In higher education, visualizing difficult topics becomes more and more important when it comes to mathematics. Most professors are able to procure a few specific visuals for their lectures, but they often struggle to find good interactive visuals that can be adapted for their needs. Due to this struggle, students’ understanding can be limited to these few examples that they can see, keeping their comprehension from reaching its full potential. This summer, I was hired to create interactive visual demonstrations for the math department using the mathematics programming language Sage.

Sage was chosen for this project because:
- It is one of few free mathematics software packages
- The software is completely open source
- Code can be written and run in the browser
- Calvin has a private Sage server to increase computing speeds
- Sage can be easily embedded into HTML
- Sage incorporates mathematics libraries from other software packages
- Sage has built-in functionality for interactives

The following are some images of the interactives made over the course of the project. Additional demos may be found at http://www.calvin.edu/~scofield/demos/kelsey

**Objectives**
- Research and learn the Sage programming language.
- Create interactive demos to help visualize mathematics, especially for Calculus, Linear Algebra, Differential Equations, and Complex Variables courses.
- Practice skills in LaTeX to provide visuals with a concise explanation.
- Compile the demos onto a website accessible by all Calvin Math department faculty.
- Prepare a research paper to advocate for the use of Sage in education, especially for creating interactive visuals.

**Methods**

The technique for creating interactives was as follows:
- Choose a topic and discuss general design and necessary features
- Write code on Calvin’s private Sage server
- Embed Sage code into an HTML page
- Write a LaTeX description to accompany and explain the Sage code
- Upload original version to GitHub for review
- Address necessary changes to functionality, features, and aesthetics
- Update GitHub repository with new version
- Begin the next demo while waiting for final review

**References**


**Special Thanks**

Professor Thomas Scofield, project supervisor
William Stein – founder of Sage
Gregory Bard – author of “Sage for Undergraduates”, the book from which I learned Sage