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Summer Research 2017

July 26, 2017

SageMathCell apps for visualization of mathematics

The mathematics summer research project SageMathCell apps for visualization of mathematics, by professor Thomas Scofield and student researcher Kelsey Norman, endeavored to create interactive applications using SageMathCell to aid in the visualization of advanced mathematics topics. Professor Scofield pursued this project because he wanted to have electronic visuals to improve his lectures, but he needed help putting them together and using his chosen software package, Sage. Sage is programming software built for pure mathematics, especially in research and education, which aims to compete with the mainstream mathematics software companies, like Mathematica and Magma. Sage was chosen for this project because it is free, easy to learn, and it runs conveniently in a browser. I, the student, easily and quickly learned Sage, then began building interactive demos that can be shared online for the entire mathematics department to use. These demos cover a wide variety of topics, primarily focused on single variable calculus, but also covering multivariable calculus, linear algebra, complex variables, and differential equations. Each demo visualizes a specific topic, often one that is difficult to draw or understand without an image, and is interactive so that a professor can enter any specifics (such as a function or number of iterations) and instantly have a clear, colorful, and precise image of the topic. In such a way the demos are built to show the concept in its most basic form, but can easily be adjusted to show interesting examples or special cases as the professor sees fit.

I approached this problem by first and foremost learning Sage, then practicing the code by interacting with a few demos provided to me by Professor Scofield. Next, Professor Scofield and I composed a list of possible apps to create, picked a few, and began working on them. Over time, we developed a system where Professor Scofield would suggest a new demo, I made a very basic version, he reviewed it and gave me specifications on how to improve it, and I completed a version that worked well and clearly portrayed the topic. Often there would be many demos in progress at once, with new demos being added to the running list while others were completed. To date, nineteen new demos have been completed, with several in process and a few still to begin, along with a short list completed by Professor Scofield before and during this project. Additionally, I have been working on an essay about the uses of Sage for education, which will hopefully be published later this year.

I have had significant personal gains from this project. First and foremost, I got to study mathematics topics in great depth to understand both how to make a visual for specific topics and how to build it in such a way as to visually explain the details of the concept. Constructing the programs has improved my coding skills, especially my speed of writing code and my techniques for efficient problem solving. I have gotten to practice my organizational and communication skills as I kept the list of demos sorted and communicated my progress to Professor Scofield, and the whole process has led me to a better understanding of education from both the professor's and the student's side. As a math and computer science major with goals of becoming a professor myself, this has been a wholly enlightening experience and one that I hope I can use in my future.