CS 311 : Computer Architecture Laboratory

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Assignment 0

I. Introduction

The project aims to simulate a scenario where a defending country (DC) deploys a wireless sensor network along its border to detect and counter infiltration attempts by an attacking country (AC). The system consists of motion sensors placed along the border, an infiltrator trying to cross undetected, and a simulation clock to track the time evolution of the scenario.

The defending country deploys a wireless sensor network along a rectangular border. Each cell in the grid has a motion sensor with a duty-cycling policy, randomly deciding whether to be ON or OFF every 10 seconds. An infiltrator attempts to cross the border, moving in steps and avoiding detection by staying stationary when sensors are ON.

II. Components

Border

- The border is a discretized rectangular strip of land with an infinite length and a defined width.
- The length is practically a very high number for simulation purposes.

Sensor

- Each cell in the grid has a motion sensor with the sensing range confined to the cell itself.
- Duty cycling policy: Sensors decide independently every 10 seconds to be ON or OFF based on a coin flip with probability p.
- The initial decision for each sensor is made at time 0.

Infiltrator

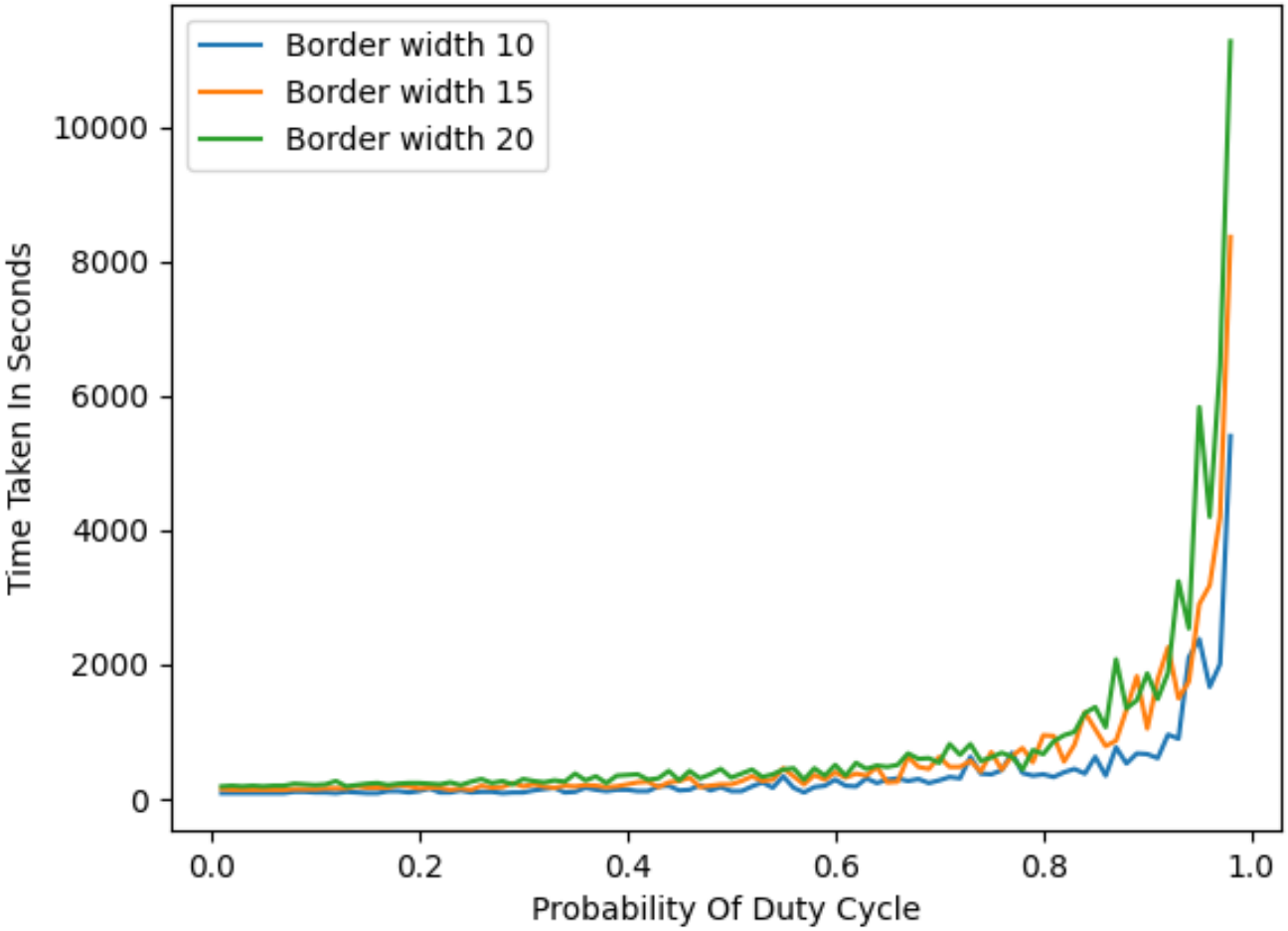
- The infiltrator moves in steps, taking 9 seconds to move to an adjacent cell.
- At each step, the infiltrator spends 1 second studying surrounding cells and 9 seconds moving (if decided to move).
- Motion sensor model: To move from cell A to cell B, both cells' sensors must be OFF; otherwise, the infiltrator is caught.

Clock

- A clock class tracks the simulation time in seconds.
- The simulation loop iterates while the infiltrator has not succeeded or been caught.
- At each iteration, the sensors and infiltrator perform tasks based on the current simulation time.

III. Results

The following line plot provides insights into the effectiveness of a wireless sensor network in border defense against infiltration attempts, comparing the time taken for every possible sensor probability ranging from 0.01 to 0.99, for three different border widths.



IV. Conclusion

From the given plot, we can deduce a few conclusions:

- For a fixed border width, a higher probability of duty cycle will result in a higher time taken by the infiltrator to cross the border.

- The time taken by infiltrator to cross the border remains almost constant for very low duty cycle probabilities, then increases in an almost linear fashion around median duty cycle probabilities, and then increases drastically in exponential fashion for much higher duty cycle probabilities.
- A wider border generally results in more time taken by the infiltrator to cross the border, with some anomalies towards the end of the spectrum.
- A higher probability of duty cycle might result in more anomalies to the previous conclusion than in case of a lower probability of duty cycle.