

Learning Dynamics: Assignment 2

Evolutionary dynamics in a spatial context

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1 Part I

Specifications Plots in this part shows the average cooperation level of 100 simulations with unconditional imitation as the update mechanism. The first rounds were played randomly, where a player would choose cooperate with a probability of $\frac{1}{2}$.

1.1 Neighborhood analysis

Remark The analysis is based on results from 50x50 lattice simulations

Moore Figure 1a shows the average cooperation level using a Moore neighborhood for each player. We can observe that the level after the first randomly played round, the cooperation dropped at around 2%. Then grows to stabilize at around 87%.

Von Neumann Figure 1b shows the average cooperation level using a Von Neumann neighborhood for each player. We can observe that the level after the first randomly played round, the cooperation dropped at around 15%. Then grows to stabilize at around 40%.

We can see that the cooperation level follows the same pattern but on a different scale. With Moore we have more neighbors, which can explain why the behaviour of the players are more *extreme*.

1.2 Lattice observation

Figure 2 shows the full matrix of cooperation for the rounds $t_0, t_1, t_5, t_{10}, t_{20}, t_{50}$. We can observe that in the first round there is more or less the same number of players cooperating and defecting. But in the second round, a large percentage of players will choose to defect, leaving only small zone of cooperation. This is due to the fact that a defecting player will usually have a better score around a mixed neighborhood of player than a cooperating player. But when a cooperating player has a cooperating neighborhood he will have high enough score to influence defecting players in his neighborhood. We can observe that in the following rounds, a sort of *cluster* of cooperation will be formed and influence the full lattice until reaching the cooperation level explained in section 1.1.

1.3 Lattice size analysis

Figure 3 shows the average cooperation level of lattices of size 20, 12, 8 and 4. The behavior seems to be the same as in the analysis made against lattice of size 50 in section 1.1, it crashes to a small level of cooperation to grows and stabilize after a number of rounds. The plots show that when the lattice size is small, the cooperation stabilize to a smaller cooperation level than bigger lattices. We can observe that for a size 4 lattice, the cooperation level is even 0 after the first round.

The reason could be that there is less players so less possibilities to form some cooperation neighborhood, that will form the clusters and grows as explained in previous section.

2 Part II

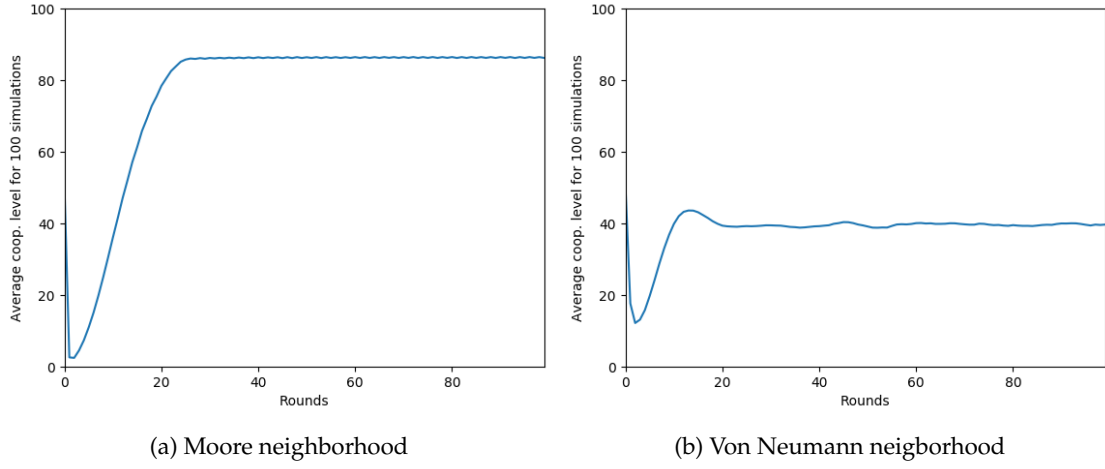


Figure 1: Cooperation level using unconditional imitation and weak prisoner's dilemma on a 50x50 lattice

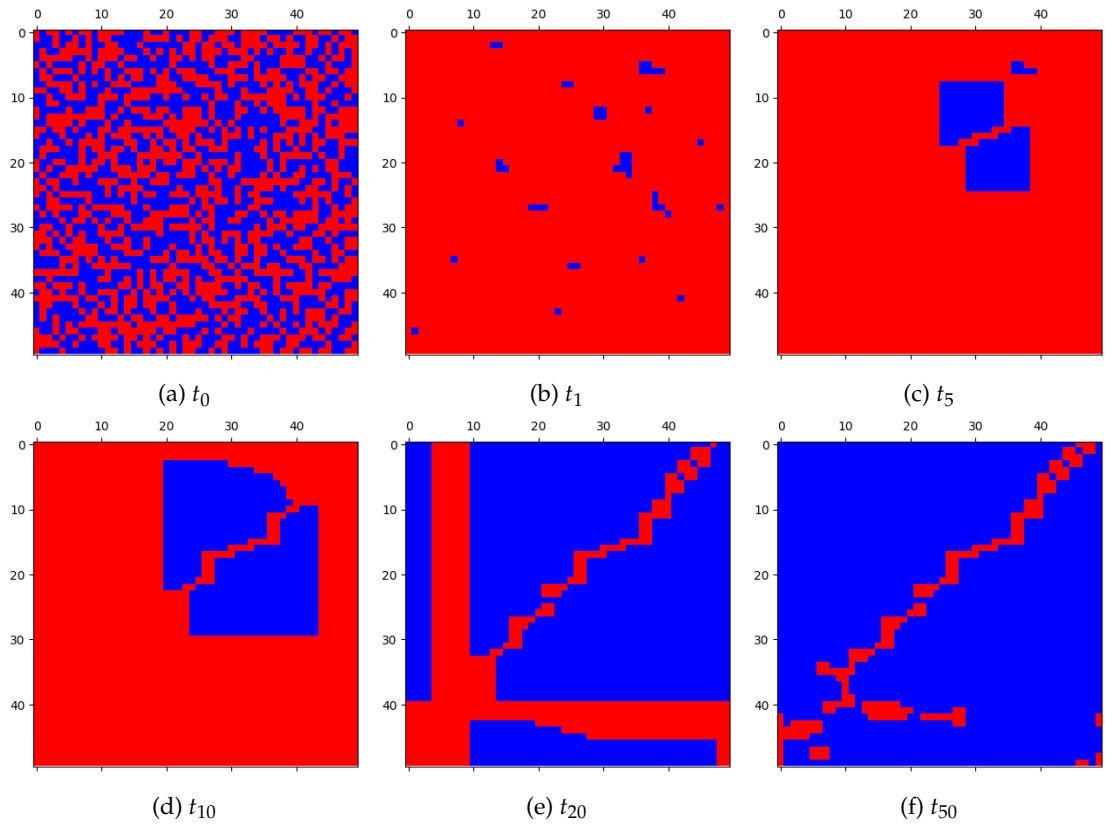
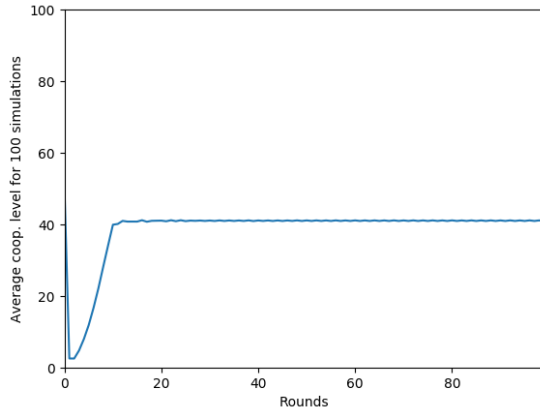
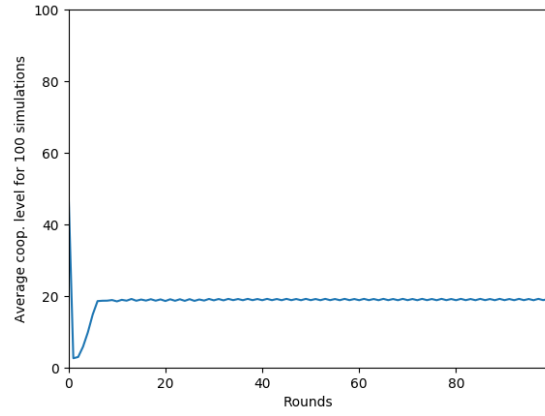


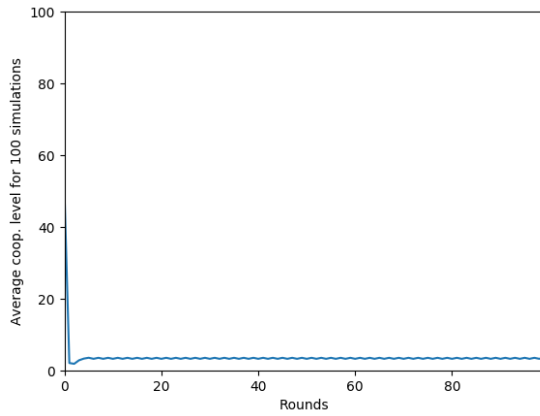
Figure 2: Visualization of a the lattice with unconditional imitation, Moore neighborhood and weak prisoner's, dilemma



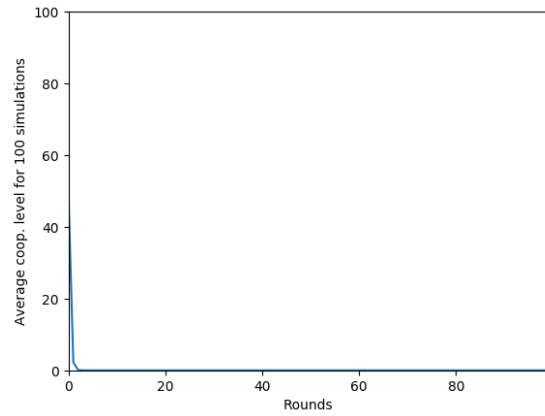
(a) 20x20



(b) 12x12



(c) 8x8



(d) 4x4

Figure 3: Cooperation level using unconditional imitation, Moore neighborhood and weak prisoner's dilemma

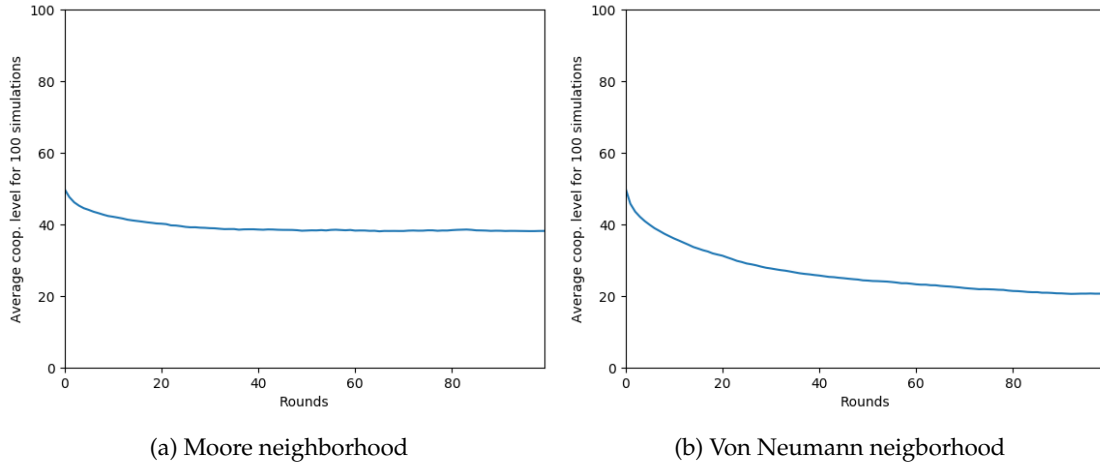


Figure 4: Cooperation level using replicator rule and snowdrift game on a 50x50 lattice

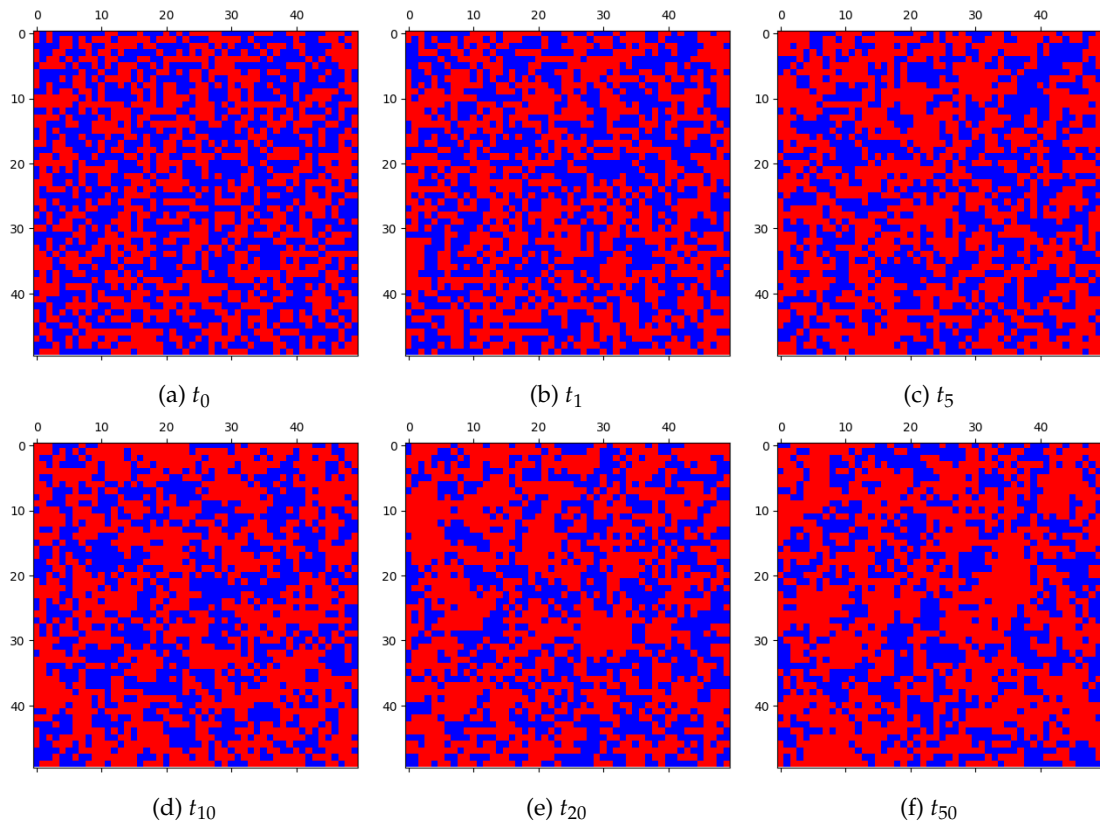


Figure 5: Visualization of a the lattice with replicator rule, Moore neighborhood and snowdrift game

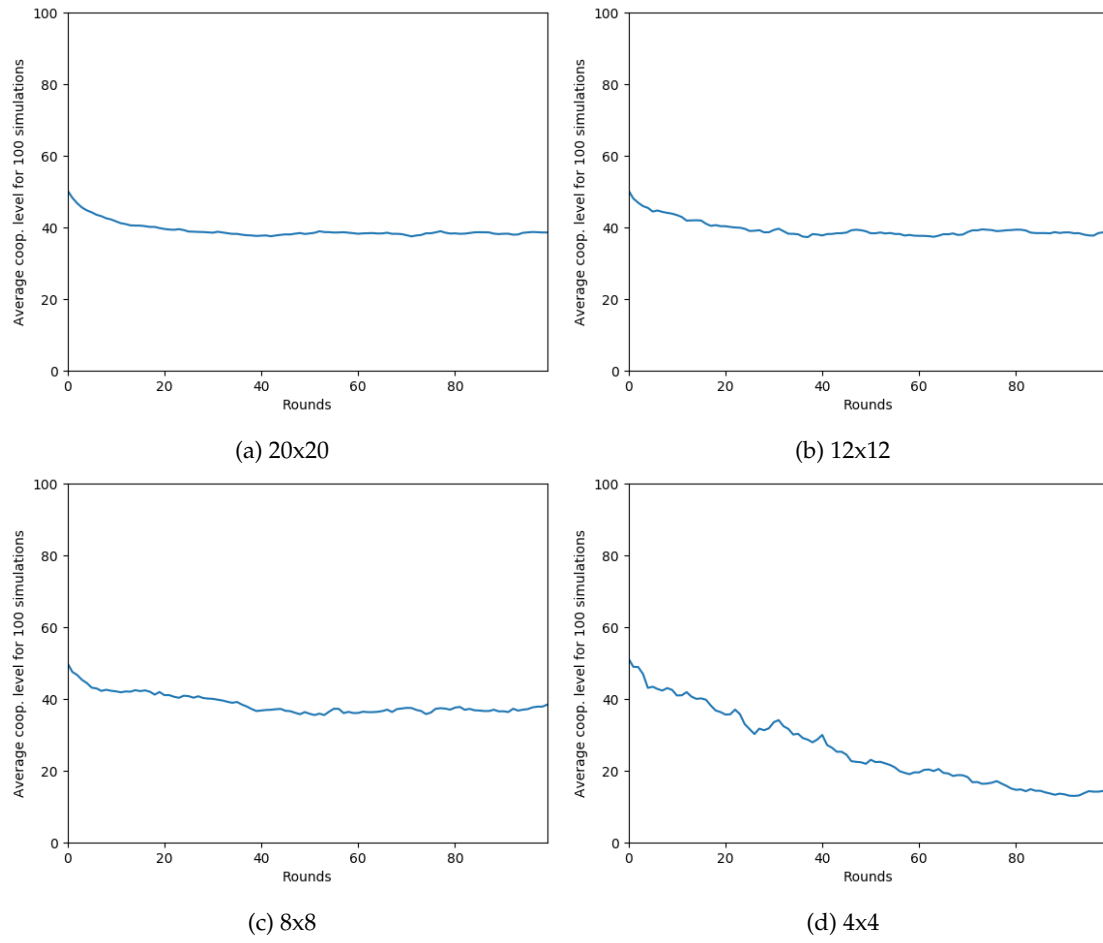


Figure 6: Cooperation level using replicator rule, Moore neighborhood and snowdrift game