CS-311 Lab

Assignment 0

Abhishek Josyula 200010021

Karthik J Ponarkar 200010022

August 9, 2022

Contents

1 Problem Statement

- There are two countries named Defending Country (DC) and Attacking Country (AC).
- Border between these two countries can be represented as a two-dimensional matrix of width W and infinite length extending both ways.
- AC's goal is to send an infiltrator to cross the border and enter the DC's land.
- DC wishes to defend its border against AC by deploying wireless sensor network along the border.

2 Modelling of different elements

2.1 Sensor

- A sensor can be placed in any cell of the border. The range of this sensor is only restricted to that cell.
- Each sensor is a motion sensor, it can only detect a infiltrator who is moving and not the one in stationary state.
- As DC wishes to extend their sensor lifetime, each sensor follows a policy of duty cycling.
- Every 10 seconds, the sensor takes a decision of whether to stay ON or OFF for next 10 seconds.
- Each sensor takes decision independently and there is a certain randomness to its decision which we have modelled using Bernoulli distribution.
- Probability that the sensor remains ON for next 10 seconds is p_ON and for the OFF state probability will be $1 - p\_ON$.

2.2 Border

- Each cell of the border has only one sensor.
- We have modelled the border as $W \times 3$ two-dimensional matrix because irrespective of where the infiltrator is currently located, he can only have access 8 of the neighbouring cells. (Pictorially represented in the Infiltrator section).
- At $time = 0$, the duty cycling of each sensor in each cell starts.

2.3 Infiltrator

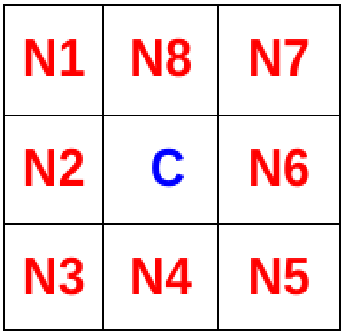

Figure 1: Infiltrator Movements

- The infiltrator moves in steps. In each step, he may move to any of the 8 cells around him.
- In the Figure 1, current position of the infiltrator is represented using **C** and the cells to which he can make a move is represented using **Ni**, $\forall i \in \{1, 2, .., 8\}$.
- Infiltrator is in sync with the sensors. Starting from $time = 0$, he makes a move every 10 seconds.
- The infiltrator spends the first 1 second studying the cells around him, and the next 9 seconds moving (if he decides to move at all).
- The goal of the infiltrator is to reach end of the border.
- The infiltrator thinks that making a horizontal move along the infinite length and moving upwards does not really gives him any progress.
- So, he makes a moves downwards only if the current cell **C** is OFF and at least one of the **N3 N4 N5** is OFF;

3 Idea

- For simulating the infiltration, we need two parameters $width$ and p_ON.
- We want to study variation of time taken by the infiltrator to cross the border with p_ON and $width$.
- Lets simulate the process with different values of $width$ by keeping p_ON constant and plot the data.
- Similarly, simulate with different values of p_ON by keeping the $width$ constant and plot the data.

4 Driver Script

- Run $\longrightarrow$ \$ *python run.py* .
- This compiles java file and runs it for varying p and w.
- Make sure *Main.java and run.py* are in same directory.
- Make sure matplotlib and numpy are installed

5 Observations and Results

After running the driver script you can see two plots.

5.1 Probability vs time

Probability(P_on) has been varied from 0.01 to 0.96 with a step of 0.01 and the corresponding time to cross by infiltrator has been recorded. For this width is fixed at 500.

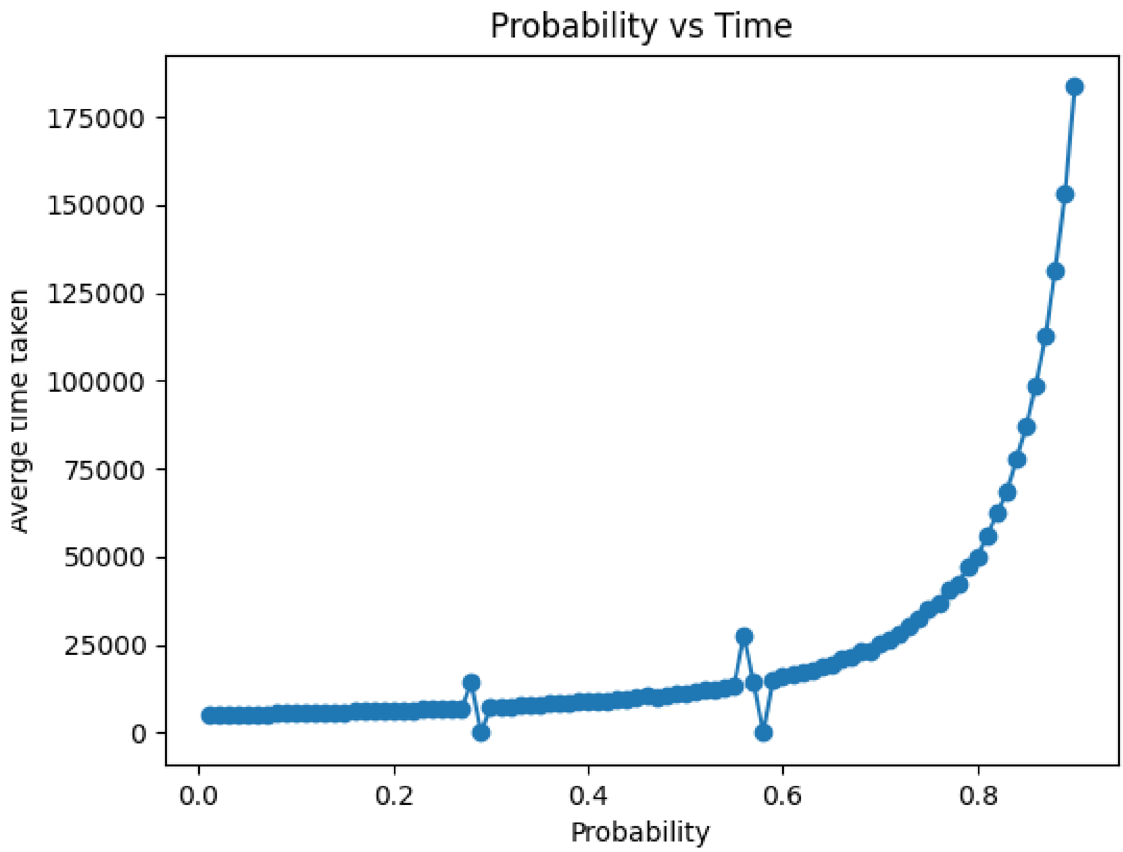

Figure 2: Width = 500

5.2 Width vs time

Width has been varied from 10 to 1000 with a step of 10 and the corresponding time to cross by infiltrator has been recorded. For this P_On is fixed at 0.5 .

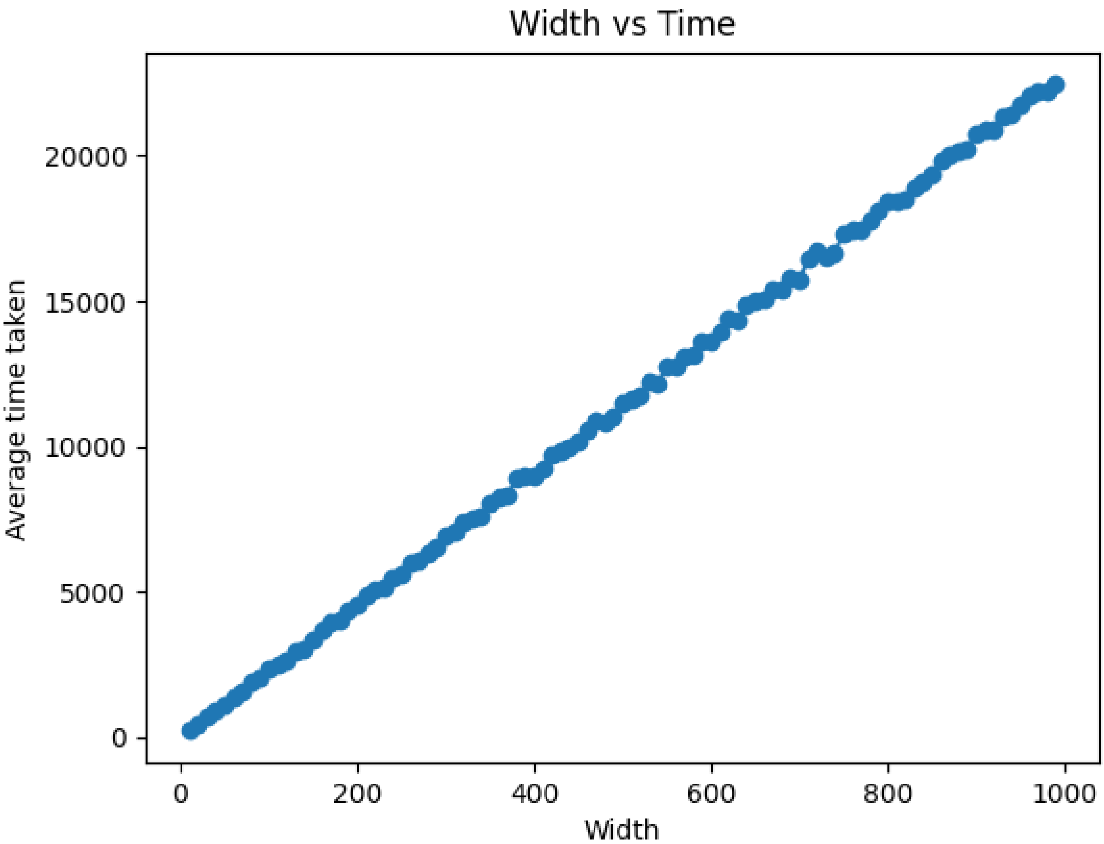

Figure 3: $P\_on = 0.5$