Université libre de Bruxelles

INFO-F-409 - Learning Dynamics

Assignment Two

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Contents

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Preliminary information

Each simulation was being executed 100 times. For the visualizations:

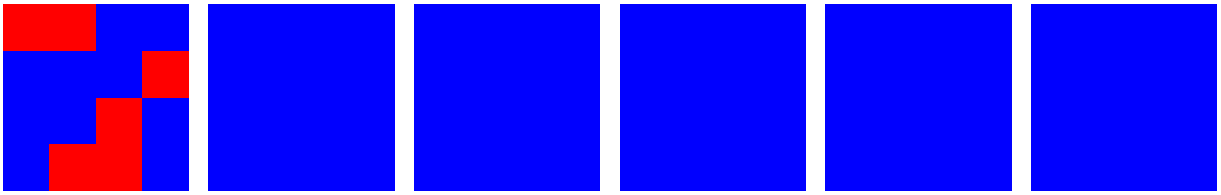
- Red signifies the action *cooperation*
- Blue signifies the action *defection*

Graphic displays one specific game, Graph shows information of all games

1 Part One - Spatial Prisoners Dilemma

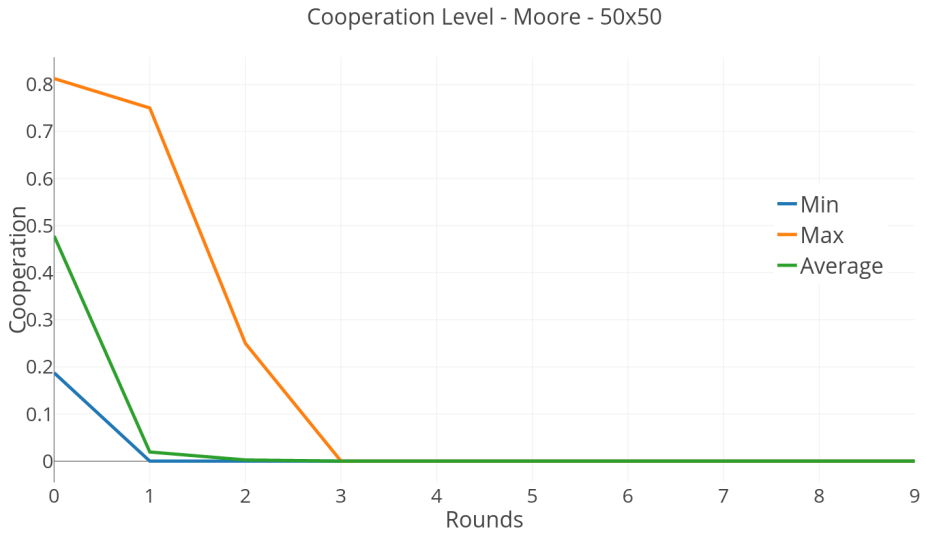
1.1 Moore Neighborhood

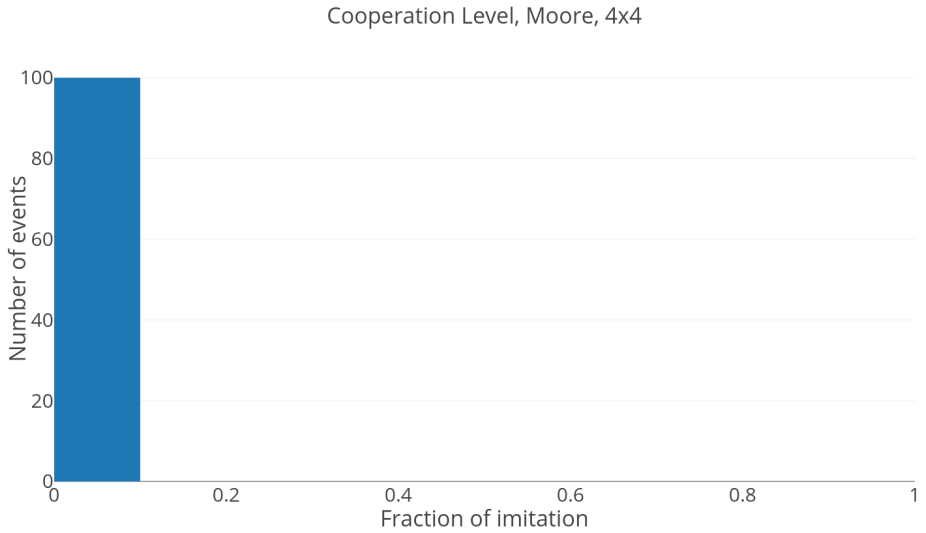
1.1.1 4x4



(a) t=0 (b) t=1 (c) t=5 (d) t=10 (e) t=20 (f) t=50

Figure 1: Prisoners Dilemma, Moore, 4x4

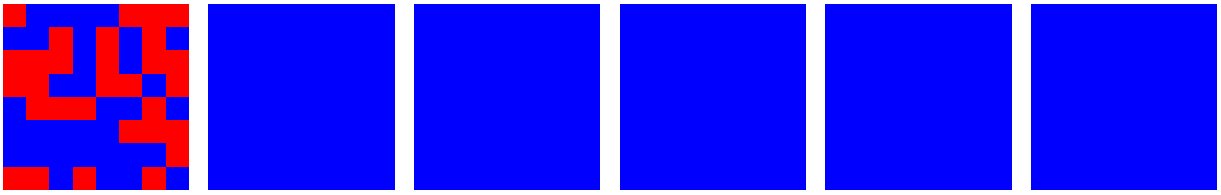




mean = 0
deviation = 0

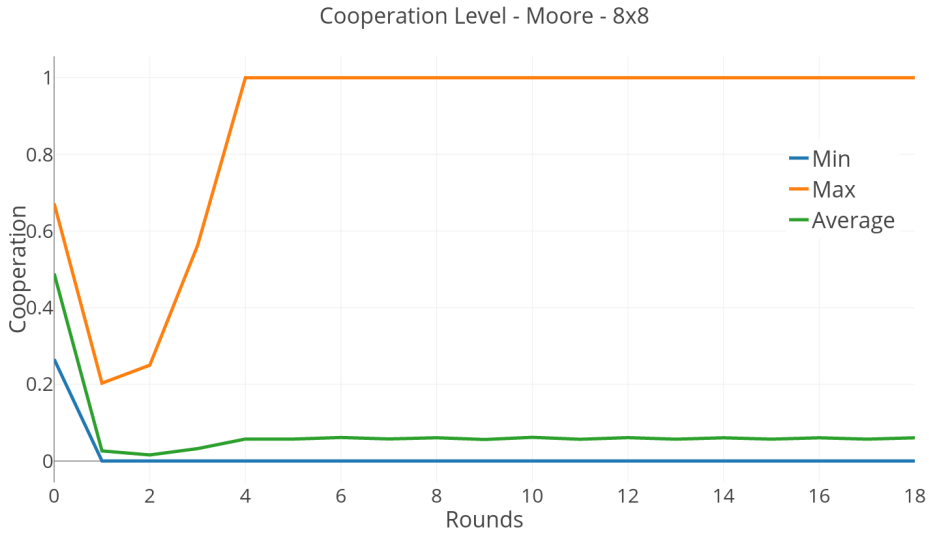
From simulating 100 runs we observe that all converge to *defecting*. It is however possible that it converges to a cooperative field, but it requires that we have a sub-matrix of 2x2 with only cooperators and all other players being defectors. This did obviously not happen during one of the simulations.

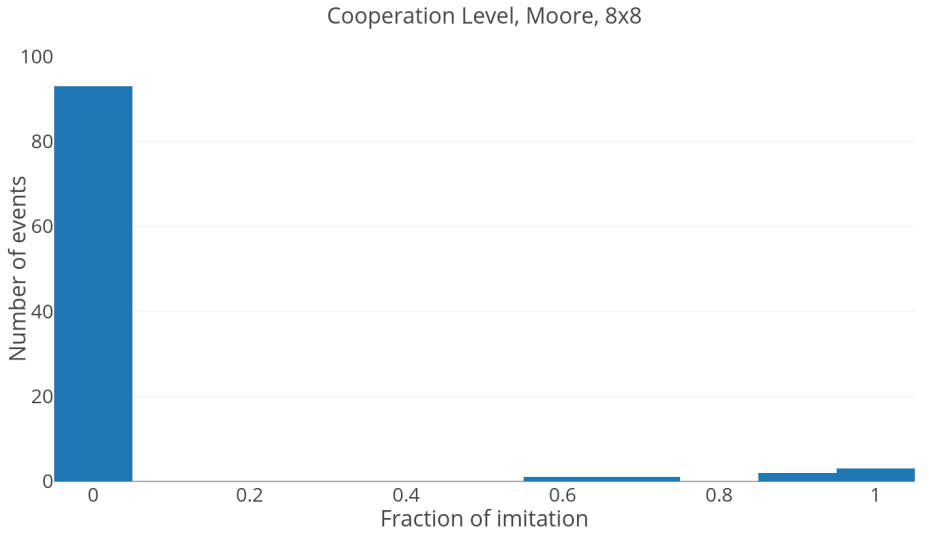
1.1.2 8x8



(a) t=0 (b) t=1 (c) t=5 (d) t=10 (e) t=20 (f) t=50

Figure 3: Prisoners Dilemma, Moore, 8x8



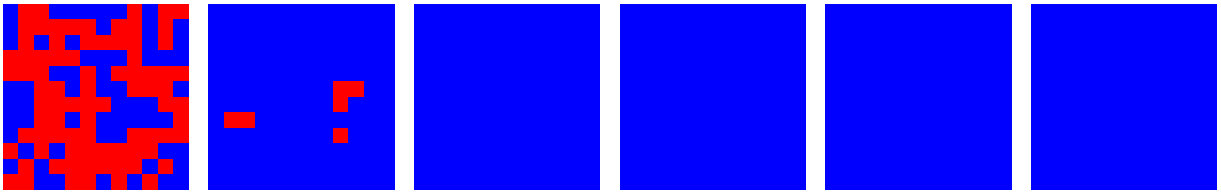


mean = 0.0605
deviation = 0.2251

converge at 10, 20 rounds

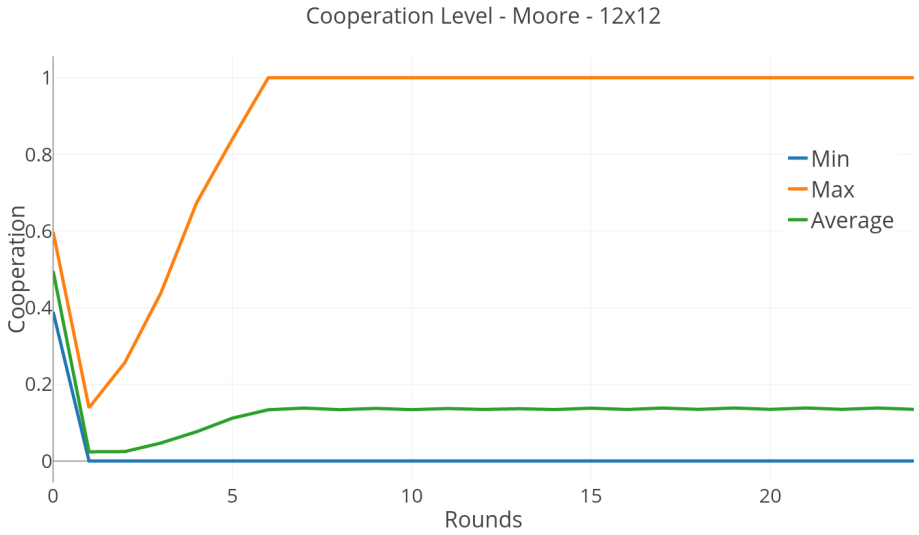
From simulating 100 runs we observe that all converge to *defecting*. It is however possible that it converges to a cooperative field, but it requires that we have a sub-matrix of 2x2 with only cooperators and all other players being defectors. This did obviously not happen during one of the simulations.

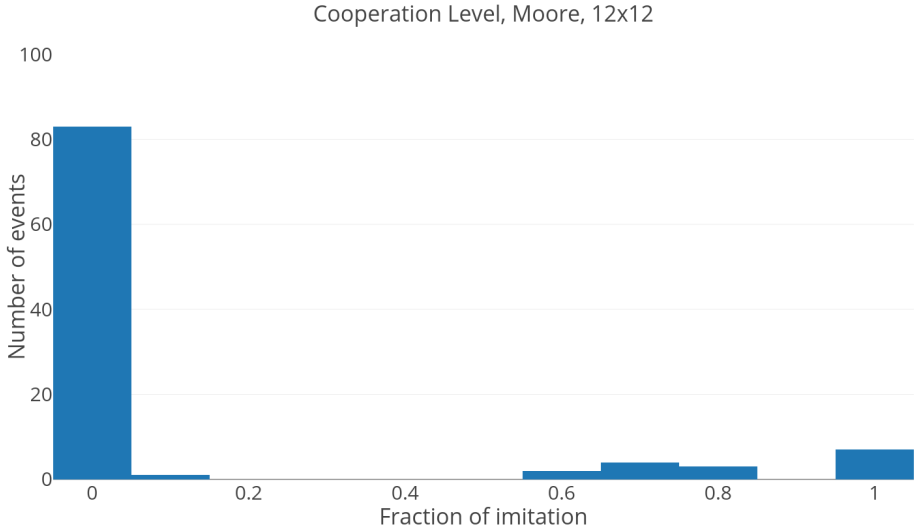
1.1.3 12x12



(a) t=0 (b) t=1 (c) t=5 (d) t=10 (e) t=20 (f) t=50

Figure 5: Prisoners Dilemma, Moore, 12x12



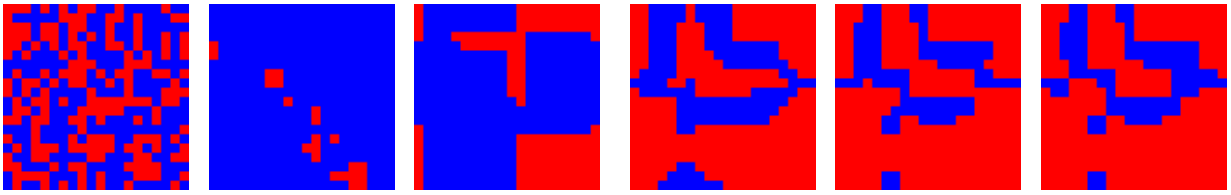


mean = 0.1347
deviation = 0.3115

converge at 10, 25 rounds

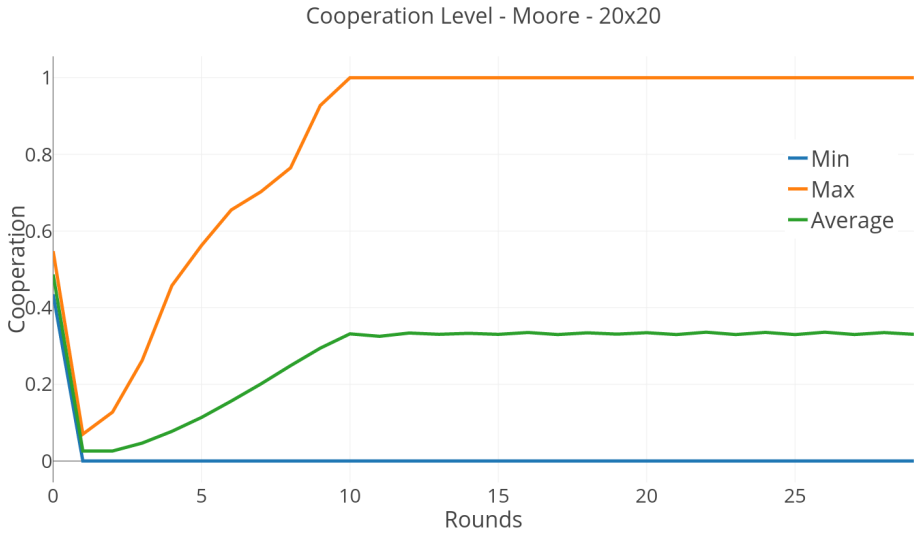
From simulating 100 runs we observe that all converge to *defecting*. It is however possible that it converges to a cooperative field, but it requires that we have a sub-matrix of 2x2 with only cooperators and all other players being defectors. This did obviously not happen during one of the simulations.

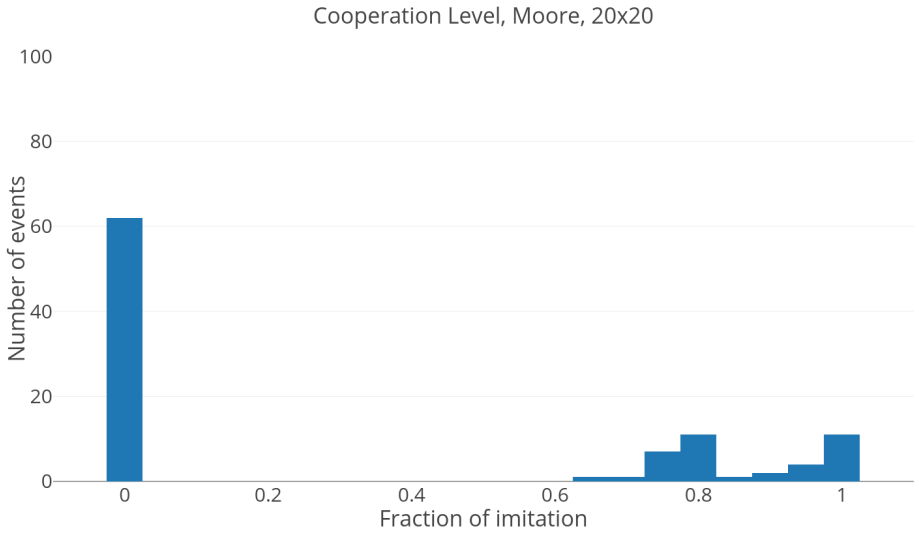
1.1.4 20x20



(a) t=0 (b) t=1 (c) t=5 (d) t=10 (e) t=20 (f) t=50

Figure 7: Prisoners Dilemma, Moore, 20x20

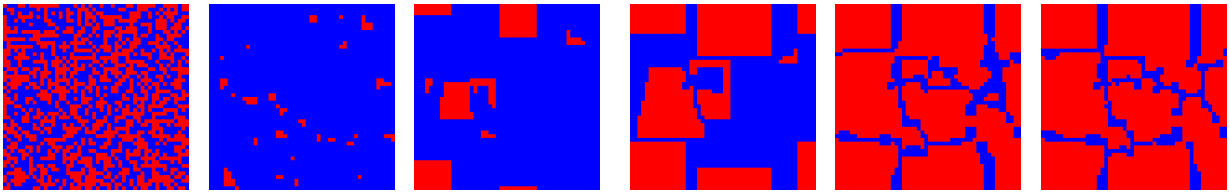




mean = 0.3305
deviation = 0.4262

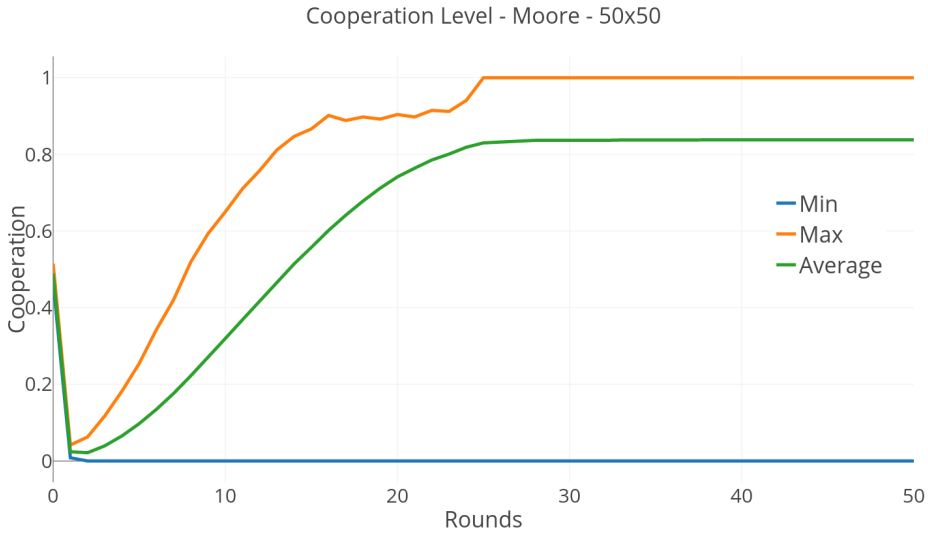
From simulating 100 runs we observe that all converge to *defecting*. It is however possible that it converges to a cooperative field, but it requires that we have a sub-matrix of 2x2 with only cooperators and all other players being defectors. This did obviously not happen during one of the simulations.

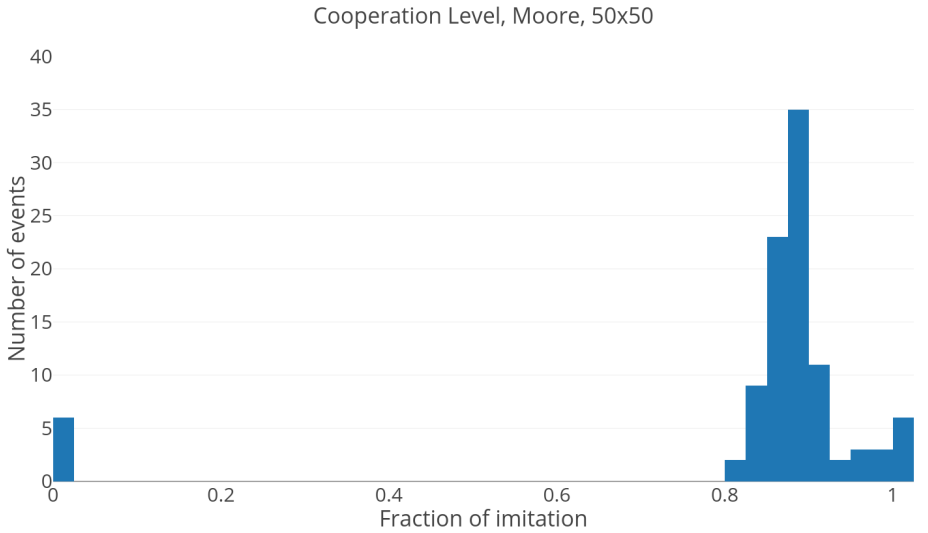
1.1.5 50x50



(a) t=0 (b) t=1 (c) t=5 (d) t=10 (e) t=20 (f) t=50

Figure 9: Prisoners Dilemma, Moore, 50x50



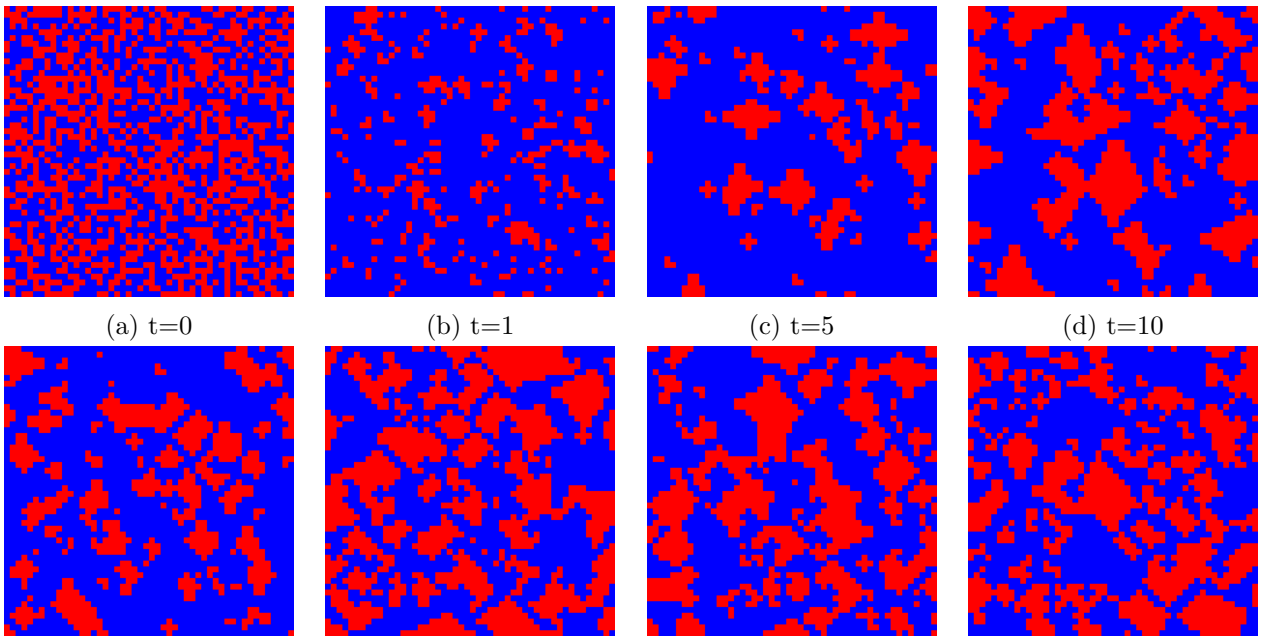


mean = 0.8379
deviation = 0.2165

blablabla

1.2 Von Neumann Neighborhood

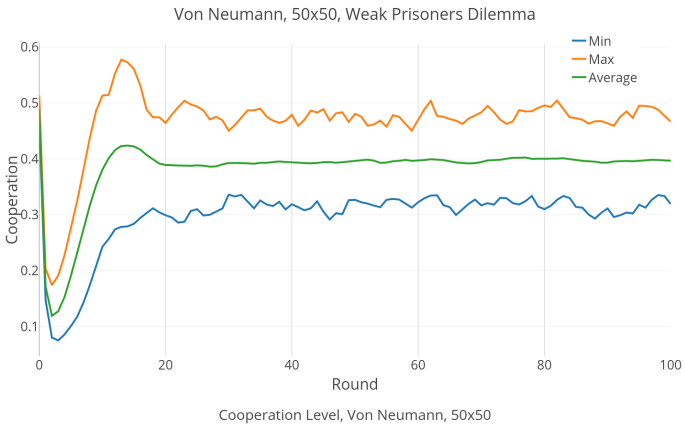
1.2.1 50x50



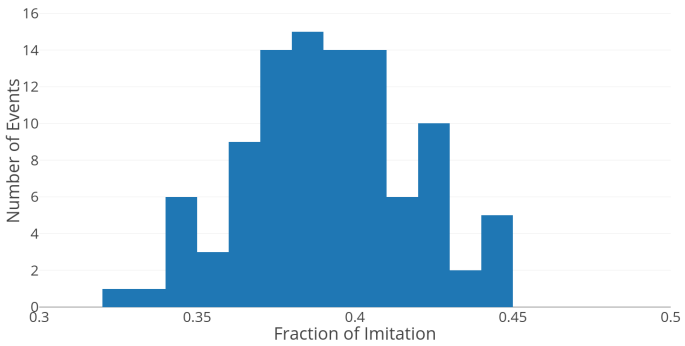
(a) t=0 (b) t=1 (c) t=5 (d) t=10

(e) t=20 (f) t=50 (g) t=75 (h) t=100

Figure 11: Prisoners Dilemma, Von Neumann, 50x50



Cooperation Level, Von Neumann, 50x50



Changing the neighborhood to the *Von Neumann* mode, we get a mean = 0.3914 and deviation = 0.0263.

2 Part Two - Spatial Snowdrift Game - Replicator Rule

Replicator rule

$$P_{ij} = \frac{1 + \frac{W_j - W_i}{N \times (max\{P,R,T,S\} - min\{P,R,T,S\})}}{2}$$

With the Snowdrift game, this formula becomes

$$P_{ij} = \frac{1 + \frac{W_j - W_i}{80}}{2}$$

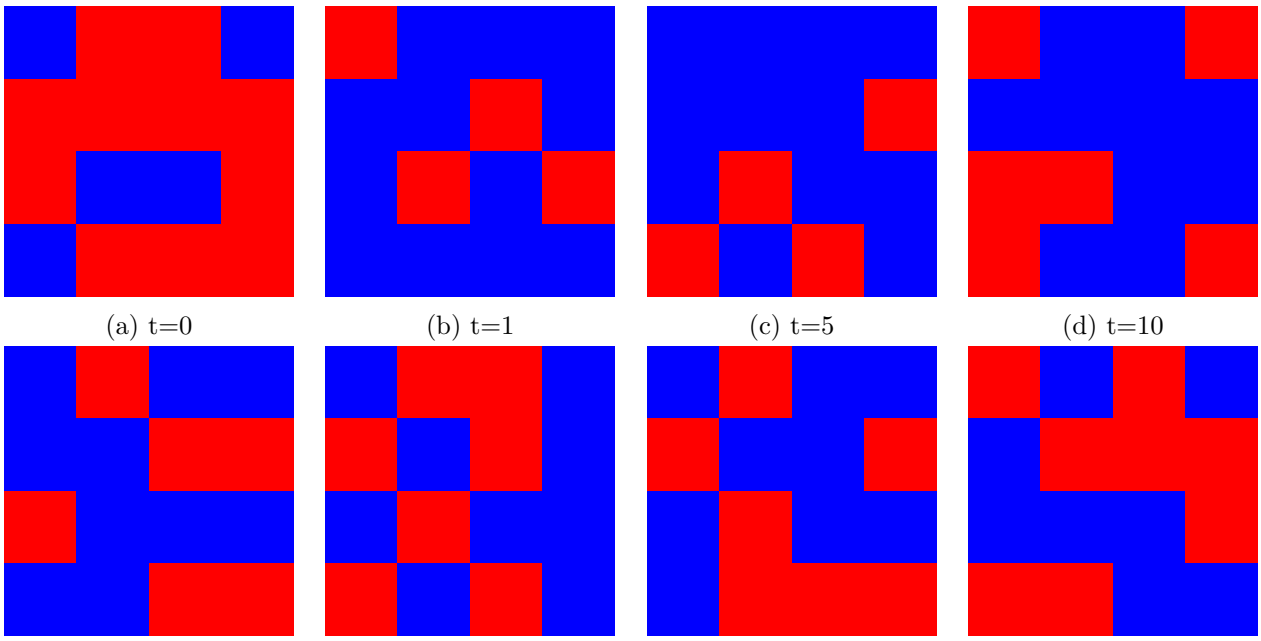
with the Moore neighborhood or

$$P_{ij} = \frac{1 + \frac{W_j - W_i}{40}}{2}$$

with the Von Neumann neighborhood.

2.1 Moore Neighborhood

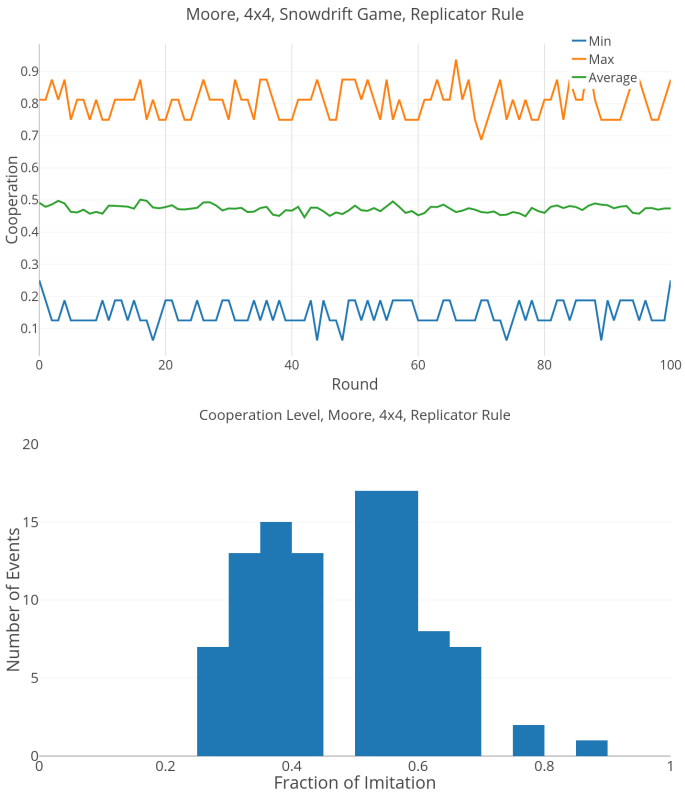
2.1.1 4x4



(a) t=0 (b) t=1 (c) t=5 (d) t=10

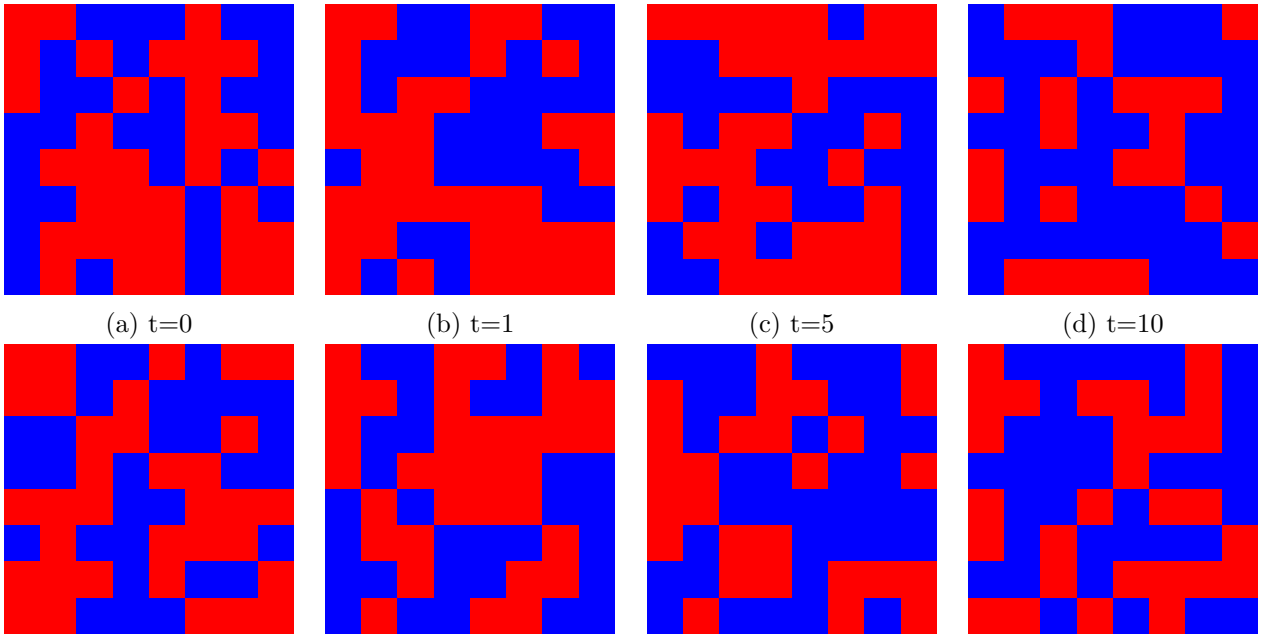
(e) t=20 (f) t=50 (g) t=75 (h) t=100

Figure 13: Snowdrift Game, Moore, 4x4



Changing the neighborhood to the *Von Neumann* mode, we get a mean = 0.4738 and deviation = 0.1354.

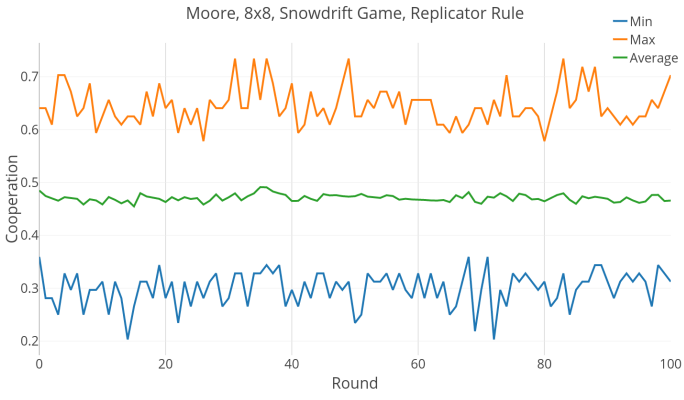
2.1.2 8x8

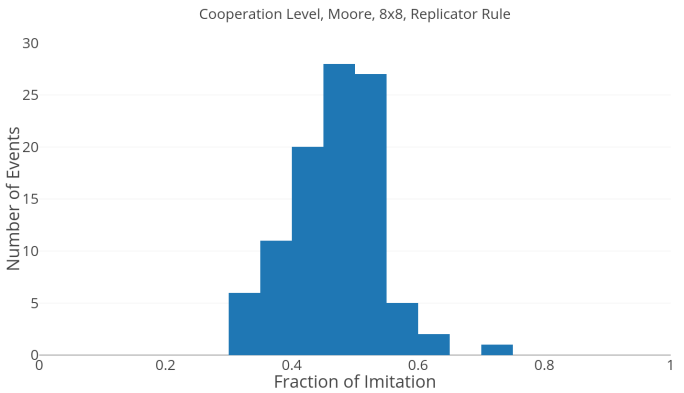


(a) t=0 (b) t=1 (c) t=5 (d) t=10

(e) t=20 (f) t=50 (g) t=75 (h) t=100

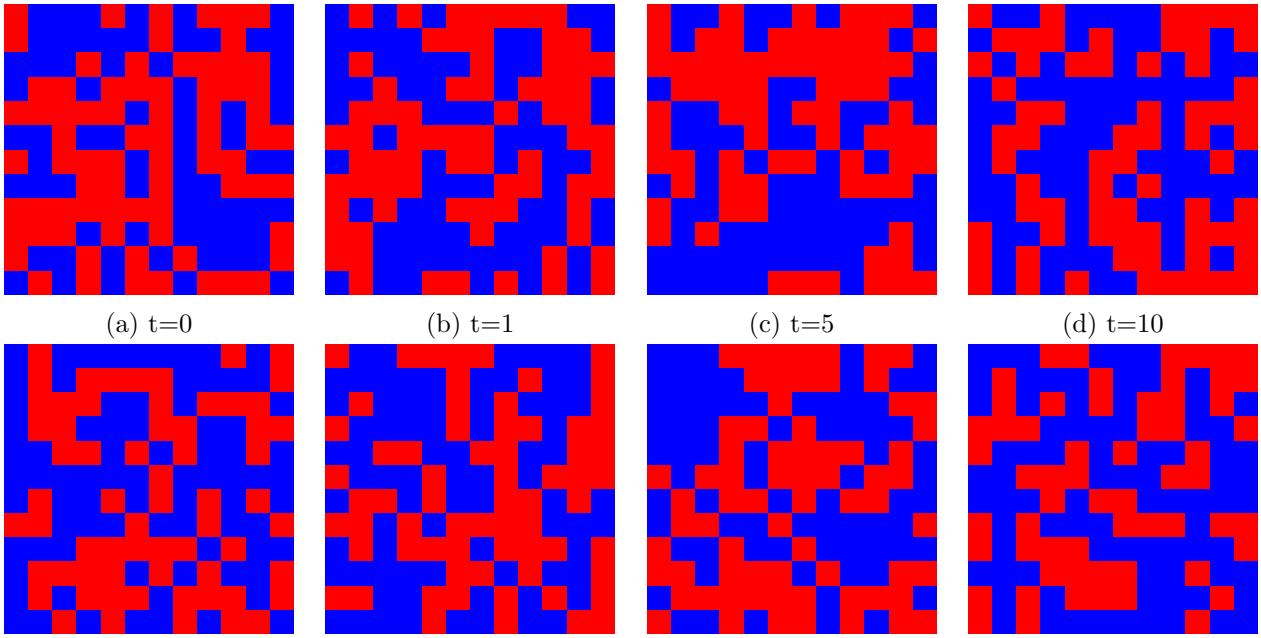
Figure 15: Snowdrift Game, Moore, 8x8





Changing the neighborhood to the *Von Neumann* mode, we get a mean = 0.4658 and deviation = 0.0698.

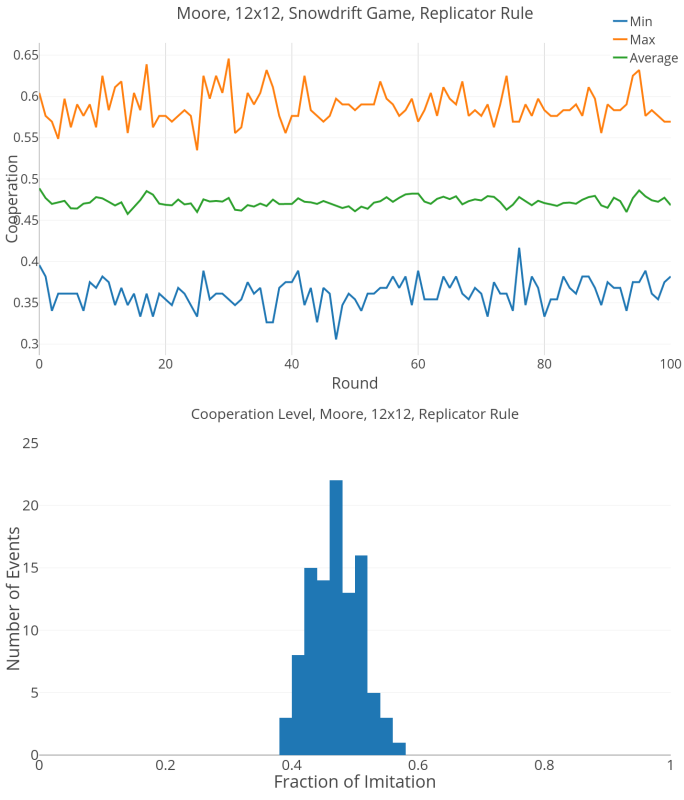
2.1.3 12x12



(a) t=0 (b) t=1 (c) t=5 (d) t=10

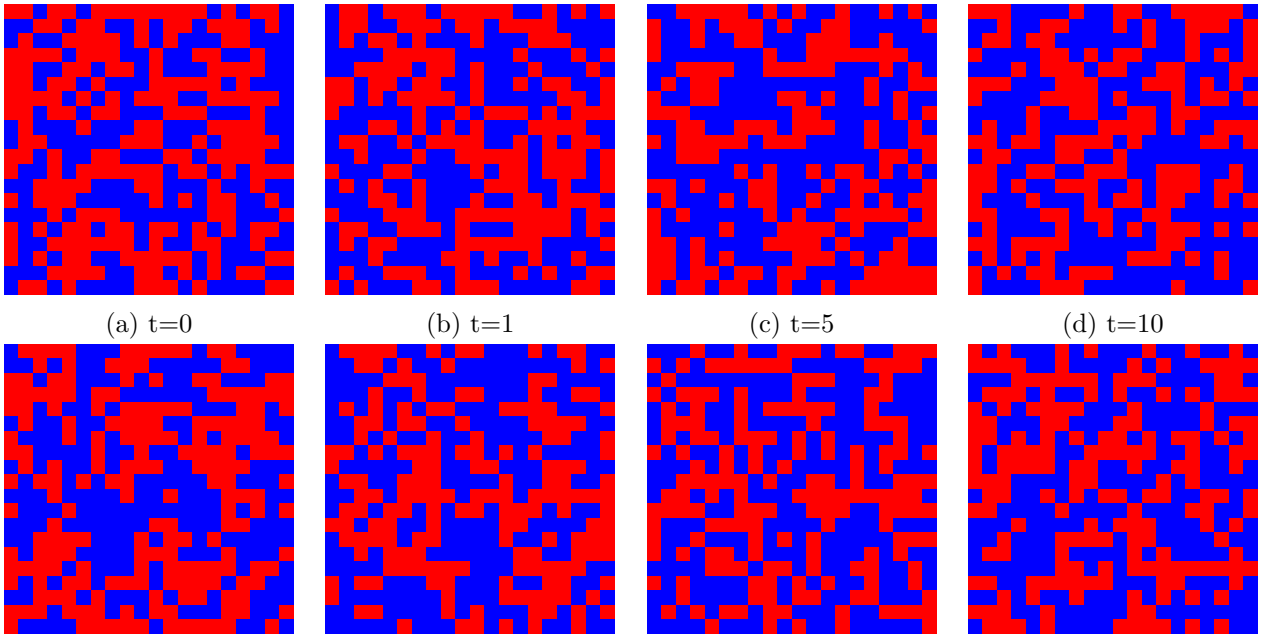
(e) t=20 (f) t=50 (g) t=75 (h) t=100

Figure 17: Snowdrift Game, Moore, 12x12



Changing the neighborhood to the *Von Neumann* mode, we get a mean = 0.4682 and deviation = 0.0384.

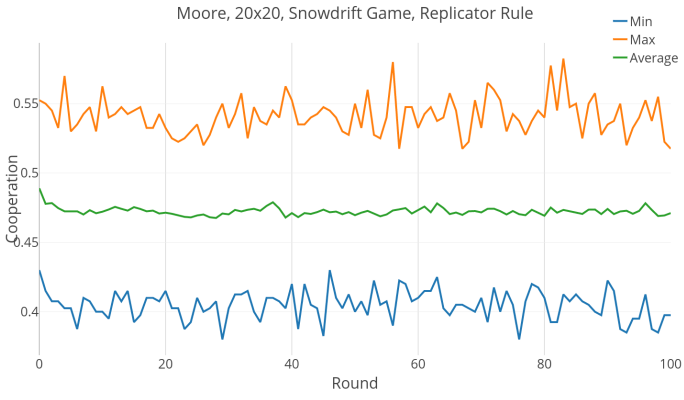
2.1.4 20x20

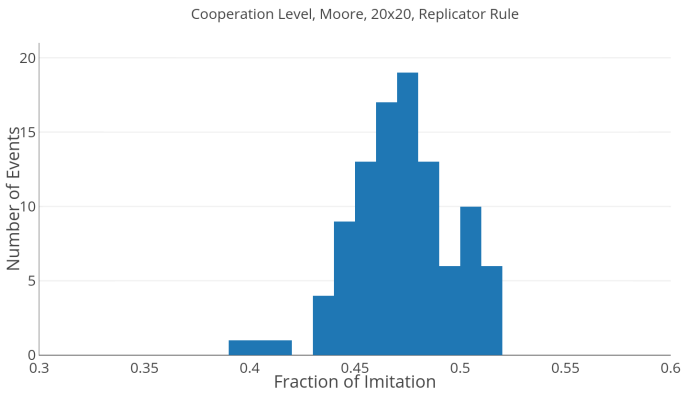


(a) t=0 (b) t=1 (c) t=5 (d) t=10

(e) t=20 (f) t=50 (g) t=75 (h) t=100

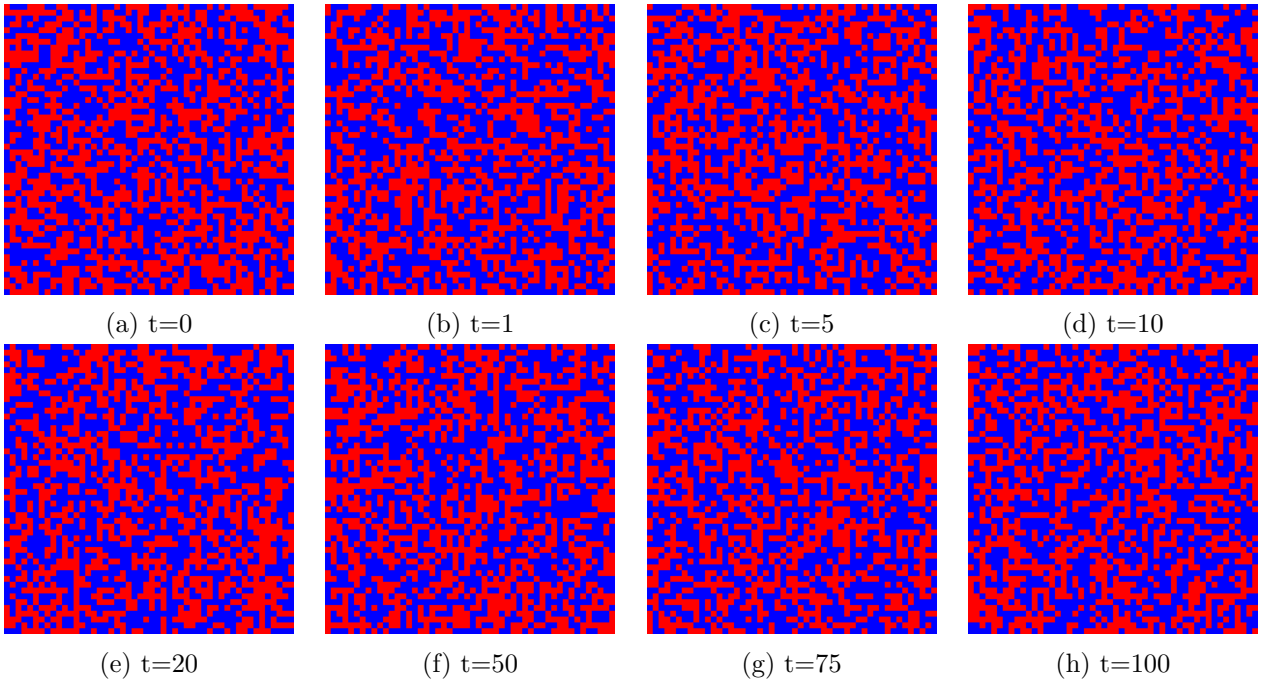
Figure 19: Snowdrift Game, Moore, 20x20





Changing the neighborhood to the *Von Neumann* mode, we get a mean = 0.4711 and deviation = 0.0239.

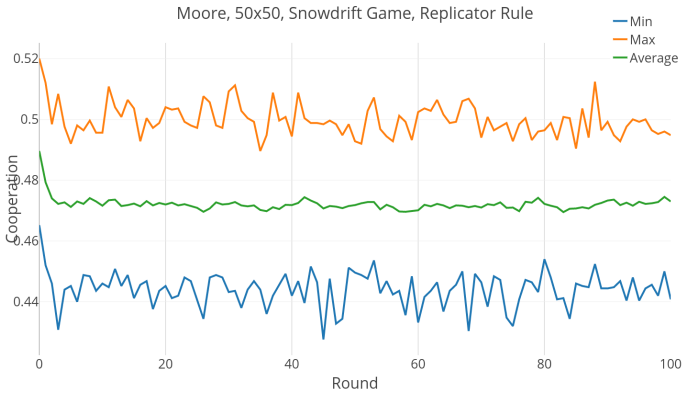
2.1.5 50x50

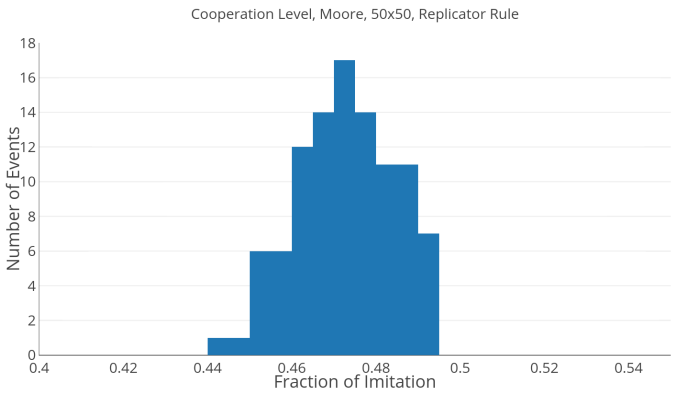


(a) t=0 (b) t=1 (c) t=5 (d) t=10

(e) t=20 (f) t=50 (g) t=75 (h) t=100

Figure 21: Snowdrift Game, Moore, 50x50

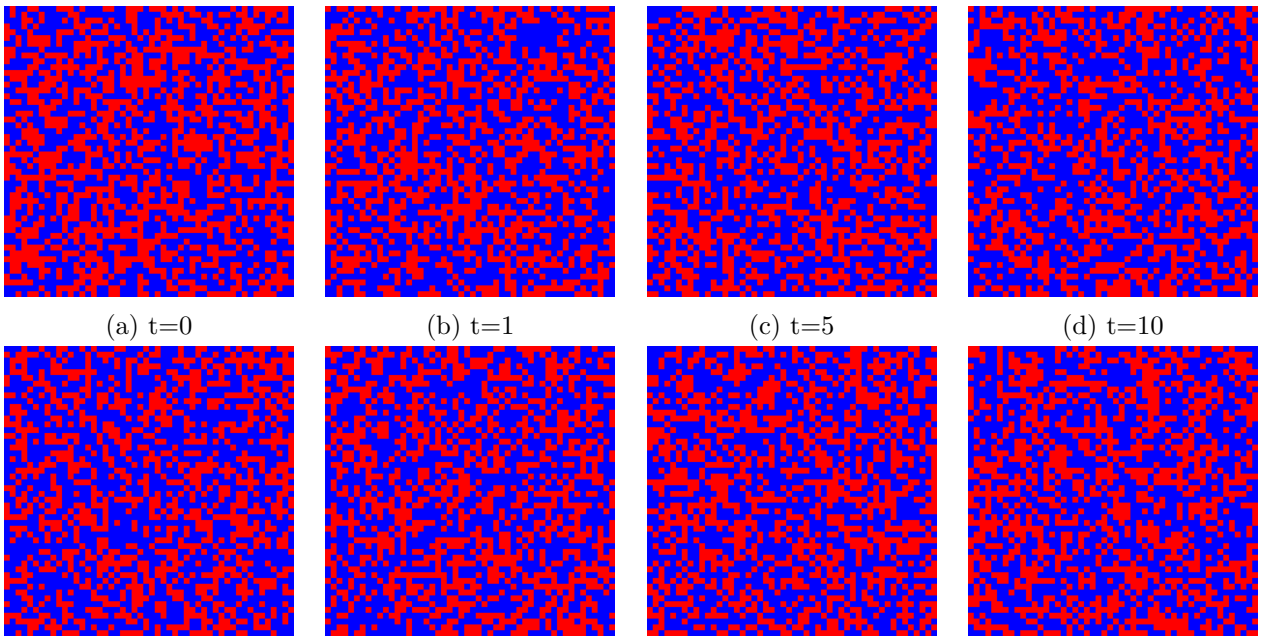




Changing the neighborhood to the *Von Neumann* mode, we get a mean = 0.473 and deviation = 0.0117.

2.2 Von Neumann Neighborhood

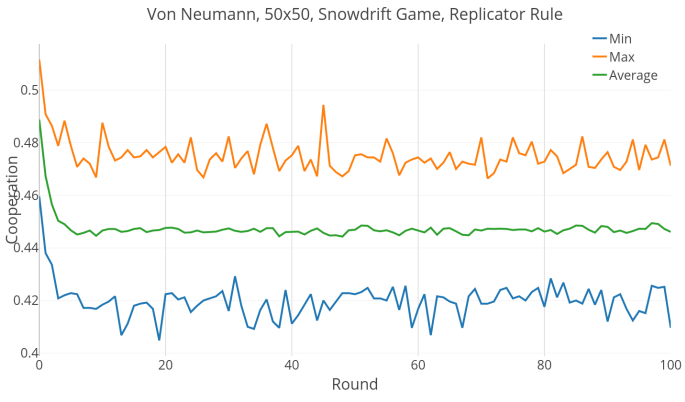
2.2.1 50x50

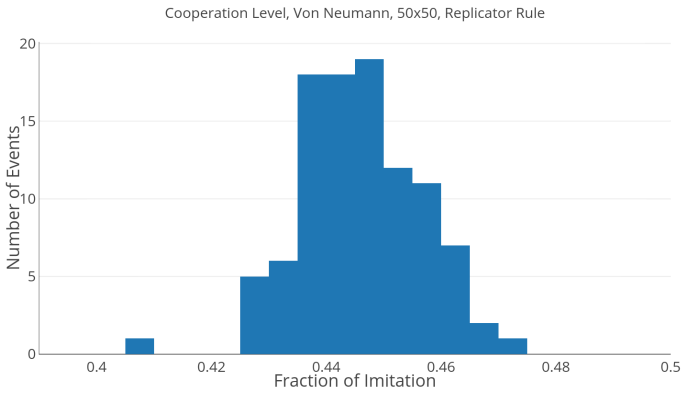


(a) t=0 (b) t=1 (c) t=5 (d) t=10

(e) t=20 (f) t=50 (g) t=75 (h) t=100

Figure 23: Snowdrift Game, Von Neumann, 50x50





Changing the neighborhood to the *Von Neumann* mode, we get a mean = 0.4461 and deviation = 0.0104.

3 Part Three