Accessible Sketchpad - Math Images

# Background Information

The DIAGRAM Center strives to ensure that accessible educational material is created, published and available for all types of disabilities and learning styles. Accessible math is one area that we are very interested in improving. Doing math on the web is becoming more prevalent and having an accessible way to show your work including sketch's, diagrams, and notes in an accessible way is currently not available.

Benetech Labs has created [Mathshare](https://mathshare.benetech.org/) (currently in beta) which is the first accessible solution that allows a student to answer a math question online and includes the steps the student took to show their work and send this back to the teacher. One of the features Mathshare has is a sketch pad to draw diagrams, but this is not fully accessible. In this project we would like to explore a tool that provides an accessible way to both create and explore mathematical diagrams.

We would like to create a stand-alone widget that could be incorporated into Mathshare or other online solutions that allows the user to pick from a library of diagram types, provide the necessary parameters, and automatically generate an accessible SVG. Ideally this tool would be written in vanilla HTML/CSS/JS to maximize integration possibilities with other platforms.

We chose SVG as the output image format since it can be made accessible and allows a student with assistive technologies such as a screen reader the ability to explore the image to get more information about the sub components the image has. For some technical details, please see: [Accessible SVG Graphs](https://css-tricks.com/accessible-svgs/#article-header-id-3). Also SVG images scale to any size without pixelation which will also help with low vision users.

To start we would like to limit the scope to a few basic geometric concepts such as:

* Pythagorean theorem (right triangles)
* Polygons where one can set the number of sides
* Ellipses

For these examples, we imagine the automatic creation of these diagrams would follow from a user providing several parameters such as: the labels/length of sides, angles, radius/diameter, circumference, line thickness, or line color. This would make it significantly more usable for students with physical disabilities or who use keyboard navigation, and could also potentially benefit students who use screen readers. See Figures 1 and 2 below on a possible solution.

We see that this tool could be expanded in the future to support other diagram types, for example simple charts and graphs.

Figure 1: Polygons

Sketch Pad Area:
Triangle labelled ABC with side AB=1, BC=2, CA=3, and angle B=90 degrees.

Below sketch Pad is a post-it note with 3 tabs Polygons, ellipses, and free hand.

Polygons are selected 
# sides = 3
Length AB = 1
Length BC = 2
Legth CA = 3
Angle A: (blank)
Angle B: (blank)
Angle C: (blank)

Figure 2: Ellipses

Sketch Pad Area:
Triangle labelled ABC with side AB=1, BC=2, CA=3, and angle B=90 degrees.

Post-it Note:  Ellipses selected (Polygons and Freehand tabs not selected)

Dropdown: (Circle) selected
radius = (blank)

# Design Requirements

* This accessible Image widget needs to be fully accessible, in both the input as well as the output. (I.E. WCAG-AA 2.1 Compliant). Benetech will be present and can help with this.
  + Input all dropdowns, form fields are accessible and have appropriate labels
  + Output overall image should have an accessible description known as its "Alt Text", we may even consider extended image descriptions if warranted. Individual pieces of the SVG should also have their own textual description (i.e. labels and values within the diagram)
* HTML5, CSS and JavaScript should be the only required technology needed, and hopefully the output accessible SVG image will only contain HTML and CSS styling.

# Useful Links and Additional Information

* **Scalable Vector Graphics (SVG) 2** W3C Candidate Recommendation *04 October 2018:* [*https://www.w3.org/TR/2018/CR-SVG2-20181004/*](https://www.w3.org/TR/2018/CR-SVG2-20181004/)
* Mathshare: <https://mathshare.benetech.org/>
* Mathshare GitHub Repo: <https://github.com/benetech/mathshare>
* Math Detective: <http://mathdetective.btechsandbox.wpengine.com>
* Accessible Data Visualizations (containing both an accessible Heat Map Table and an Assessible SVG Bar Chart.): <http://diagramcenter.org/diagram-reports/diagram-report-2019/datavizualization.html>
* Fizz Studio (Accessible Data Visualizations): <https://fizz.studio>
* **Web Content Accessibility Guidelines (WCAG) 2.1** W3C Recommendation 05 June 2018: <https://www.w3.org/TR/WCAG21/>
* **Accessible Rich Internet Applications (WAI-ARIA) 1.1** W3C Recommendation 14 December 2017: <https://www.w3.org/TR/wai-aria-1.1/>