Skype A Scientist - Mallory Gaspard, Cornell University
Fall 2019
Shelling Model Exploration

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1 Similarities and Open Spaces: Background for the Schelling Model

In our everyday lives and throughout history, we notice that people tend to groups themselves together based on some shared belief, opinion, etc. We can uncover a lot about human behavior in various scenarios if we can *model* the way that people move. In the 1970's, Thomas Schelling, a sociologist at Harvard University, developed a mathematical model to learn about segregation patterns within neighborhoods. In making his model, Schelling based his logic off of the idea that a person will always move to be near other people who share the same beliefs. With this in mind, the Schelling Model is constructed in the following way:

1. Construct a grid of squares
2. Place two different types of people around the grid with only one person per square
3. A person will move away from their square to a new square under two conditions:
   (a) If the new square is empty
   (b) If the new square is next to squares that have people of the same type
4. A person will stop moving if they have at least a certain number of neighbors that match their type

2 Makin' Moves: The Paper Simulation

We are going to do a quick paper simulation of the Schelling Model using the grids below. To begin, we list the following definitions of terms that you'll need throughout the activity:

- **Red Agent** - a red dot occupying a square in the grid
- **Blue Agent** - a blue dot occupying a square in the grid
- **Neighbor** - a particular agent's neighbor is any dot occupying a square that shares a side with the particular agent's square. Example: In the first diagram, the red agent in square (2,1) has a blue agent for a neighbor in square (1,1) and a red agent for a neighbor in square (3,1).
- **Threshold** - the threshold is the minimum number of neighbors of a certain person's type that must be present around a person before they stop moving to new locations.
- **Satisfied** - an agent is satisfied with their current location if they have at least the threshold number of neighbors that match their type.

Now that we have the definitions above, we will follow the following steps to run our own, on-paper, Schelling simulation.

Shelling Simulation Steps:

1. Beginning with the first grid that shows the starting arrangement of red and blue agents, select any agent on the grid.

2. Now that you have selected an agent, move that agent to an empty square. You can only move an agent according to the following rules:

   (a) You can only move the agent by one space.

   (b) You can only move the agent left, right, up, or down.

   (c) You cannot move the agent diagonally.

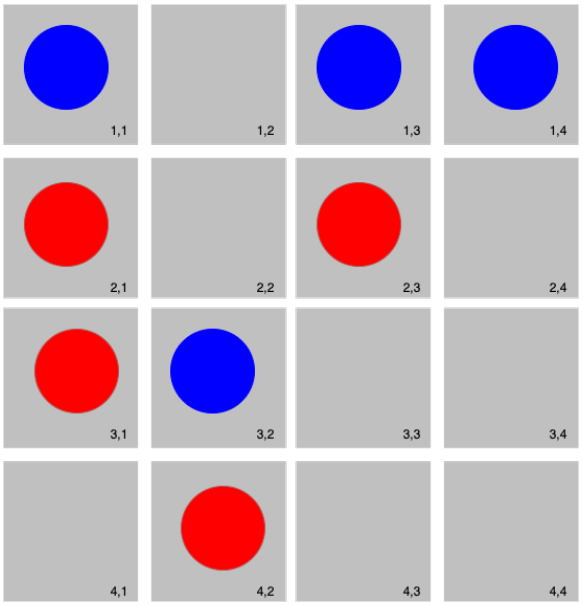
   (d) If the agent has the threshold number of neighbors, the agent will no longer want to move.

3. Repeat this process by finding each of the other agents on the grid who are eligible to be moved, and move them according to the rules above.

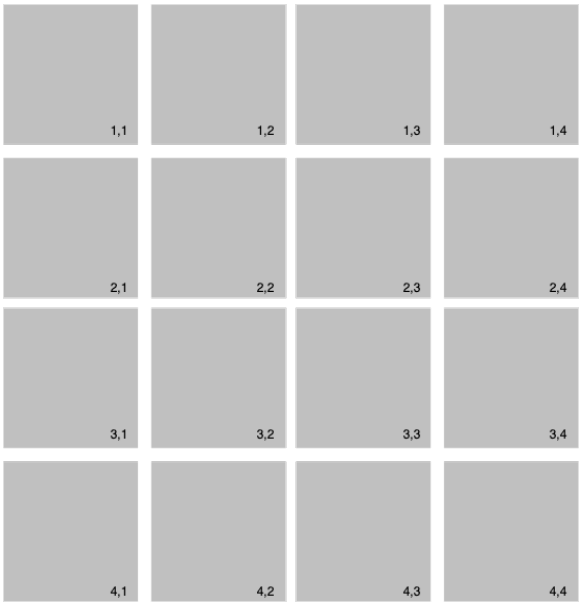
4. Now fill in the blank grid labeled “Iteration 1” with the new configuration. Note: if you do not have red and blue pens, you can write an “R” in the squares that have a red agent and a “B” in the squares that have a blue agent.

5. Repeat this process outlined above to fill the next two blank grids labeled “Iteration 2” and “Iteration 3.”

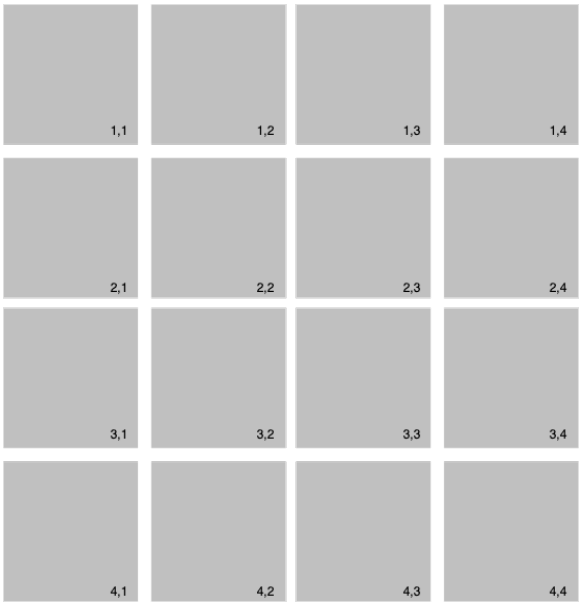
Shelling Simulation Grids



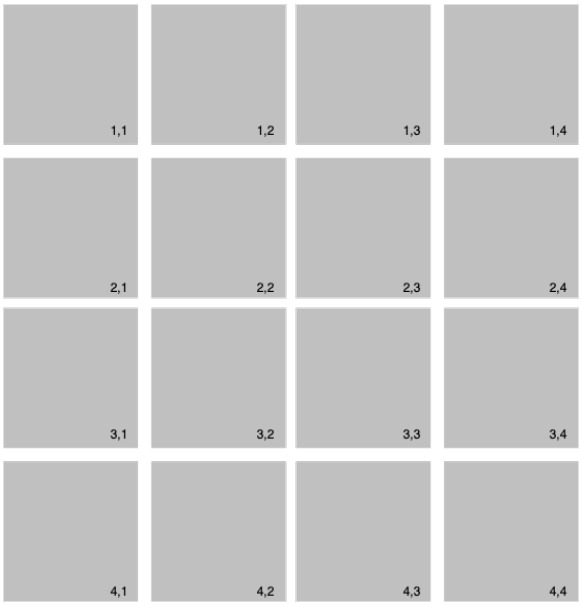
Initial configuration



Iteration 1



Iteration 2



Iteration 3

3 Discussion and Takeaways:

Question1. After 3 steps of the Schelling Simulation, what do you notice about the grid and the moves that agents are making at each step?

Question2. Do you notice any optimal routes for a person to take through the grid to get to their desired neighbors quicker / in fewer steps?

Question3. Will all agents in the grid eventually be satisfied with their location? Why or why not? Do some locations appear to be more favorable for a particular agent than others?

Question4. What are some of the limitations of the Schelling Model? Did the creators of the model make any assumptions about the way that people behave? If so, what are they?

Some links to and resources with more info about the simulation and related simulations:

Online Schelling Simulation: http://nifty.stanford.edu/2014/mccown-schelling-model-segregation/.
Schelling's Actual Paper: https://www.stat.berkeley.edu/ aldous/157/Papers/Schelling$_{Seg_{Models.pdf}}$
An online game based on the model: https://www.citylab.com/design/2014/12/an-immersive-game-shows-how-easily-segregation-arisesand-how-we-might-fix-it/383586/