Homework 1

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1. INTRODUCTION

This homework involved the use of various numerical integration techniques. One notable method was Gaussian quadrature, which essentially uses a series of orthogonal polynomials to calculate weights of crucial x points of the integrand. These points are then used to calculate the integral.

2. 5.3

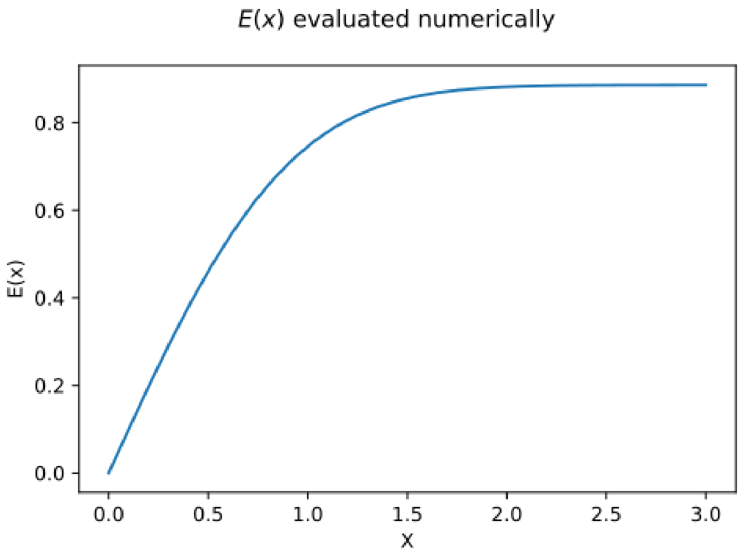

FIG. 1:

Problem 5.3 involved evaluating the integral $\int_a^b e^{-t^2} dx$ with any numerical method. I chose to use Simpson's rule which takes a linear combination of values of the function to form a quadratic between the points of the data set.

3. 5.4

In 5.4 we used an intensity function to recreate the diffraction patten commonly seen in telescopes. We did this by first reducing the dimensions of our intensity, a function that depends on both x and y in a 2d plane, to a Bessel function that is just dependent on the radius distance from the center. A graph of the Bessel function at various m's can be seen in figure 2.

We then used this function with an m of 1 to recreate the diffraction pattern seen in a telescope by creating an array and calculating the r from the center based on your position in the array. This r was then fed into our Bessel function to calculate a density at a point in the array. We then fed this array in as a heat map to produce the graph seen in figure 3

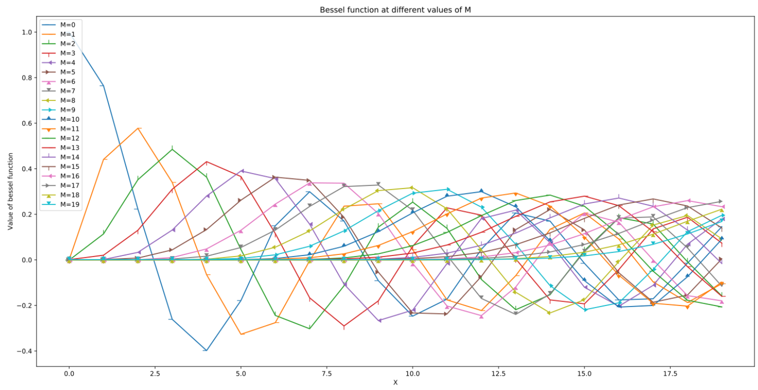

FIG. 2: Deltoid plot using Cartesian plot

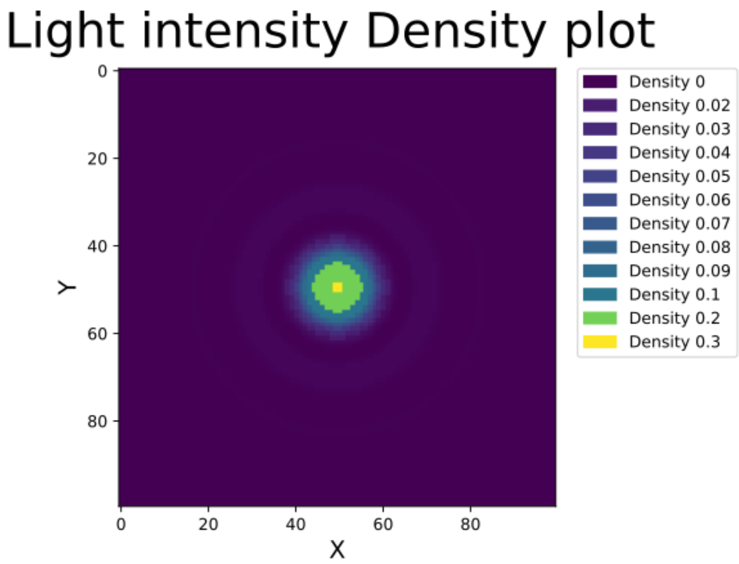

FIG. 3: Diffraction pattern

4. 5.9

Problem 5.9 involved calculating the heat capacity of a solid piece of aluminum. This was done by evaluating an integral using Gaussian quadrature. I then used this method and 50 points to produce the plot in figure 4.

5. CONCLUSIONS

I found this homework to be of appropriate length but I wish we had spent more time with the idea of Gaussian quadrature before using it on the problem set. Albeit this feeling could be a result of me being sick and missing class on Monday, where you might have gone over Gaussian quadrature in more depth. If that is the case, disregard the previous comment.Other than that I found the problem set to be pretty fair and very instructive.

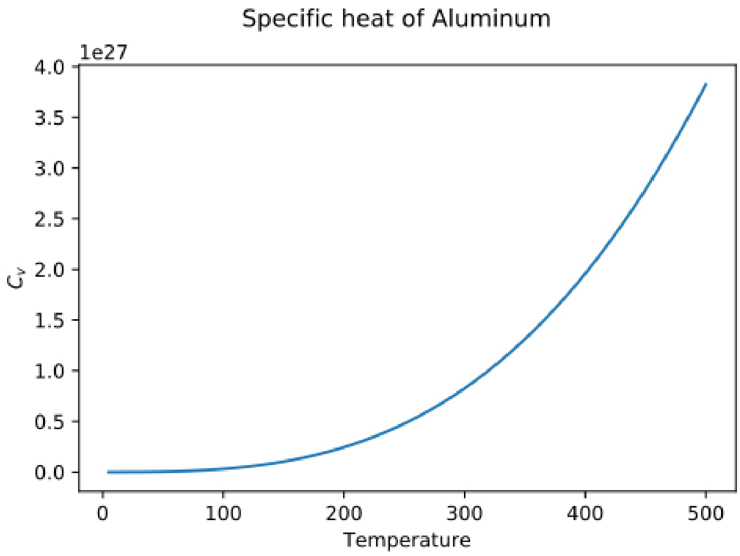

FIG. 4: Heat capacity of aluminum