Further Investigation into Schelling's Model

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Goal

I had the following questions:

- Under what conditions does Schelling's model begin to break down?
- Keeping the agents' preferences constant, how can we change the parameters such that the average similarity converges to difference values?
- What affects the the rate of convergence of the average similarity (amt. of segregation in system)?

My thought: let's change how the unhappy agents choose a new cell to live.

- Classically, agents move to the nearest empty cell where they would be happy.
- Let's try having the agents take a random walk.

Recap of Schelling's Model

1. Two types of agents (white and black) located on an 8×8 board.
   - (picture a chessboard)
2. Each type of agent wants to have at least $x\%$ of their neighbors similar to them.
   - Originally one agent wanted at least $\frac{1}{3}$ of neighbors to be similar.
   - And the other agent wanted at least $\frac{1}{2}$ of neighbors to be similar.
3. If an agent's preferences are not met, then they are unhappy.
4. During each iteration of the model, an unhappy agent is randomly selected.
5. Then the selected agent moves to the **nearest** empty cell such that they are happy.

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3. If an agent's preferences are not met, then they are unhappy.
4. During each iteration of the model, an unhappy agent is randomly selected.
5. Then the selected agent searches for a new cell where they would be happy via a **random walk**.

What is a random walk?

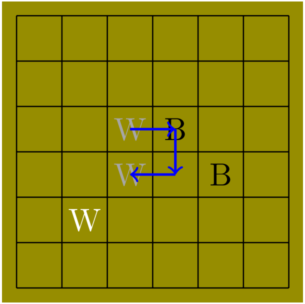
- After an agent is selected to move, the agent randomly selects a direction that they could move.
  - e.g. North, South, East West (updated appropriately at borders)
- The agent then "moves" to the cell adjacent to their current position in the selected direction.
- If the cell is empty and the agent is happy, then the agent "settles" in the cell and turn is over.
- Otherwise the agent randomly selects a direction and moves to that cell, repeating the above steps.
- Eventually the agent will either find a cell they like, or will have taken more than 100 steps.
- If the agent takes more than 100 steps, they return to their original cell and their turn is over.

Example of a Random Walk

Suppose that W is selected to move and wants $\geq \frac{1}{2}$ of neighbors to also be white.

The Random Walk:

1. Goes East.
2. Goes South.
3. Goes West.
4. Finds empty and happy cell.



Measuring a state in Schelling's model

We can measure a state by measuring the *average similarity* or the *average happiness*.

$$\text{Similarity(agent)} = \frac{\#\text{ neighbors of agent's race}}{\#\text{ of neighbors}}$$

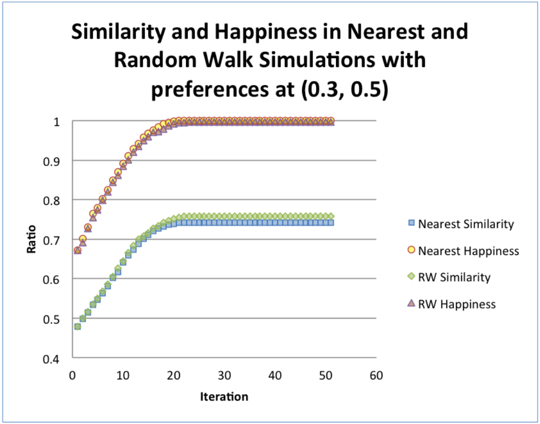
$$\text{Similarity(state)} = \text{Average similarity of all agents}$$

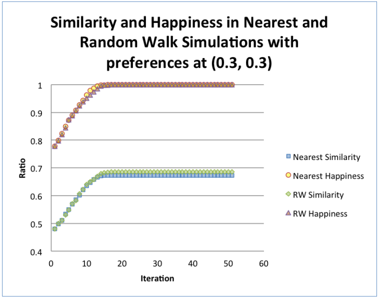
$$\text{Happiness(state)} = \frac{\#\text{ happy agents}}{\#\text{ total agents}}$$

Similarity gives you the amount of segregation in the system.

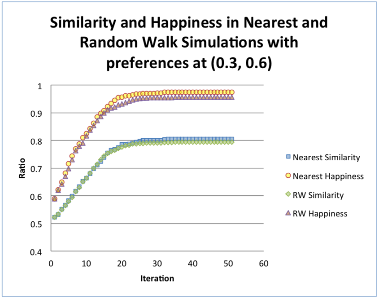
Results

- Initialize a random state.
- Run the model 50 iterations.
- Record average similarity and average happiness at each iteration.
- Ran 25 trials and plotted averages (see right).
- The nearest and rw trials used the same initial states.

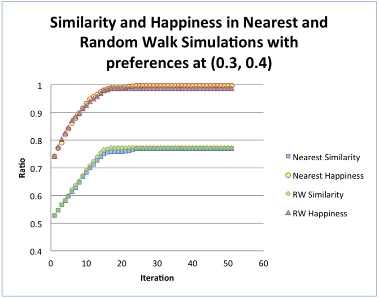




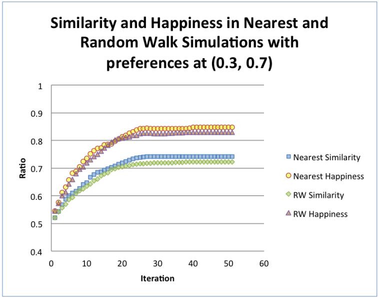
Similarity and Happiness in Nearest and Random Walk Simulations with preferences at (0.3, 0.3)
Ratio
Iteration
Nearest Similarity
Nearest Happiness
RW Similarity
RW Happiness



Similarity and Happiness in Nearest and Random Walk Simulations with preferences at (0.3, 0.6)
Ratio
Iteration
Nearest Similarity
Nearest Happiness
RW Similarity
RW Happiness



Similarity and Happiness in Nearest and Random Walk Simulations with preferences at (0.3, 0.4)
Ratio
Iteration
Nearest Similarity
Nearest Happiness
RW Similarity
RW Happiness



Similarity and Happiness in Nearest and Random Walk Simulations with preferences at (0.3, 0.7)
Ratio
Iteration
Nearest Similarity
Nearest Happiness
RW Similarity
RW Happiness

Analysis of the model

So unfortunately, I didn't find any parameters for which the nearest model and random walk model exhibited different behavior.
Ideas for further investigation:

- Change max number of number steps an agent can take in their random walk.
- Change border conditions (in particular, make the border a torus instead of an edge)
- Inspired by Zach's talk: every x iterations, force a happy person to move at least y cells away from their place.
- Try modeling socioeconomic inequality by giving agents a certain amount of steps they can take in their random walk (give some agents more steps than others).
- Try reversing Schelling's model. Instead of agent's desiring a particular composition of neighbors, neighbors have a desire about whether or not they want to live by you.
    - Would perhaps model living near sex offenders/felons/sexism - phenomena with outward effects

Philosophical Analysis

Other goal: To what extent can we make conclusions about society based on knowledge gained from Schelling's model?

- Since Schelling's model is a huge simplification of reality, it's arguable whether the results translate to society.
- My thought: let's make Schelling's model a tiny bit more realistic and see what happens.
    - I think adding the random walk is a *huge* change to Schelling's model.
        - The model is no longer nondeterministic
        - etc.
- We saw: results were the same.
- What it suggests:
    - The core component of Schelling's model (preferences/racism and happiness) is robust.
    - Changing the procedure around the core doesn't seem to change much about the model.
    - Suggests to me that the mechanism is secondary to the phenomon
    - i.e. how we react to racism is secondary to the existence of racism.

The Upshot

- Need to do more work.
- Tentative thinking: the random walk does not break Schelling's model
- So the "core" idea of Schelling's model is robust.
- ''core'' idea = preferences/happiness
- ''non-core'' idea = movement procedure