CS 311, Assignment 0 - Report

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Problem Introduction-:

There is an infiltrator at the attacking side which is trying to cross the border to reach the defending countryside. Each cell in the border has a sensor which based on the toss of a biased coin (with probability p of heads) is turned on at the occurrence of a head.

The sensors will catch the infiltrator only when he is moving and not stationary. Every 10s the status of the sensor is re-determined. It takes 9s for the infiltrator to make a move. Thus the time to make a decision is 1s only.

Objective-:

Depending on the width and the value of p, the time taken by the infiltrator will vary widely taken over many cases. We study the variation with different values of p and width and plot the graph of the same.

Parameters in Consideration-:

1. Length - Taken to be infinite i:e 1000.
2. Width- Variable Parameter. Test case- {5,10,15,20,25,30,35,40,45}
3. P- Lies in (0,1), variable parameter. Test case - {0.1,0.2,0.3,0.4,0.5,0.6,0.7,0.8,0.9}

Preliminary Analysis-:

We see that, if the value of p is increased the chances of each sensor in the cell being ON is more. Thus, when the frequency of sensors being ON is increased, it becomes difficult for the infiltrator to cross the border. So the time taken for a successful attempt increases.
In short increasing p value increases the time taken by the infiltrator.

Secondly, quite obviously , the larger the width is the more cells it has to move and more decisions to be taken, so the time taken to cross the border increases.
So increase in width increases the time taken to cross the border.

Our Movement of Infiltrator-:

We have assumed that the infiltrator would not want to move backwards i.e. towards AC.
So following are the cases taken into consideration

1. Around a particular cell, there are 8 choices where it can move.
2. Since it should move ahead or stay at the same level, only 3 cells forward the current cells are tested for the sensor being ON or OFF.
3. Once any of the cells, ahead are detected OFF along with the current cell, the infiltrator
4. moves ahead. If no choice infiltrator stays there and the current time changes.
5. If the current cell sensor is ON, the infiltrator stays in the same position.

Testing of Parameters-:

With the above movement of an infiltrator in mind, for each (p,w) pair we will have more than one time taken possibility. So we took 70 iterations for each (p,w) pair and took the average of each case.
So we obtained in total p*w. (Each p-value combined with each w value), time taken.

Classes and Code-:

As wisely suggested in the assignment itself, with further additions we designed the following classes-:

1. Coin- Takes p as an argument. Generates a random number to determine heads or tails.
2. Sensor- Each cell has a sensor, which depending on the value returned by coin, decides to be turned on or off
3. Border- The entire border is combined of many cells(sensors). So the overall movement of the infiltrator which depends on the surrounding cells is obtained by the border status.
4. Infiltrator-: The status of the infiltrator i:e it's current position coordinates and it's next move is included in this class with respective data members and functions.
5. Clock-: All this while the current time, next tick and total time are obtained through updating clock object.
6. Main.java- The file which contains the driver function and includes objects of all the classes to move the infiltrator.

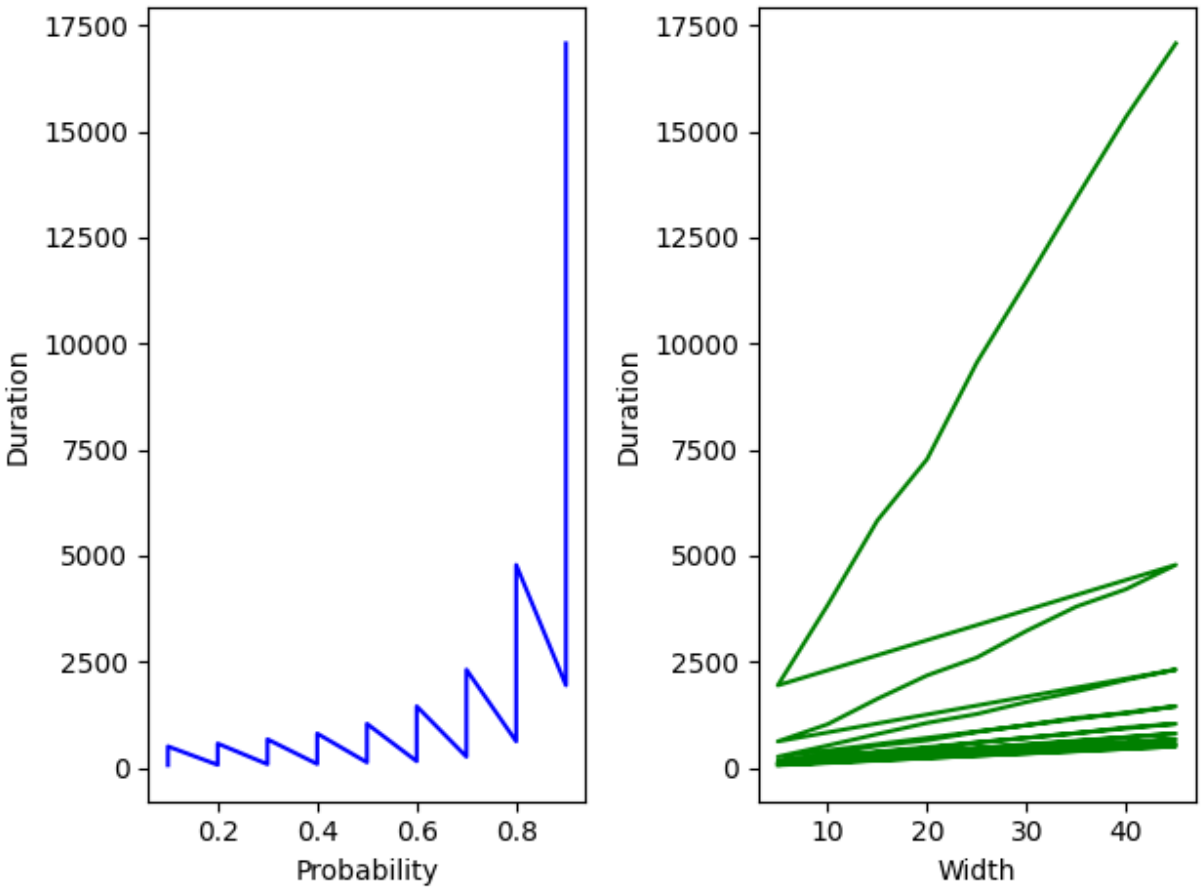
CLI COMMANDS-:

```
javac Main.java
java Main input.txt output.txt
python graph.py
```

RESULTS-:

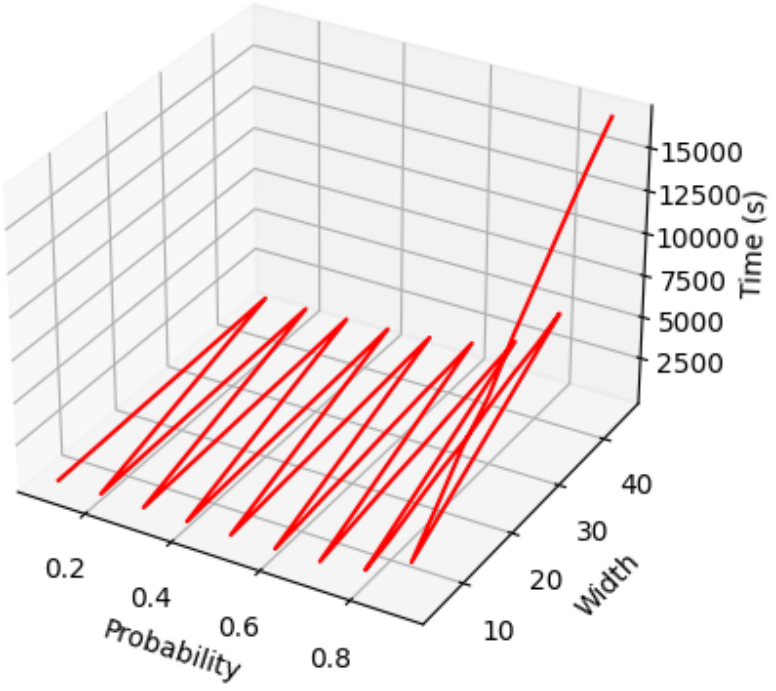
1. Output.txt- Gives (p,w, average time taken) for each case
2. Graph.py- uses the output.txt to generate the 3-dimensional **graph.png** with p,w, and time_taken variations and two 2-dimensional graphs in **graph_pw.png**

GRAPHS OF TEST CASE-:



GRAPH ANALYSIS-:

In the 1st graph, for each value of p(probability), the kink represents the change in width. Further, as the p value increases the local maxima and local minima also increase.
Similarly in the 2nd graph, the kink represents the change in the value of p(probability). For each line, the value of p is fixed, and as w increases the time taken increases. Again with the increasing value of p, the slope of the line and the intercept also increases.



GRAPH ANALYSIS-:

We can clearly see that as the p value was increased the time_taken also increased which and the same with the width parameter. This validates the preliminary analysis.