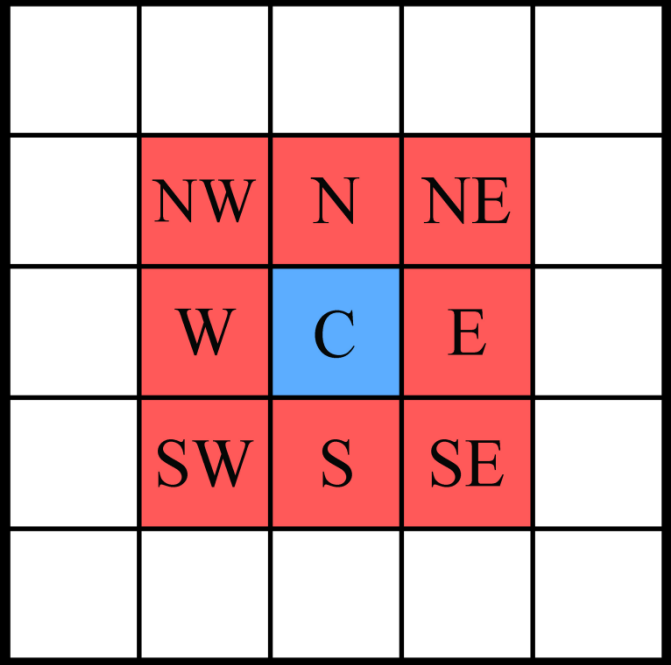
Computer modeling of physical phenomena

05-06.03.2024

Lab II: Spatial Prisoner's Dilemma

Playing on a grid...

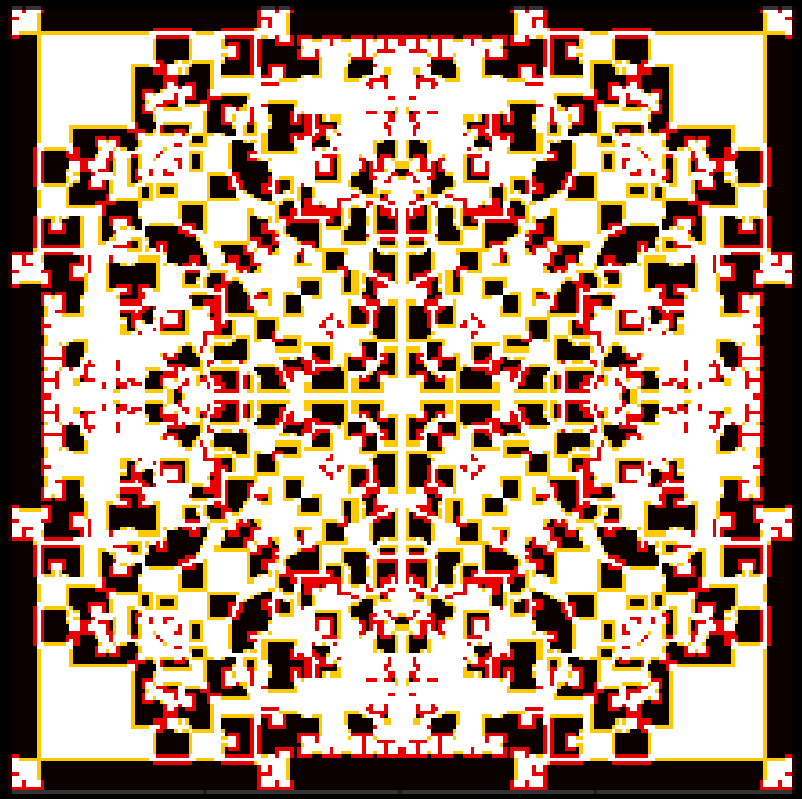


- Each player plays PD with all the (Moore) neighbours (including himself) using a given strategy (either always defect or always cooperate).
- The total payoffs are calculated.
- In the next round, the player adopts the strategy of its most successful neighbour (including himself).

Color coding

Use four different colors to mark:

- defectors that were cooperators in the last round (dc)
- defectors that were defectors in the last round (dd)
- cooperators that were defectors in the last round (cd)
- cooperators that were cooperators in the last round (cc)



Payoff matrix

(A's payoff, B's payoff)

Player A \ Player B	cooperate	defect
cooperate	(CC,CC) reward for mutual cooperation	(CD,DC) sucker's payoff and temptation to defect
defect	(DC,CD) temptation to defect and sucker's payoff	(DD,DD) punishment for mutual defection

- Take CC = 1, CD = 0, DC = b and DD = 0.
- The only free parameter is then b (temptation to defect).

Task 1

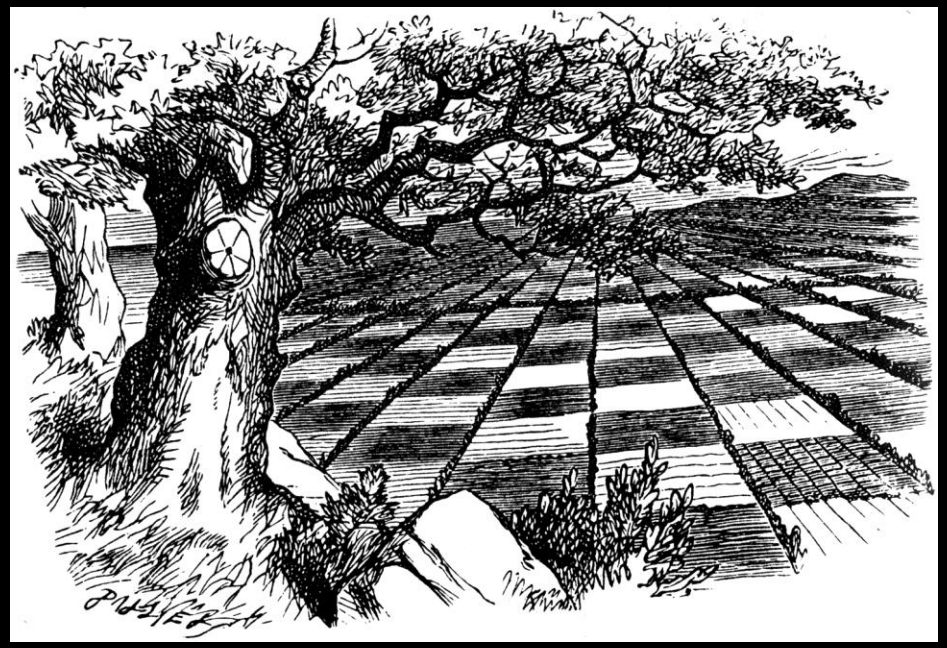
- Run spatial PD on 201x201 grid with PBC.
- Start with a single defector at the center.
- Take b = 1.9 and b = 2.08.
- Make movies illustrating the evolution of such a system.
- Do not use loops over space!

Task 2

- Start with random distribution of 50% cooperators and 50% defectors.
- Run the simulation up to the steady state and calculate the final percentage of defectors (f).
- Repeat the calculation for several b values, plot f(b) dependence, run additional simulations corresponding to the b values in the region of large df/db (to resolve the details of f(b) dependence).
- Illustrate the change of patterns with b with a few images.

Extra task

- Include other strategies, memory-based (e.g. Tit-for-Tat & Pavlov) and random. Play M games between neighbours before they adopt the strategy of the most succesful one (you can try e.g. M = 5).
- When plotting, use different colors for the strategies.
- How does it change the dynamics? Who wins? What happens if you include some noise in decision-making?



Points

1. Evolution of SPD for b = 1.9 and b = 2.08 – 0.5 p.

2. Plot of final percentage of defectors vs b – 0.5 p.

3*. Evolution of SPD with other strategies (memory-based and random) and noise – 0.2 p.