Math 310: Probability and Statistics Project

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Team Members:

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GitHub Repository Link

Programming language used: Python

Libraries required: turtle, matplotlib

Task 1:

Both the mathematical and simulated versions run the same way. At first, a list of probabilities is made which can be changed as the users wish. Then another list of randomly generated numbers between 0 and 1 is created which is then ran through a loop. If conditions are used to check if the probability is of moving left or right and so the walk model is moved left or right accordingly.

Task 2:

Both the mathematical and simulated versions of this task also run the same way. At the start probabilities of both of the walk models are set and can be modified. They are then set apart by a variable, which can be changed too. The program is then started in the form of a while loop which at first checks if both the models are at the same position and then walks them just as task 1 does. As soon as they are at same point, the program stops and prints the time taken for them to meet. As assumption that we have made is that both of the nodes have to exactly be at the same position for the simulation to end, if say they cross over each other and reach some other position then they will have never met and hence the simulation won't end at that position.

Task 3:

At first, we set up the move sizes and angles on which the model can rotate. Then a circle is created and walk model is started from the middle of it. It keeps moving with a randomly selected step size and angle from their lists until it leaves the circle. As soon as it leaves the circle, it is reset back to the middle of the circle and again starts to move. This keeps on happening until the user closes the turtle graphics window. The assumption here will break if there is restriction on the node not leaving the test region at all. We have tried to implement an absorption model as the one mentioned in section 3.2 in the referenced research paper. The node is absorbed and brought back to the origin.

Task 4:

This task is the same as task 1 but with one major difference. The step size is now a continuous uniform variable between 0 and 1. This is done using the uniform function of the random module.

Task 5:

This task is again same as task 3 but with some major difference. The step size is now a continuous uniform variable between 0 and 1. The orientation is also now a continuous random variable, which is between 0 and 2π. This is done using the uniform function of the random module.

Task 7:

This task is a modification of task 5 where the step size is converted into a discrete random variable but the orientation is kept a continuous random variable between 0 and 2π.

Task 8:

This task is a further modification of task 5 in which two nodes were to be located within a circle randomly. In this task we had to calculate the average number of steps taken by two nodes so that they are within 1-unit distance from each other. To obtain average steps, we iterated over the loop 5 times to obtain the total number of steps taken and then we divided the total number of steps by 5. The current location is calculates by the pos() function of the turtle graphics. Assumption here is same as task 3 that the node will leave and then reset back to the starting position, which is the center of circle.

References:

http://www2.math.uu.se/~sea/kurser/stokprocmn1/slumpvandring_eng.pdf

Figures

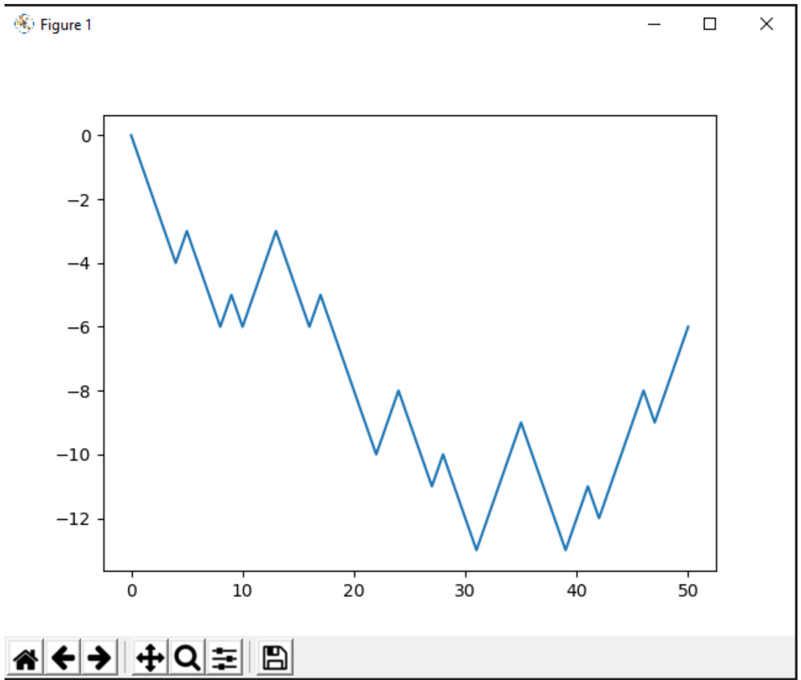


Figure 1: The mathematical model showing the expected distance of the model in task 1 after 50 steps

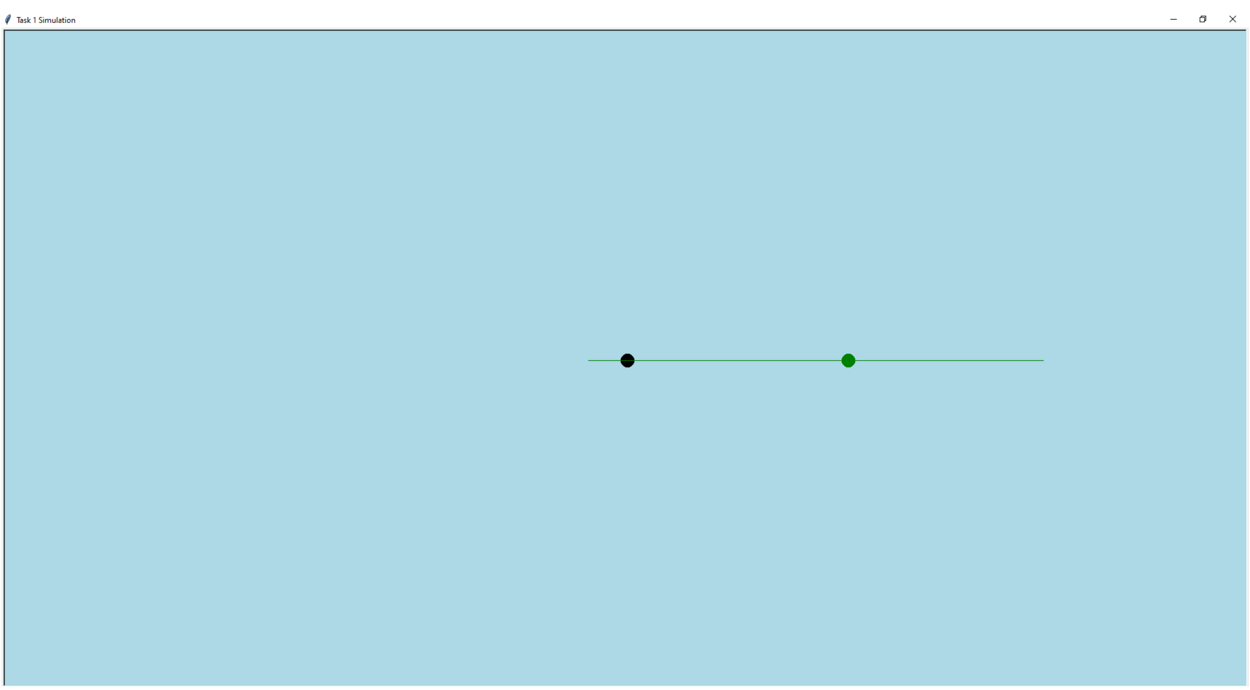


Figure 2: The simulated model of task 1 showing position of the node (green circle) after 50 steps. Black circle is the starting position.

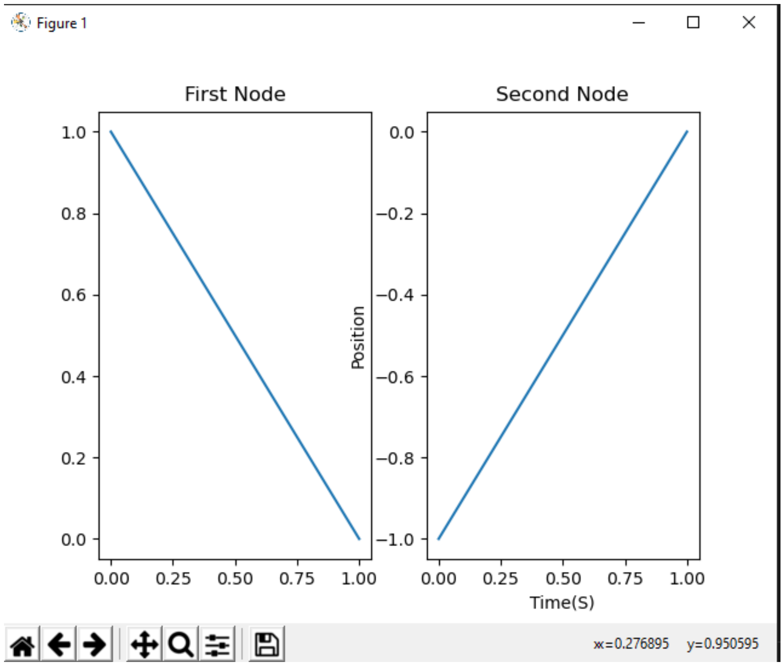


Figure 3: The mathematical model of task 2 showing the point where both of the nodes meet each other

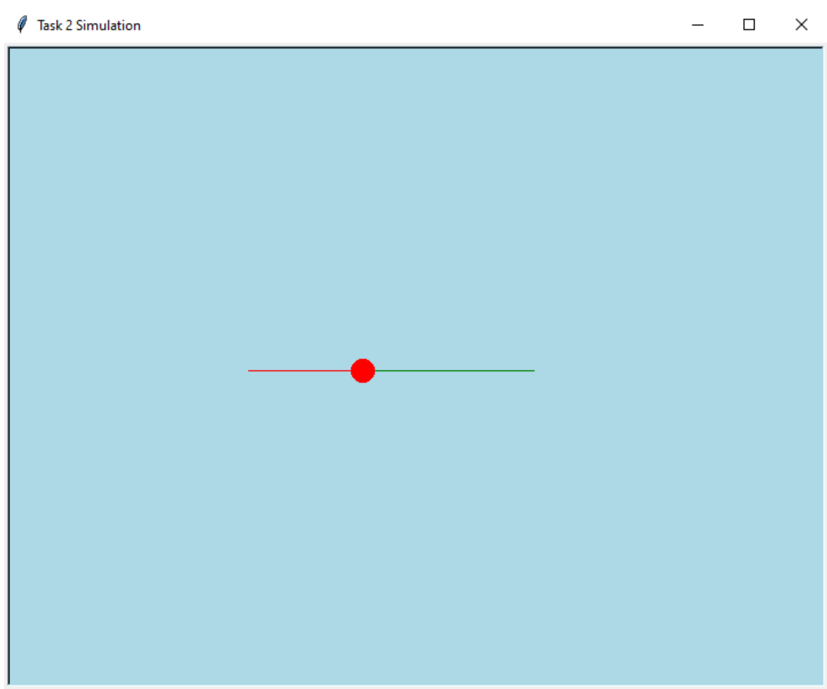


Figure 4: The simulated model of task 2 showing the point where both of the nodes meet each other

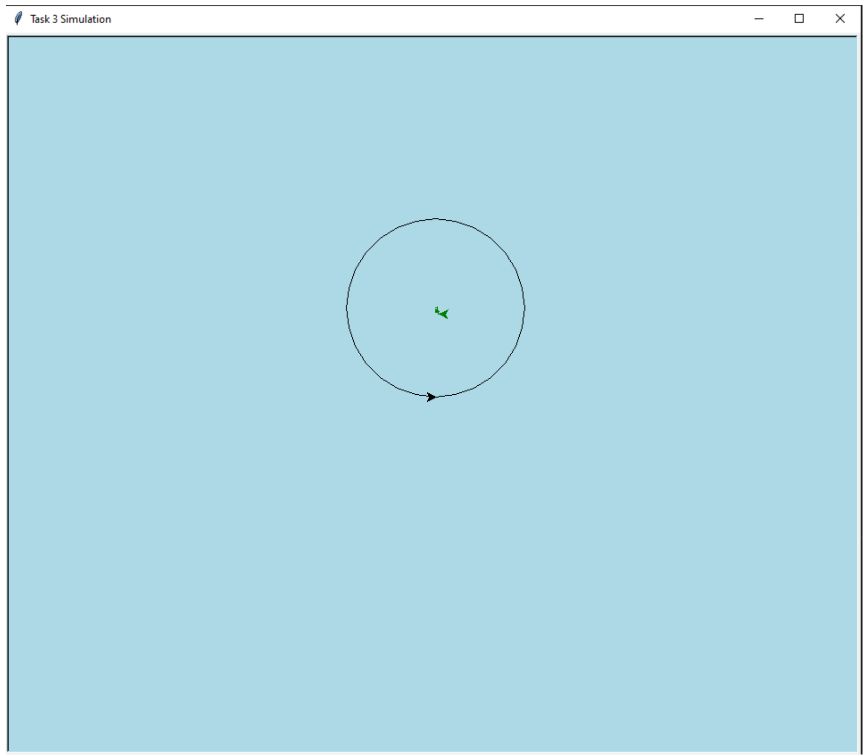


Figure 5: The simulated model of task 3 showing a node moving with discrete step size and orientation inside a circle of radius of 100 units

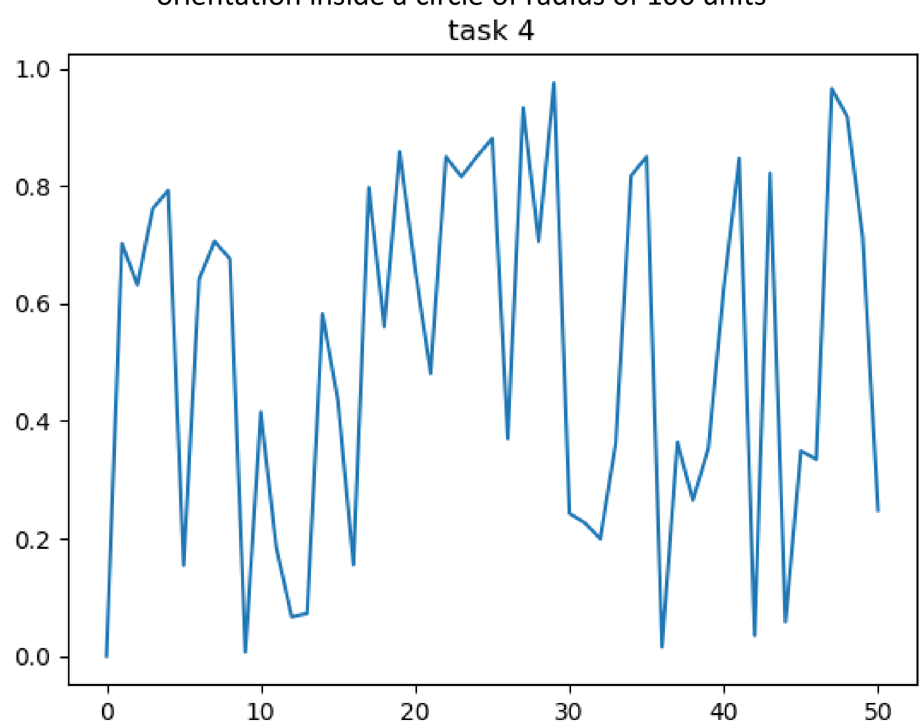
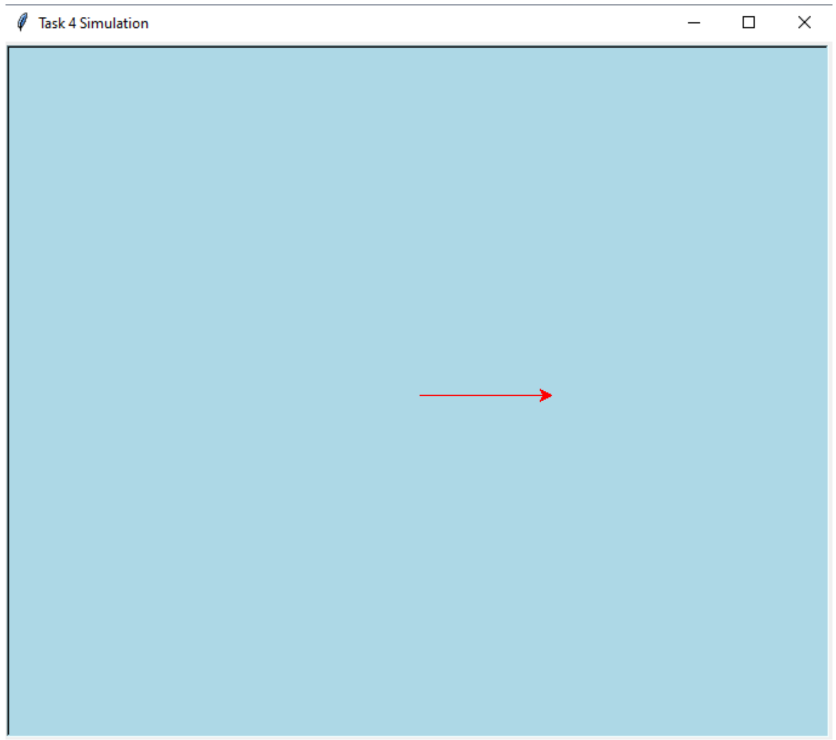


Figure 6: The mathematical model of task 4. It can be seen that the step size is a continuous random variable



Firgure 7: The simulation of Task 4. It will look practically same as task 1's simulation

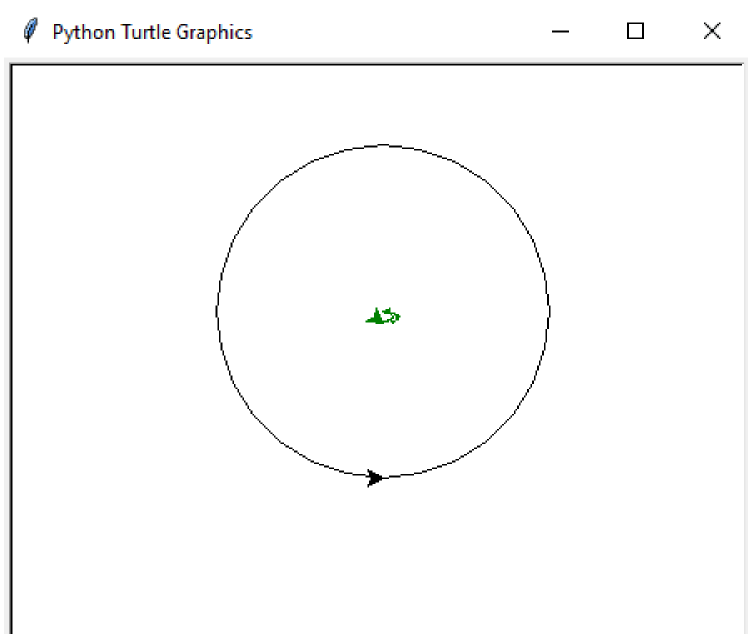


Figure 8: The simulation model of task 7. It will also look same as simulation of task 3 as the step size cannot be observed on a picture

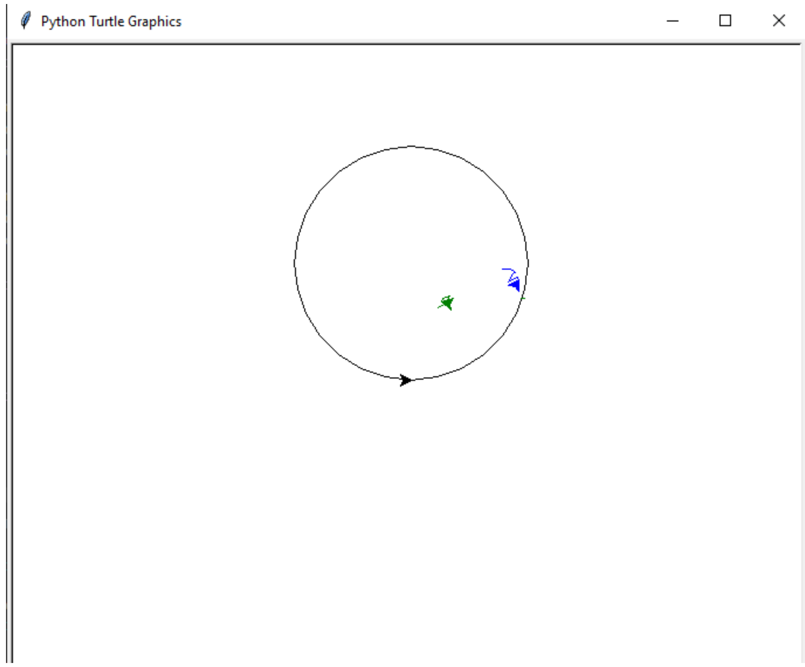


Figure 9: The simulation of task 8 showing two nodes inside the circle