CMPT/MATH 420: Numerical Analysis

Laboratory 7

Due: End of Lab Period Oct. 31 spooooooooooky

It's Halloween and Dr. Cameron doesn't have a costume :(. He has a last minute idea to still be allowed into the King's Halloween party: he will break apart a pumpkin and wear it as a hat. The pumpkin breaks into 3 pieces which modelled as the functions $h(x) = \sin(x) - 1 + \sqrt{x}$ on the interval $[1, 5]$ and $f(x) = \frac{\sin(x)}{x}$ and $g(x) = e^{x^2}$ both on the interval $[1, e]$ (obviously using a very bizarre unit of measurement). He's already late so he doesn't have time to try each of the pieces on, so you will need to decide which piece will fit his head best given that his head has area 1.5 according to the same unit of measurement. He's already self-concious for wearing such a pathetic costume, so he wouldn't be able to bear it if the pumpkin falls off his head, so please find the one whose area is closest to his head.

1. Given that this very reasonable situation is almost certain to happen again, we want to write code to select the best pumpkin pieces regardless of how the pupkin splits. So, write a function `TrapezoidRule(f,a,b,xvals)` that returns the list Trapezoid Rule of f on the interval $[a, b]$ sampled at the numbers in the list `xvals`. Note: your code should check that `xvals[0]=a` and `xvals[len(xvals)-1]=b` and return an error if it does not.

2. Test your function to approximate the area of
   - $h(x)$ on the interval $[1, 5]$ sampled at the endpoints,
   - $f(x)$ on the interval $[1, e]$ sampled at $x_0 = 1,\ x_1 = 1.5,\ x_3 = 2,\ x_4 = 2.5,\ x_5 = e$, and
   - $g(x)$ on the interval $[1, e]$ sampled at $x_0 = 1,\ x_1 = 1.5,\ x_3 = 2,\ x_4 = 2.5,\ x_5 = e$.