ECSE 543: Assignment 3

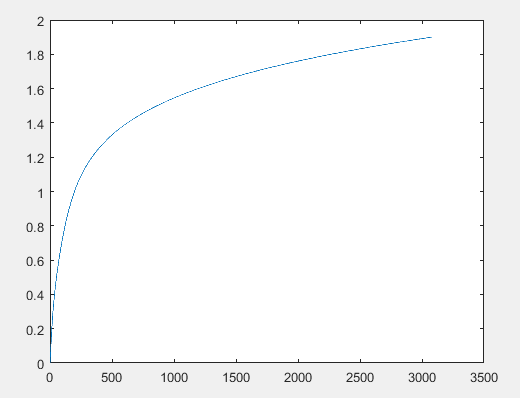
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# Question 1

## Part A

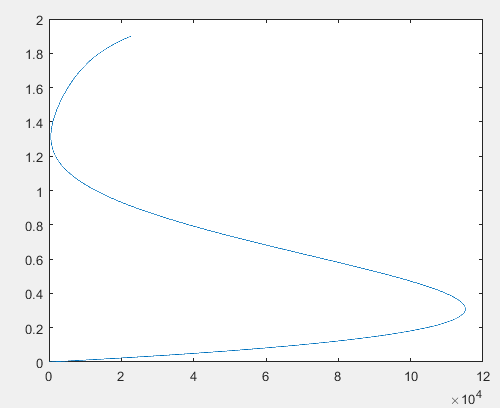
The code for the interpolation of this polynomial was done by the function “Lagrange.m”. A plot of the 6 points passed into the function Lagrange is shown below –



As the curve seems pretty smooth it seems like the result is plausible and is a good representation.

## Part b

When the function runs over the points B = [0, 1.3, 1.4, 1.7, 1.8, 1.9] we see the following plot –

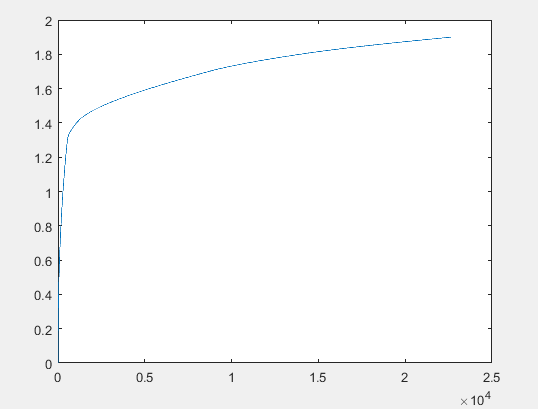


It can be seen that this graph does not look anything like a H versus B graph and therefore not a plausible representation.

## Part C

If we happen to know both function values and first derivative values at a set of data points, then piecewise cubic Hermite interpolation can reproduce those data. But since we are not given the derivative values, we need to define the slopes somehow. However, we would have to do this for two types of points, the edge points such as the start and end points and also for the internal points. For the internal points we calculate this by finding the differences in the x-axis and creating a delta by dividng the differences in the x points with the difference in the y-points. We can then use this delta along with the differences in the x-axis to form the slopes. For the end points we can find the slopes by interpolating using the deltas between the first and second points and the second last and last points using their deltas. The codes for cubic hermite interpolation can be found in ‘cubicHermiteInterpolation.m’ and ‘calculateSlopeInternal.m’. The following plot is found with B = [0.0, 0.2, 0.4, 0.6, 0.8, 1.0] –

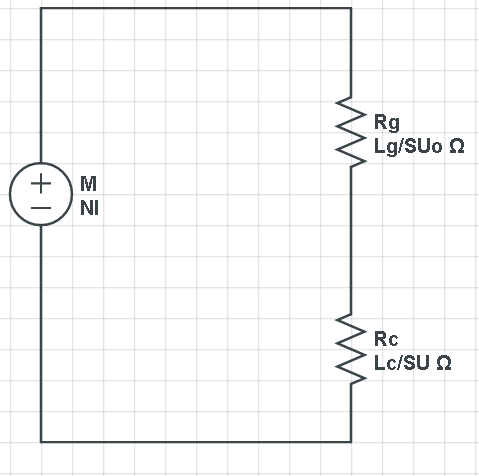
For B = [0, 1.3, 1.4, 1.7, 1.8, 1.9] we get the following –



We can see that it produces a better curve for points that are widely separated which the Lagrange fails to do.

## part D

For this part we come up with the following circuit -



Substituting given values we find the equation –

0

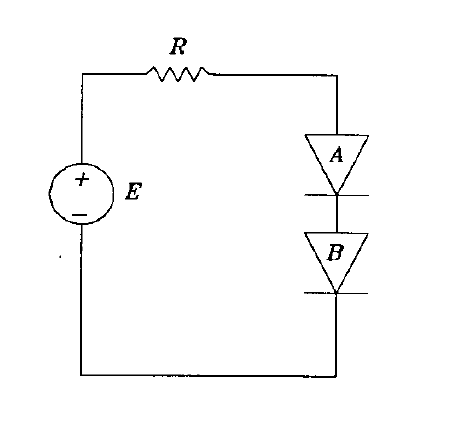
Where is found by doing a linear piecewise interpolation of the values of B and H given to us. The function to do this interpolation is written in “piecelin.m”.

## Part e

# Question 2

## part a

From the following circuit we determine voltages at the two nodes by following the conventions mentioned in the diagram –



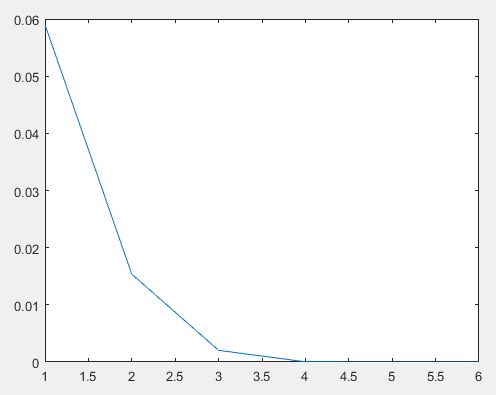
V2

V1

We find the two equations of F to be –

## part B

We modelled the circuit in “ElectricCircuit.m” and the solver was written in the file “newRapCircuit.m”. It took us 5 iterations to get to our selected error margin . The final voltages were found to be V = [0.183430837132538, 0.0832765631282870]. The following shows a plot of number of iterations against difference and we can see that the convergence is actually quadratic.

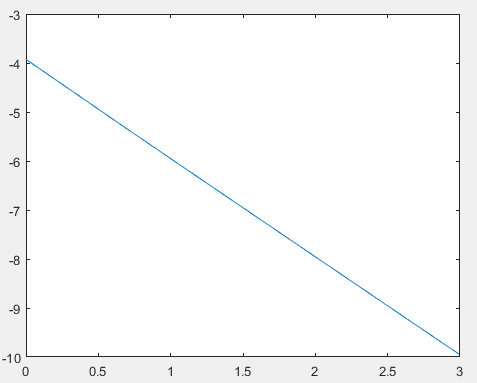


# Question 3

The test code for this question is written in “integrationTest.m”.

## part A

The function to carry out integration was written in “integration.m”. It basically computes a running sum of the values of the function at the given number of sections and returns these values at midpoints multiplied by the length of the section. The error versus the number of segments is plotted below –



We can see that the log10Error versus log10N produces a linear graph. This means that increasing the number of segments does not reduce the absolute error of this computation.