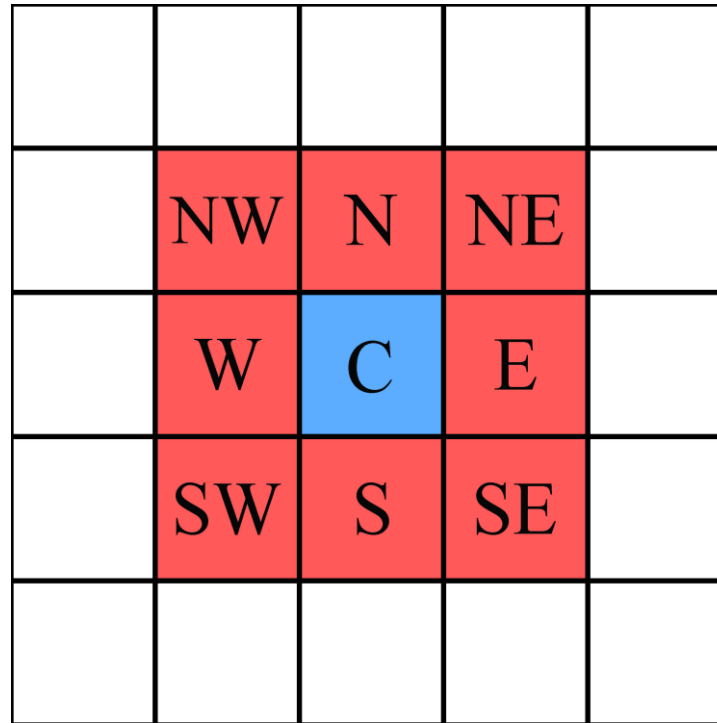


# Computer modeling of physical phenomena



Lab XI – Spatial Prisoner's Dilemma

# Playing on a grid...

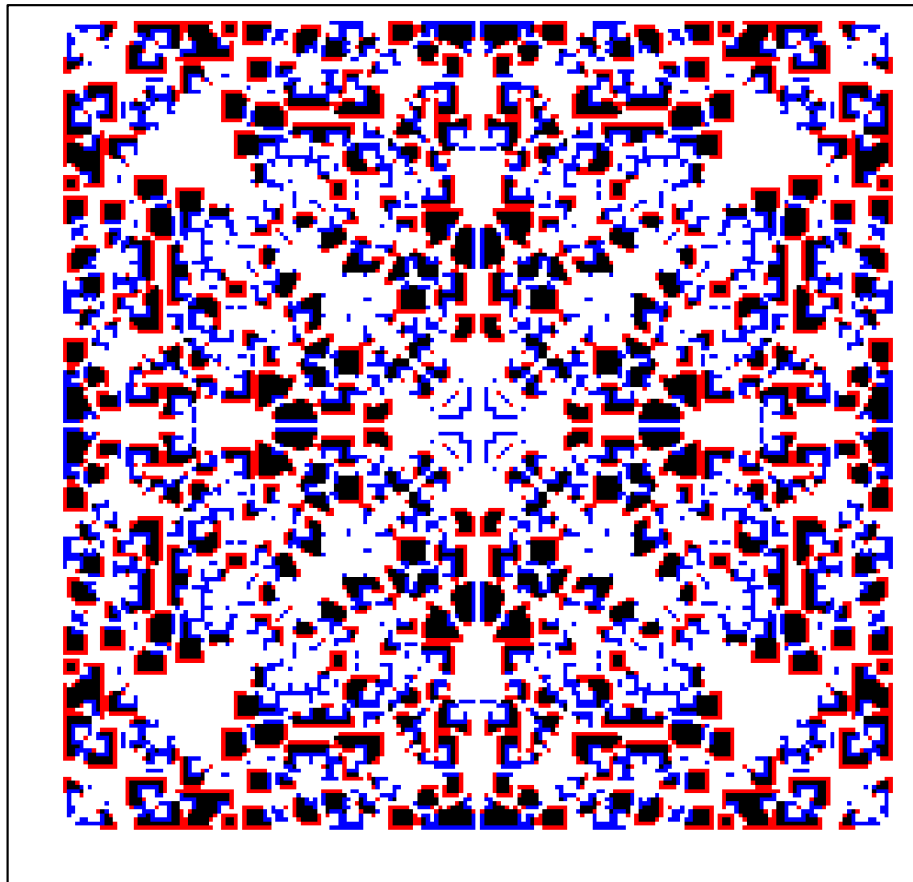


- each player plays PD with all the (Moore) neighbours including himself using a given strategy (either: always defect or always cooperate)
- the total payoffs are calculated
- in the next round, the player adopts the strategy of its most successful neighbour (including himself)

# 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 B	
		cooperate	defect
Player A	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  $b$  (sucker's payoff)

# Task no. 1

- run spatial PD on 201x201 grid with periodic b.c.
- start with a single defector at the center,
- take  $b=1.9$  and then also  $b=2.08$
- make a movie illustrating the evolution of such a system

# Task no. 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 change of patterns with  $b$  with a few jpegs

# Extra task

- include other, memory-based strategies: Tit-for-Tat & Pavlov
- how does it change the dynamics? Who wins?

