 – final decisions
- March 15 – Early registration deadline**
- March 15 – camera ready
- May 13 & 14 – W4A Conference
- May 15 & 16 – W4A Hackathon

Acknowledgements

- Simons Foundation
- Big Ten Academic Alliance
- Mozilla Foundation
- TextHelp: For localisations into Spanish and French