COLLEGE OF SCIENCE
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Honors Capstone Research (HCR)
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Labs for Calculus: Learning Through Collaborative Discovery

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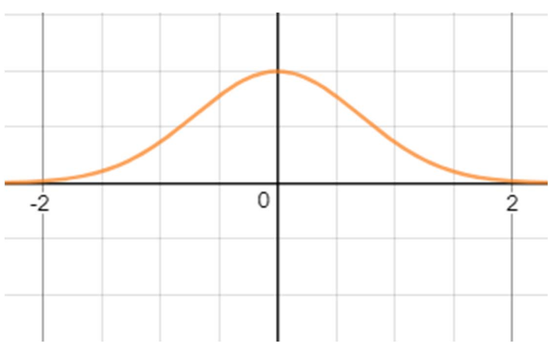
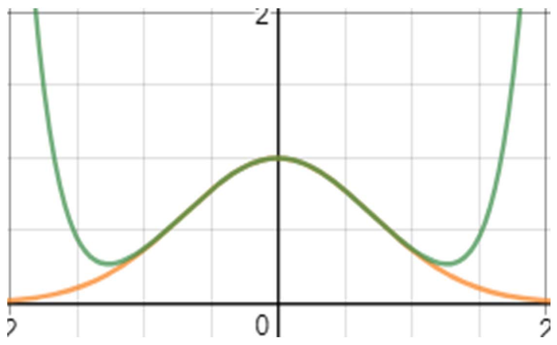
Introduction

The purpose of this project was to produce 31 labs to be modularly included in calculus as part of calculus sections. Each lab will give students an opportunity to work collaboratively on projects that place focus on conceptual understanding rather than computation or memorization.
These labs provide students with the opportunity to see the underlying principles of calculus illustrated in a way that if done by hand would require hours and hours of calculuation, focus, and frustration.
In order to best demonstrate this philosophy, the lab on the topic of Taylor polynomial expansions, a very important topic in math, science, and engineering, is analyzed here.

I.) Motivation

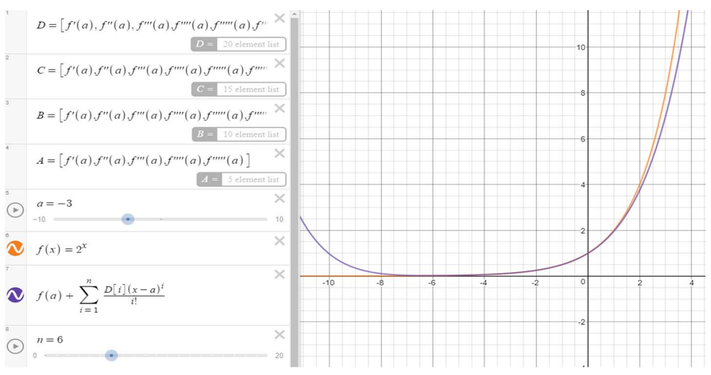
The lab begins by motivating the need for polynomial approximations of functions by providing an example of a function that is easily differentiable and shows up in many applications, but has no elementary antiderivative: a constant multiple of the bellcurve. We then have the students collaboratively try to estimate the exponential function by means of polynomaials and then compose this with the exponential function to produce an estimation



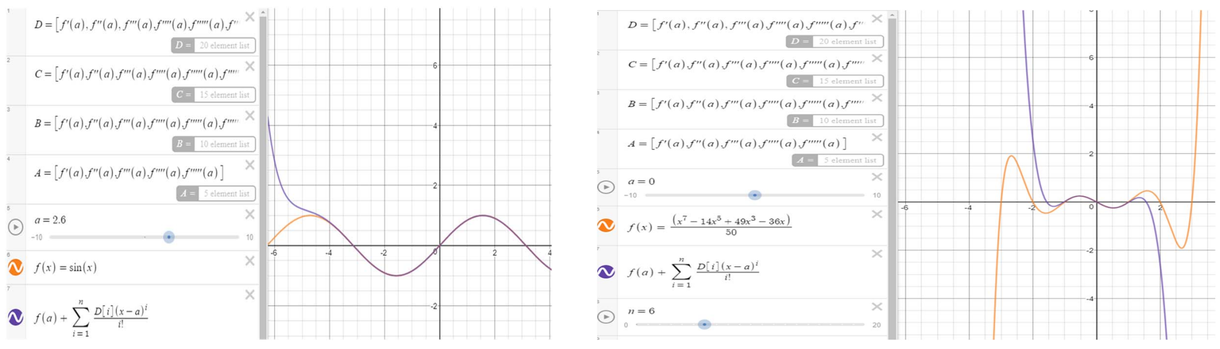


II.) Generalization

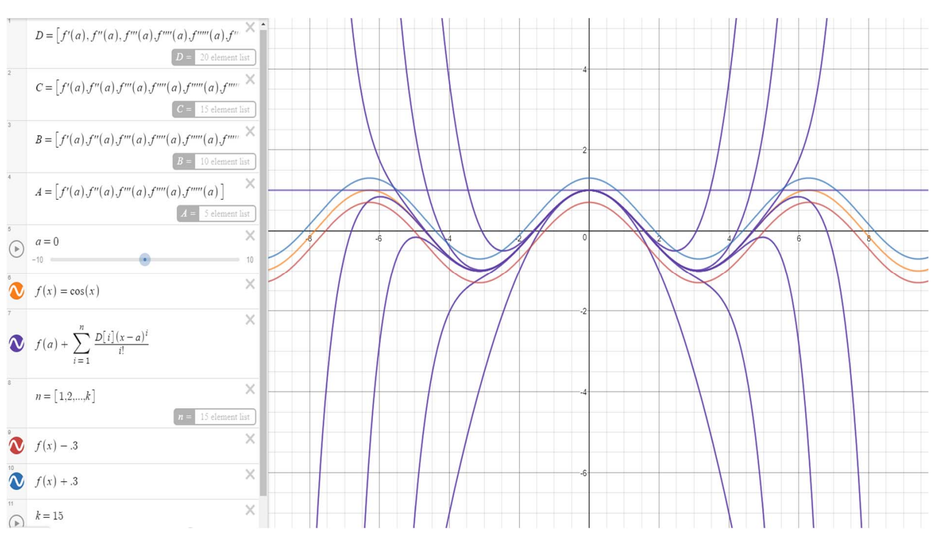
The next part of the lab was focused on showing and demonstrating a generalized method for finding the polynomial approximation of a function. The code was made a general as possible to allow for a student to change the degree of the approximation, center of the approximation, and the function being approximated on the fly by only moving a slider or changing very few values in the code. This allows for students to produce as many examples for themselves as they need. Notice how few values on the left are changed in the proceeding examples.

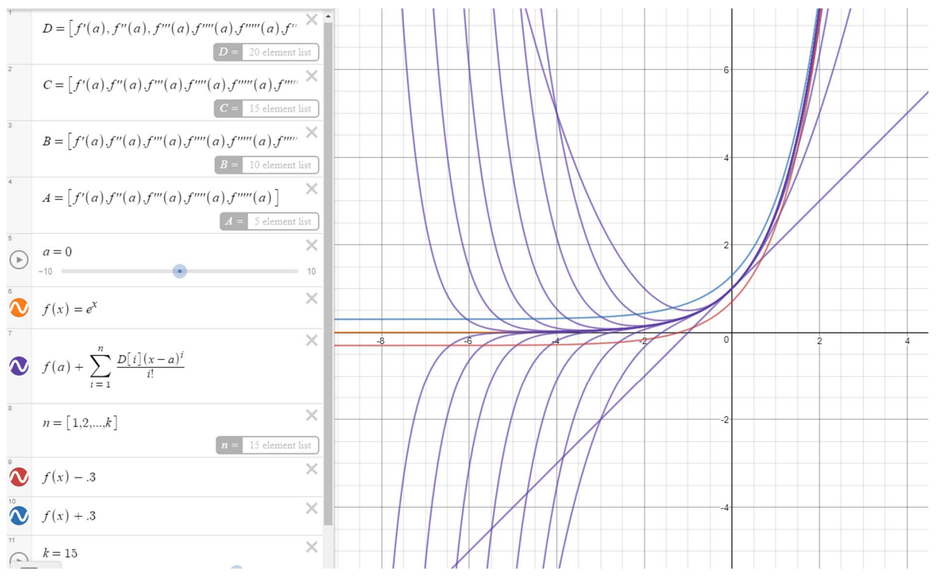


III.) Illustration



Finishing off this lab, the students are instructed to alter the code slightly to allow for multiple approximations at the same time, allowing for the following output, that was meant to demonstrate the increasing interval of close approximation for higher degree taylor polynomials.





Conclusion

This lab is just one of thirty-one that will be used in the calculus sequence here at UAH in order to increase student understanding of course material without requiring any extra instruction time. Each was created as a guided inquiry into problems designed for the purpose of increasing student understanding and success in later classes that require the calculus sequence as prerequisites.

References

1. ..Calculus 4th Edition by Michael spivak
2. Learning by Discovery: A lab manual for Calculus by Anita Solow
3. University Calculus, early Transcendentals: Hass, Weir, Thomas

Acknowledgements

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