MATH299M/CMSC389W – *Visualization Through Mathematica*
Spring 2019 – Ajeet Gary, Devan Tamot, Vlad Dobrin
Model H7.1: Integral of a Function as Area under a Curve
Assigned: Friday March 15th, 2019
Due: Monday April 1st, 2019 11:59PM

Note: Between models H7.1, H7.2, H8.1, H8.2, H9.1, and H9.2 (Group 2) you need only complete 3 assignments.

Now that you have RegionPlot at your command, shading sections of the plane is easy. You can also utilize RegionPlot in conjunction with Plot, Graphics, etc. using Show, giving you a broad array of diagrams you can create visualizations for.

You'll remember from Calculus I and II that the integral of a function f(x) from a to b can be thought of as the area under f(x) from a to b, in fact the standard approach to understanding integrals is by way of *Riemann Approximations*, which use rectangles, trapezoids, etc. to estimate the area under a curve, and then take a limit to get the actual area.

For this project you need to create a model that allows the user to *see* what the definite integral of a function is area-wise, that is, it should allow the user to input an arbitrary function, vary the bounds of integration, see the area under the curve as a shaded region, and see the numerical output of the definite integral visible for comparison.

Note that when f(x) passes below the x-axis, we consider those areas to be negative, so it's possible here to get a "negative area".

Keep in mind the user experience with respect to the range of the Plot both vertically and horizontally – the user gets to pick the function, a, and b - as they vary these, the window should scale in an aesthetic and useful way so that all of the desired information is visible.

Possible extensions:

- Can you make this model accommodate integrals where one or both of the bounds is infinite?
- Can you make it work for piecewise functions using Piecewise (you can look up the documentation here: https://reference.wolfram.com/language/ref/Piecewise.html)
- You could make a full-blown Riemann rectangle visualization where the user gets to control the number of rectangles to really see the area approach the area under the curve, that would be *awesome*. After making that adding options for left, right, midpoint and trapezoidal versions would be an easy addition.