# Accessibility Features in the new MathJax Version 3

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MathJax is a Javascript library for high quality typesetting of mathematics on the web. Since its beginnings one of its goals is to provide accessibility support for blind and visually impaired people; either by supporting third party assistive technology or, more recently, via its own integrated accessibility extension. MathJax has undergone a major reimplementation effort over the last two years and in the new version 3 release, the accessibility extension is again an important aspect of the library. We will present an overview of the accessibility features of MathJax, which include:

* Automatic voicing of formulas
* A choice of speech rules like MathSpeak and ClearSpeak
* Interactive navigation with synchronised highlighting
* Nemeth Braille output
* Support for advanced mathematical content

## MathJax and Accessibility

Although mathematical formulas on the web can be represented in their own specialized markup language (MathML), which part of the HTML5 standard, only very few major browsers implement MathML rendering natively. Consequently the MathJax library has become a quasi-standard for displaying mathematics on the web with the added advantage that it can directly process syntactic formats generally preferred by mathematicians, like LaTeX and AsciiMath.

While MathJax provides some accessibility support such as zoom, magnification, and copy&paste features, directly, its main focus is on high-end typesetting in all browsers and on all platforms. More advanced accessibility features are supplied via the Speech Rule Engine (SRE), an open source library for generating speech for mathematics on the web. SRE processes syntactic mathematical expression, e.g., expression given in Presentation MathML, and gives them a more meaningful semantic interpretation, which can then be translated into speech output. This semantic representation also serves as basis of other interactive accessibility features implemented with SRE.

## Screen Reading and Braille Support

MathJax provides accessibility support for readers that rely on screen reading technology by exposing the speech generated by SRE. It thereby aims to follow its philosophy to render mathematics regardless of the particular user environment. That is, it aims to provide the same user experience, for all browsers and platforms. For aural rendering, this means that it tries to present speech output regardless of whether or not a screen reader has native mathematics support.

This is achieved in several ways: Speech for an entire expression is given via aria-labels to screen readers. Alternatively, speech events for all component sub-expressions are supplied via an exploration interface that can be triggered when focus is on a formula. This interface allows a user to interact with a complex formula by step-wise exploring it, listening to the expression and its components at their own speed and at a progressively more finegrained granularity. This exploration interface also provides support for dyslexic user via synchronised highlighting of expression during speech generation and interaction.

SRE provides a number of rule sets to generate different types of speech for mathematics, the most prominent of which are MathSpeak and ClearSpeak. These rule sets can be chosen either by the content author or by the reader via user options. This allows a customization of the reading experience to suit both the particular mathematical content and the readers personal preferences.

Thanks to funding from the Big-10 Universities, in its latest version, SRE adds support for Nemeth braille in its output options. This feature has been integrated into MathJax to enable simultaneous output of speech via a screen reader and braille via a braille display.

## Support for Advanced Mathematics

While much of the existing assistive technology support for mathematics is aimed at secondary school education, the new accessibility features in MathJax also aim to provide better support for more advanced mathematics found typically in University teaching and research, where sources are generally available as LaTeX markup. With support from the Simons Foundation, we developed improved semantic recognition of source material as well as means to exploit context information in documents. One particular emphasis is to provide better accessibility to advanced mathematical content exploiting information gained from the original LaTeX code, to provide more appropriate speech for different areas of Mathematics but also for subjects like Physics, Chemistry and Logic. While this goes beyond what is possible with well defined rule sets like MathSpeak or ClearSpeak, the goal is to fit the generated language closer to what is actually used in a particular scientific subject. In particular, our aim is therefore to ease the study of mathematics for more people with visual impairments as well as to encourage subject specialists to contribute via better authored content, semantically meaningful LaTeX packages, and expert knowledge for speech generation.