Modeling and Simulation, MC312
Lab-10

November 8, 2023

In this lab, we will explore outcomes using cellular automata (CA) numerically. For this lab, choose one scenario from those listed below, frame a question, and try to see how the model helps you develop an understanding.

1. (**Epidemic modeling using CA on a 2D grid**) We have earlier used compartment models to study the spread of epidemics. To model epidemic spread on a 2D lattice, we can imagine that each cell represents the state of an individual. For example, in the SIR model, the states are susceptible, infected, and recovered. The transmission of infection occurs through contact, while the recovery is without interaction. We assume each individual can interact with four immediate neighbors (von Neumann neighborhood). The probability of a susceptible getting infected depends on the number of infected neighbors. With only a few initially infected, simulate the state of the epidemic through your set of rules.

2. (**Adoption of products using CA on a 2D grid**) Using differential equations, we have studied models such as one by Bass for the adoption of products. Let us revisit this problem now from the perspective of CA. Assume that initially, there are a few who have already adopted the product and that the probability that a new adopter adopts depends upon the number of its neighbors who have adopted it already. With this assumption, simulate the model on a lattice. Now imagine that there is a competing product. Refine your model to include this competition and examine its consequences.

Note

- The main aim of the lab is to learn Cellular automata simulations.

- You should check how sensitive are your observations to the size of the grid, choice of boundary conditions and other parameters in the problem.

- The model will become quite complex to examine, if not studied systematically. Think what would be a systematic way to study such systems.

- There is no need to submit a latex report. Instead, you should have your working code and all the visualizations ready during the viva.