Particle Methods
Spring Semester 2023

Homework 1

Due date: 15.03.2023

Part 1

Watch interview with J. Conway, www.youtube.com/watch?v=R9Plq-D1gEk

Part 2

Read T. Schelling's paper, www.jstor.org/stable/pdf/1823701.pdf

Part 3

Write a program using language of your choice (C, C++, Matlab, python, ..) implementing variation of Schelling's model in 2D with the following conditions:

- Grid size: 100 by 100
- Boundary conditions: periodic in both directions
- Number of empty cells: 10%
- Number of agent types: 2 (call them red and blue, or anything else)
- Distribution of agents: 50/50 (i.e. 45% of cells are occupied with red agents, and 45% with blue)
- Initial distribution of agents and empty cells on the grid: random
- Size of the neighborhood: 1 cell radius (i.e. 8 adjacent cells)
- Number of neighbors of the same type for the agent to be "happy": H (to be varied) (note that we don't count empty cells, e.g. agent surrounded by all empty cells in not happy in our model)

a) Initialize the system with random distribution of agents and empty cells. Take H equal to 4. Run simulations and count number of iterations needed for all agents to become happy. During each iteration, go through the list of all agents once in specified order and allow unhappy agents to move in particular way. Try different options.
For the order in which agents are updated try:

- going consequently along rows of the grid
- random sequence of agents

For the way each unhappy agent moves try (don't forget to take into account periodicity of the system):

- moving horizontally (to the left or to the right, or randomly) to the nearest empty cell (note that we don't care if the new location will make the agent happy immediately after the move)
- moving in random direction (up, down, to the left or to the right) to the nearest empty cell

For choices above, run several cases with different random initial conditions and observe the number of iterations needed to reach happy state of all agents. Also, check if there are any visible artifacts in the final distribution of agents. Briefly summarize your results and propose good strategy for selection of agent update order and moving direction.
b) Use the good strategy that you found in a). For the simulation parameters listed above, try values of H from 1 to 8. Are there any transitions in system behavior and final (if any) configuration due to variation of H? Briefly summarize your results.
Please submit your code together with the report.