

The UTMOST Sage Cell Repository

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The first UTMOST (**U**ndergraduate **T**eaching in **M**athematics with **O**pen **S**oftware and **T**extbooks) project was a National Science Foundation CCLI Type 2 grant (2010–2014) that promoted open-source software and open-source curriculum in the undergraduate mathematics classroom. The players were:

- American Institute of Mathematics (DUE–1022574)
- Drake University (DUE–1022036),
- Stephen F. Austin State University (DUE–1020957),
- University of Colorado Boulder (DUE–1020687)
- University of Washington (DUE–1020378)

Highlights of UTMOST 1.0

The products for the first UTMOST grant included:

- CoCalc (formerly SageMathCloud): a comprehensive cloud computing environment for education and scientific computing.
- Sage Cell Server: a mechanism to embed live computations into any webpage.
- PreTeXt (formerly MathBook XML): a framework for writing mathematics that can be published in a variety of formats.
- Sage Education Workshops: workshops for learning how to use Sage for the teaching and learning of mathematics.
- AIM Open Textbook Initiative: an editorial board to identify and support quality open-source textbooks.

The second phase of UTMOST was launched in Fall 2016 and supported by the National Science Foundation as a two-year IUSE grant. The players are:

- American Institute of Mathematics (DUE-1626455): Rob Beezer, David Farmer, Kent Morrison
- Stephen F. Austin State University (DUE-1625223): Thomas Judson
- University of Colorado Boulder (DUE-1624998): Susan Lynds
- University of Michigan (DUE-1624634): Vilma Mesa

Highlights of UTMOST 2.0

- We are investigating how students and instructors use textbooks.
- We are further developing and supporting PreTeXt, including an author's workshop in May 2017.
- We are advance the AIM open textbook initiative.
- We are developing and will maintain a repository of Sage cells.

Sage, an Open-Source Alternative

- William Stein founded SageMath in 2005. Rather than reinventing the wheel, Sage (which is written mostly in Python and Cython) integrates many specialized mathematics software packages into a common interface, for which a user needs to know only Python.
- The Sage community has been the driving force for developing Sage. Developers include both students and professionals.
- The philosophy of SageMath is to use existing open-source libraries wherever they exist, including Maxima, R, GAP, and NumPy to name only a few.
- In 2013, Stein launched SageMathCloud (now CoCalc), a web-based cloud computing and course management platform for computational mathematics.

- **Sage is for gearheads???** Although Sage has extensive documentation and examples on the Internet, a students (and a few faculty) have expressed frustration learning Sage.
- **Sage cells make life easy.** Sage cells are self-contained Sage calculations that can be embedded in any web page. This allows Sage commands to be executed on a remote server. See <http://utmost-sage-cell.org>.

Sage Cell Origins

- In 2011, William Stein and Jason Grout implemented a proof-of-concept “Single Cell” server designed to be a web interface for a single Sage computation. A team led by Jason (with UTMOST NSF funding and a Drake University grant) designed and implemented the first version of SageMathCell in the summer of 2011.
- Ira Hanson worked with Michael Gage, Jason Aubrey, Davide Cervone, and John Travis to allow Sage cells to be embedded in WeBWork problems and other external pages.
- The Android and iOS apps, which relied on SageMathCell, were built by Ivan Andrus and Volker Braun.
- SageMathCell is now supported by CoCalc and the NSF UTMOST Project and is currently maintained by Andrey Novoseltsev (University of Alberta).

A Look at Sage Cells

- **A Sage cell repository.** Project UTMOST is creating a repository of Sage cells organized by mathematical topic to help authors work more efficiently and to allow authors with minimal Sage knowledge to incorporate Sage into their documents (<http://utmost-sage-cell.org>).
- Robert Beezer. *First Course in Linear Algebra (FCLA)*: <http://linear.ups.edu/html/fcla.html>.
- Thomas W. Judson. *Abstract Algebra: Theory and Applications (AATA)*: <http://abstract.ups.edu/aata/>.
- Thomas W. Judson. *The Ordinary Differential Equations Project (The ODE Project)*: <http://faculty.sfasu.edu/judsontw/ode/html/odeproject.html>.

Resources

- PreTeXt—A lightweight XML application for authors of scientific articles, textbooks and monographs by R. Beezer (<http://mathbook.pugetsound.edu>).
- CoCalc—collaborative environment for doing mathematics by W. Stein (<https://cocalc.com>).
- The Sage cell repository—a repository of Sage cells at the CuratedCourses project: <http://utmost-sage-cell.org>
- SageMathCell—an easy-to-use web interface to Sage (<https://sagecell.sagemath.org>).
- SageMath—a free open-source mathematics software system licensed under the GPL (<http://www.sagemath.org>).
- UTMOST—An NSF project that promotes open-source software and open-source curriculum in the undergraduate mathematics classroom (<http://utmost.aimath.org/>).

Thank You for Listening

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