1 Model Description

Agent based models are a class of computational models in which we study a complex system by reducing that complex system into its tiny constituents or agents and we study the interactions between these agents and how these interactions lead to a collective behaviour on a macroscopic scale. The Schelling model of segregation is a type of agent based model which illustrates how the agents' tendencies and biases regarding their neighbours can lead to a segregated population overall.

1.1 Lattice/Grid

The first type of population configuration used in this analysis is a lattice/grid configuration. An agent is represented by a block in the lattice grid. In a lattice configuration, a block is said to be a direct neighbour of another block if one of the edges of those two blocks touch each-other. In a lattice configuration each agent(except the ones which touch the walls of the grid) have 8 direct neighbours. The agents which are at the corner of the grid have 3 direct neighbours and the remaining agents which touch the side of the grid have 6 direct neighbours each. This analysis considers only the direct neighbours while simulating the Schelling's model in a grid.

1.2 Random Network

The second type of population configuration used in this analysis is a random network configuration. In this network a node represents a single agent and the links between two nodes indicates that the agents corresponding to those nodes are neighbours of each other. In this analysis a random network was constructed using Erdos-Renyi algorithm i.e $G(n,p)$ model. Here, n=Total number of nodes and p=Probability of edge creation between two nodes.

If n is large then the average degree of a random network is very likely equal to the product of n and p i.e the average degree in case of an ER-Random network can be approximated by np. This fact will be used in this analysis to set the average degree of the random network equal to a specific value.

If a node is not satisfied, then that node cuts one of its negative connections and establishes another connection with some other node and repeats this process till it gets satisfied. This process it repeated for the whole network.

n (number of link)	600	600	600	600
p (probability of connection)	0.006666	0.01	0.013333	0.016666
Average Degree	≈4	≈6	≈8	≈10

2 Results

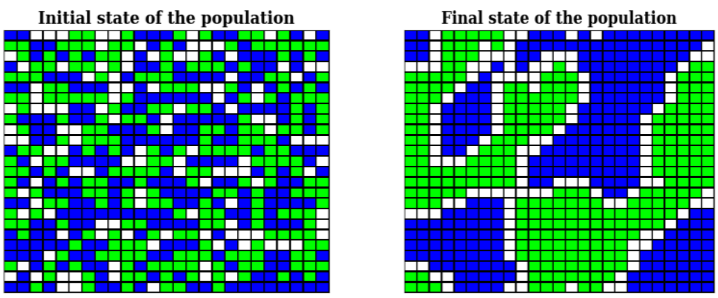

Figure 1: Parameters- Grid Size=25x25, Population=500, Ratio of x and y agents=1, Neighbour similarity threshold required to satisfy an agent=80%

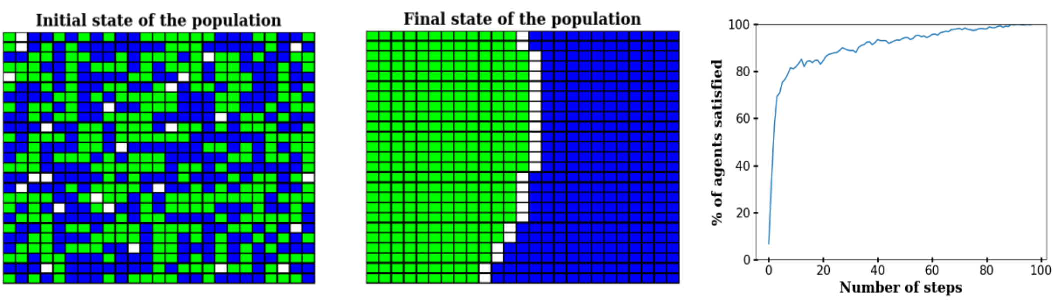

Figure 2: Parameters- Grid Size=25x25, Population=600, Ratio of x and y agents=1, Neighbour similarity threshold required to satisfy an agent=80%

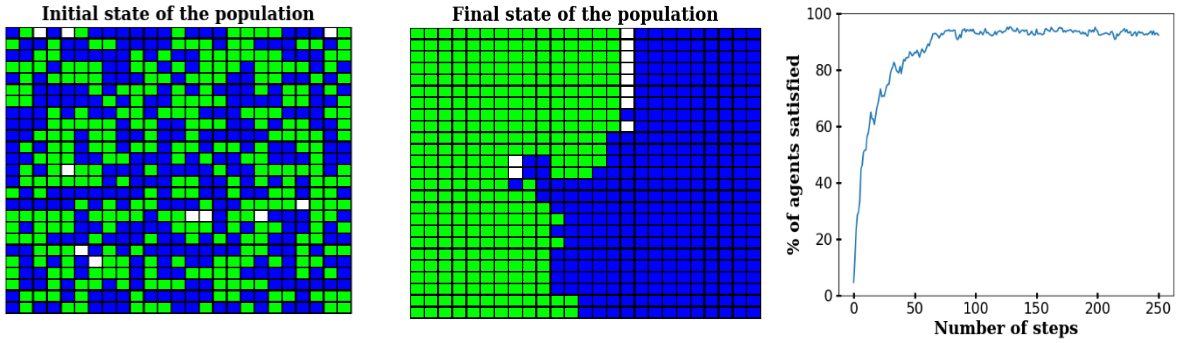

Figure 3: Parameters- Grid Size=25x25, Population=615, Ratio of x and y agents=1, Neighbour similarity threshold required to satisfy an agent=80%

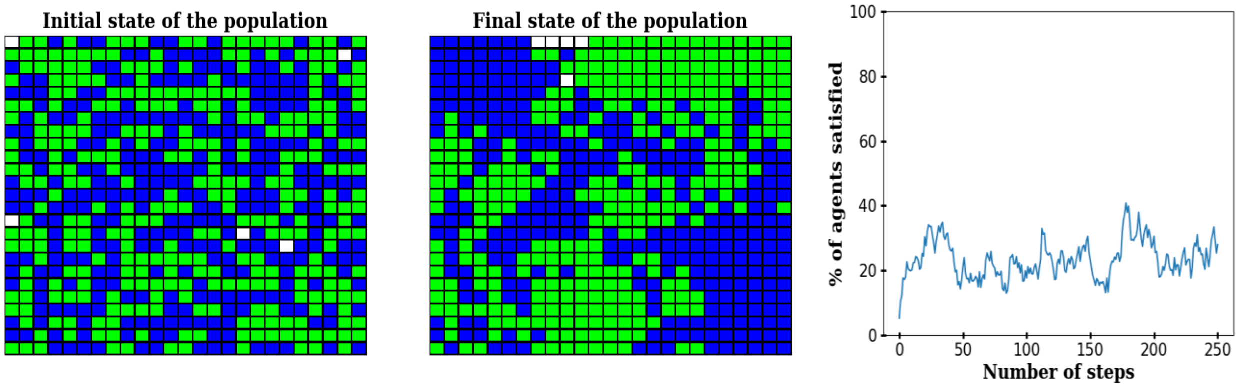

Figure 4: Parameters- Grid Size=25x25, Population=620, Ratio of x and y agents=1, Neighbour similarity threshold required to satisfy an agent=80%

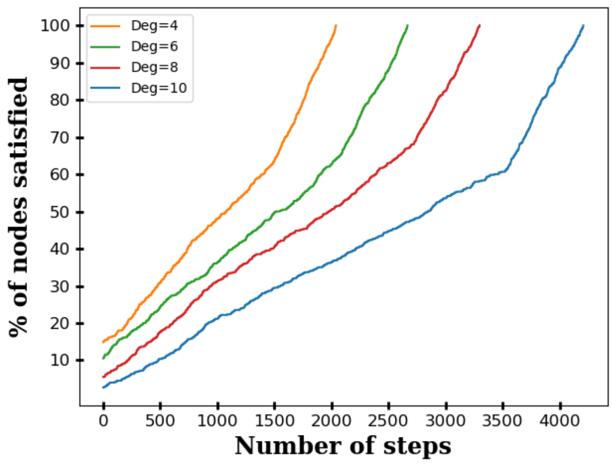

Figure 5: Plot of percentage of satisfied nodes vs number of steps for a random network with various values of average degree. Parameters- Number of nodes=600, ratio of x and y agents=1, Neighbour similarity threshold required to satisfy a node=80%

3 Discussion

Note: The steps plotted for grid configuration and random network have different meanings and so the two population configurations can't be compared directly based on number of steps by looking at the plots above.

a) From Fig 2 and Fig 3 we can conclude that all the agents in a sparsely populated grid can get satisfied more easily as compared to a densely populated grid. Also, in extremely densely populated grids, it is mostly impossible to satisfy all the agents(Fig 4).

b) The final state of a system highly depends on the initial position of the agents in a sparsely populated grid.

c) In case of random networks, a network with higher average degree takes longer and more iterations to reach 100% node satisfaction state but the overall behavior of a random network while it reaches 100% satisfaction state is similar if we vary the average degree of the network.
Here average degree is varied such that it stays very low with respect to the total number of nodes.