

Dilemma

Author: Per Knops

Supervisor: Neil Yorke-Smith

h.j.m.t.knops@student.tudelft.nl, n.yorke-smith@tudelft.nl

Introduction

- In the prisoner's dilemma cooperation is better for the group, defection however is better for the individual
- Agents have no memory
- How does reputation influence the resistance to bad agents?

	B cooperates	B defects
A cooperates	3	0
A defects	5	1

Solo reputation

- Each agent has an own reputation, and a threshold for cooperation
- Expected is that reputation increases resistance and improves cooperation
- This is indeed the case in the configurations with bad agents: reputation makes for less bad agents and more cooperation

	pop	bad	good	coop
k_0	1765	0	1765	100.0%
k_0 rep	1760	0	1760	100.0%
δ	-0.3%	0.0%	-0.3%	0.0%
k_1	1753	22	1732	98.9%
k_1 rep	1757	8	1749	99.5%
δ	0.2%	-63.6%	1.0%	0.6%
k_2	1775	26	1749	98.5%
k_2 rep	1759	12	1747	99.2%
δ	-0.9%	-56.2%	-0.1%	0.8%



Spatial configuration

- Agents are spawned on a grid
- Each round agents will decide to cooperate or defect
- The result of the game impacts the chance to procreate

Group reputation

- The reputation is determined by the average reputation of a group, and each agent has a threshold for cooperation for each group
- Expected is that reputation increases resistance and improves cooperation
- The resistance to bad agents has improved by introducing reputation
- The cooperation with agents of other groups has improved, however the cooperation with agents of the same group has gone down

	pop	bad	good	coop _s	coop _d
k_0	1780	0	1780	100.0%	100.0%
k_0 rep	1781	0	1781	99.6%	97.9%
δ	0.1%	0.0%	0.1%	-0.4%	-2.1%
k_1	1707	1346	361	100.0%	28.0%
k_1 rep	1688	846	842	97.3%	43.4%
δ	-1.1%	-37.1%	133.3%	-2.7%	55.1%
k_2	1674	1445	229	100.0%	19.3%
k_2 rep	1686	1241	445	97.9%	25.1%
δ	0.7%	-14.2%	94.6%	-2.1%	30.2%

Reputation

- Agents can look up reputation of other agents
- The reputation of each agent is the percentage that agent cooperated
- Each agent can then decide to cooperate or defect



Results

- On average over all experiments the population and the cooperation percentage do not differ very much when using reputation
- There are a lot more good agents when reputation is used, and the population of bad agents decreases
- Therefore, using reputation improves the resistance to bad agents

δ pop	δ bad	δ good	δ coop
-1.4%	-27.5%	45.2%	1.3%

Bad agents

- Agents that always defect when opponent is not of the same group
- When groups are used \Rightarrow bad agents cooperate with own group, defect with other groups
- When no groups are used \Rightarrow bad agents never cooperate
- Three different configurations are used, in which the number of bad agents differs

Configuration	p_{bad}
k_0	0
k_1	0.05
k_2	0.10

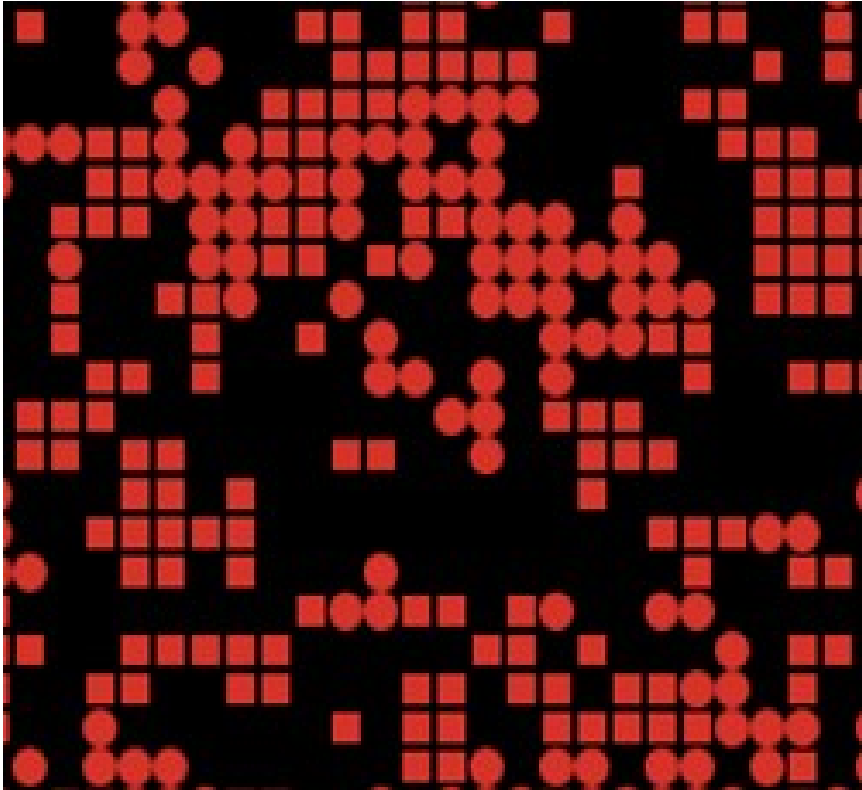
References

B. Baranski *et al.*, "The Impact of Group Reputation in Multiagent Environments," 2006 IEEE International Conference on Evolutionary Computation, 2006, pp. 1224-1231, doi: 10.1109/CEC.2006.1688449.
Nadathur, S., Nadathur, S., & Profile, V. M. C. (2021, 18 mei). Extortion in Prisoner's Dilemma. Blank on the map. <http://blankonthemap.blogspot.com/2012/09/optimal-strategies-in-iterated.html>

Introduction

- In the prisoner's dilemma cooperation is better for the group, defection however is better for the individual
- Agents have no memory
- How does reputation influence the resistance to bad agents?

	B cooperates	B defects
A cooperates	3 3	0 5
A defects	5 0	1 1



Spatial configuration

- Agents are spawned on a grid
- Each round agents will decide to cooperate or defect
- The result of the game impacts the chance to procreate

Reputation

- Agents can look up reputation of other agents
- The reputation of each agent is the percentage that agent cooperated
- Each agent can then decide to cooperate or defect



Configuration	p_{bad}
k_0	0
k_1	0.05
k_2	0.10

Bad agents

- Agents that always defect when opponent is not of the same group
- When groups are used \Rightarrow bad agents cooperate with own group, defect with other groups
- When no groups are used \Rightarrow bad agents never cooperate
- Three different configurations are used, in which the number of bad agents differs

Solo reputation

- Each agent has an own reputation, and a threshold for cooperation
- Expected is that reputation increases resistance and improves cooperation
- This is indeed the case in the configurations with bad agents: reputation makes for less bad agents and more cooperation

	<i>pop</i>	<i>bad</i>	<i>good</i>	<i>coop</i>
k_0	1765	0	1765	100.0%
k_0 rep	1760	0	1760	100.0%
δ	-0.3%	0.0%	-0.3%	0.0%
k_1	1753	22	1732	98.9%
k_1 rep	1757	8	1749	99.5%
δ	0.2%	-63.6%	1.0%	0.6%
k_2	1775	26	1749	98.5%
k_2 rep	1759	12	1747	99.2%
δ	-0.9%	-56.2%	-0.1%	0.8%

Group reputation

- The reputation is determined by the average reputation of a group, and each agent has a threshold for cooperation for each group
- Expected is that reputation increases resistance and improves cooperation
- The resistance to bad agents has improved by introducing reputation
- The cooperation with agents of other groups has improved, however the cooperation with agents of the same group has gone down

	<i>pop</i>	<i>bad</i>	<i>good</i>	<i>coop_s</i>	<i>coop_d</i>
k_0	1780	0	1780	100.0%	100.0%
k_0 rep	1781	0	1781	99.6%	97.9%
δ	0.1%	0.0%	0.1%	-0.4%	-2.1%
k_1	1707	1346	361	100.0%	28.0%
k_1 rep	1688	846	842	97.3%	43.4%
δ	-1.1%	-37.1%	133.3%	-2.7%	55.1%
k_2	1674	1445	229	100.0%	19.3%
k_2 rep	1686	1241	445	97.9%	25.1%
δ	0.7%	-14.2%	94.6%	-2.1%	30.2%

Results

- On average over all experiments the population and the cooperation percentage do not differ very much when using reputation
- There are a lot more good agents when reputation is used, and the population of bad agents decreases
- Therefore, using reputation improves the resistance to bad agents

$\delta \text{ pop}$	$\delta \text{ bad}$	$\delta \text{ good}$	$\delta \text{ coop}$
-1.4%	-27.5%	45.2%	1.3%

References

B. Baranski *et al.*, "The Impact of Group Reputation in Multiagent Environments," *2006 IEEE International Conference on Evolutionary Computation*, 2006, pp. 1224-1231, doi: 10.1109/CEC.2006.1688449.

Nadathur, S., Nadathur, S., & Profile, V. M. C. (2021, 18 mei). *Extortion in Prisoner's Dilemma*. Blank on the map.
<http://blankonthemap.blogspot.com/2012/09/optimal-strategies-in-iterated.html>