

Rob Beezer et al.
UTMOST Grant Committee

December 24, 2015

To whom it may concern:

My name is Drew Youngren. I am a Clinical Assistant Professor of Mathematics at New York University and am writing to express interest in the pending UTMOST proposal, specifically incorporating the use of Sage software in the teaching of linear algebra to undergraduates. I would be interested in teaching at least one section of our undergraduate linear algebra course (MATH-UA 140) in each semester of the 2017–2018 year. I have furthermore spoken to my colleague Trushant Majmudar, who is interested in participating at least as a control section and possibly using the software component as well.

I have taught linear algebra in several recent semesters here at NYU and previously in Bard College's early college program. Each semester, I tell my students that linear algebra is arguably the most fundamental subject for doing higher level mathematics (and physics and economics and data science and ...) but no one realizes that in his or her first semester. The chief hurdle is that applications using linear transformation between 2- and 3-dimensional spaces, those that can be done with paper and pencil, often fail to capture the imagination. I do exhibit some larger-scale computations during lecture using *Mathematica*, but it is often in my mind that it would be much more instructive to have the students programming these themselves. Wolfram's proprietary language does not make this very practical. I have thought about migrating to Sage or other open platform to make these more easily shared with students, but participating in this grant would actually make it happen.

I currently use *Mathematica* in all the courses I teach for presenting lecture material mostly because it makes authoring little interactive slides (say changing the angle in a rotation matrix or moving points around to see how they effect linear regression models) easy. Students get something out of using sliders to set parameters, but it is not as immersive as writing the code that will do, say, singular value decomposition. I actually did implement Sage itself in a statistics course back in 2011. At that time I was teaching at Bard High School Early College, which is a New York City public high school that awards an Associates degree from Bard College to students who complete the program. I had mixed results as there wise a wide gap in exposure to computational systems. Some did some rather creative things, but for others it was just a means for computing CDF values on a bunch of different distributions, which isn't nothing, I suppose.

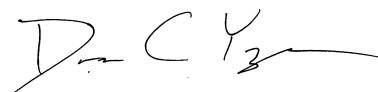
I have been familiar with Sage for a long time, and have a working command of Python, but I am far from an expert, and that I can do so much more in *Mathematica* has been a detriment to my learning more. Back in 2011, there was no SageMathCloud, or certainly not as it looks now. I remember the class I had my students sign up for accounts simultaneously on one of the public Sage servers at the time and bringing it to its knees. I am looking forward to using the current version.

New York University is of course a large private university, but we get a rather diverse crowd in our mathematics courses with a large portion of international students alongside commuter students from Queens. Those that take linear algebra are a mix of hard science and computer

science majors as well as many students completing a minor in mathematics. For many of these students, linear algebra may be the last mathematics course they take, and so it would be helpful to leave them with an appreciation for using the techniques on closer-to-real-life data sets.

I have many ideas about the implementation of technology in undergraduate courses, but I certainly won't claim to have an answers about the right way to do it. I look forward to being part of a larger conversation about it.

Sincerely,

A handwritten signature in black ink, appearing to read 'Drew C. Youngren', with a stylized flourish at the end.

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