**Problem 2**

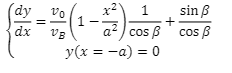
For the ferry boat problem, find an optimal angle 𝛽 with which the boat travels on the shortest path between the two banks. We assume 𝑎=8miles, the flow speed 𝑣0=20mph and the boat’s speed 𝑣𝐵=30mph.

Python 3.9 was used for this program. I additionally use several Python libraries. This program can be run by running Test 3.py. I used Visual Studio Code to code and run.

**Algorithm Description**

I first generated a temporary beta which is the E[X] +- a random number between [-0.1, 0.1].

Then, solve the differential equation using forward euler: y[i+1] = y[i] + h \* ((2/3) \* (1 - ((x[i]\*\*2) / (8\*\*2))) / np.cos(bTemp) + np.sin(bTemp) / np.cos(bTemp))



I calculate the distance of this path: distTemp = distTemp + np.sqrt(h\*\*2 + (y[i+1] - y[i])\*\*2)

I use an initial T value of 0.04, and then I do fast annealing: T = 0.04 / for loop idx

Then, I use the metropolis method to see if I will accept this new step.

𝑃(𝑌)=min{1,exp[−𝐸(𝑌)−𝐸(𝑋)/𝑇]}

If the new state is better than the original, than I accept this state.

If not, I take it with the probability in the formula. I generate a random number from [0,1]. If this generated number is less than the probability, than I accept.

**Results**

Beta is around -.43 radians, with the optimal distance being around 16.38.

**Performance**

There are no issues with performance.