

Rethinking Calculus I with OER and Dynamic Visualizations

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PROJECT BACKGROUND

Towson runs 11-13 sections of Calculus I every semester, about 300 students per semester total.

Course set-up prior to Fall 2018:

Textbook: Stewart's Calculus

- eBook access for one semester \$81
- Loose-leaf physical copy \$161

Online homework: proprietary system WebAssign

Computer labs: Written in *Mathematica*; many of the labs emphasize coding and Mathematica syntax.

Coordination: No coordination of course schedules, no uniform grading policies.

IMPLEMENTATION

Opted for a systemic approach, completely overhauling the existing course

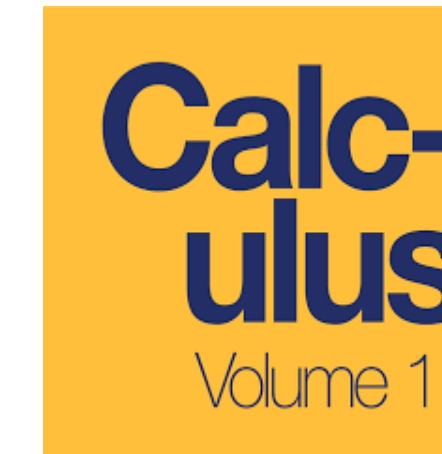
New Set-up:

Textbook: OpenStax Calculus I, open source, free download

Online homework: WeBWork, open source software, hosted at Towson

Computer labs: wrote new labs utilizing *SageMath*, open source software, embedded as webpages

Coordination: common schedule, homework, and exams; uniform grading policy



IMPACT

Support:

- M.O.S.T. Scaling OER grant
- Hosting (from Towson) for WeBWork and Labs

- Significant change for every Calculus I course offered at Towson for the last three semesters, including 12 sections per semester, 19 different instructors and nearly 1000 students.
- This semester our students are saving \$100 off the price of the eBook of the original (Stewart's Calculus) plus they have access to the textbook forever (not just for the semester.)
- Students who opt for a hardbound copy of the textbook can buy one for \$33.50.

IMPACT

- Improved access to course materials (estimated savings of \$60,000 for the students annually)
- Common schedule improved student study communities (students from different sections can study together)
- Increased faculty discussion of teaching practices for the course
- Shifted focus of computer labs from syntax to visualization
- New labs developed for this course continue to be used and revised and have the potential to be used by others wishing to adopt this textbook.
- Calculus II courses have adopted the new textbook, but not other aspects of redesign (e.g. still use old labs).

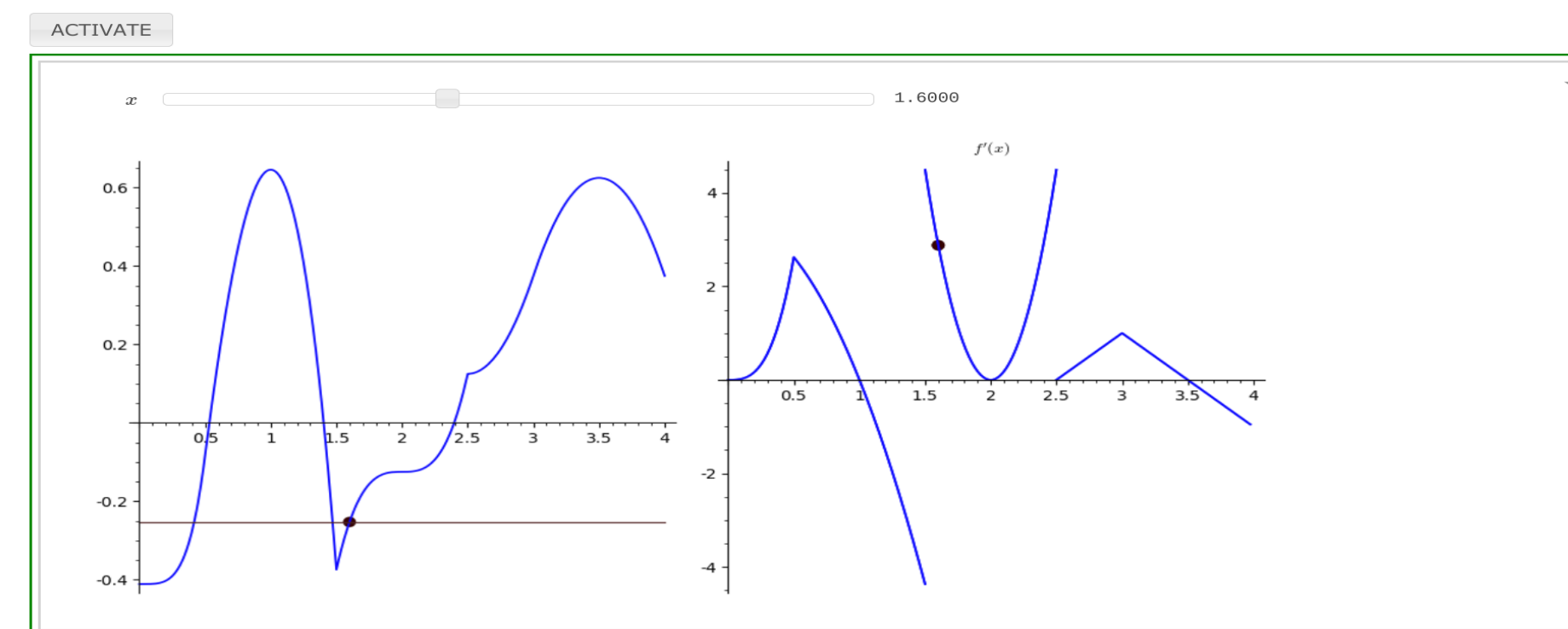
SAMPLE LAB

Calculus I at TU

Extreme Values

We say a function $f(x)$ has an **absolute maximum** on an interval I at c if $f(c) \geq f(x)$ for all $x \in I$. An **absolute minimum** is defined similarly, by flipping the inequality. If $f(x)$ has either an absolute maximum or an absolute minimum on I at c , we say that $f(x)$ has an **absolute extremum** at c .

On the other hand, we say a function $f(x)$ has a **local maximum** at c if $f(c) \geq f(x)$ for all x near c , though there may be larger values further away from c . A **local minimum** is defined similarly to local maximum, and $f(x)$ has a **local extremum** at c if it has either a local maximum or a local minimum.



LESSONS LEARNED AND FUTURE PLANS

- Successful introduction of OER in all the aspects of a course is possible (but time consuming).
- Sustained commitment of a group of faculty and continued institutional support are important
- The course is in its third semester of OER implementation, continues to improve towards better student outcomes.

Next:

- Improved faculty training for teaching with the computer labs
- Increased OER support for struggling students
- Develop SageMath labs for Calculus II