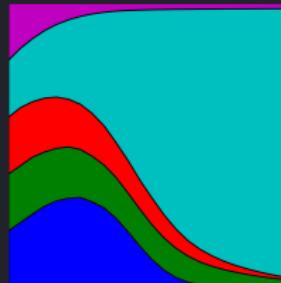


Understanding responses to environments for the Prisoner's Dilemma

Max Planck Institute for Evolutionary Biology

@NikoletaGlyn





rebloggy.com/post/animals-bat-black-and-white-eyes-creepy-horror-gore-halloween-animal-bats-vampir/101865318472

$$\begin{bmatrix} (3,3) & (0,5) \\ (5,0) & (1,1) \end{bmatrix}$$



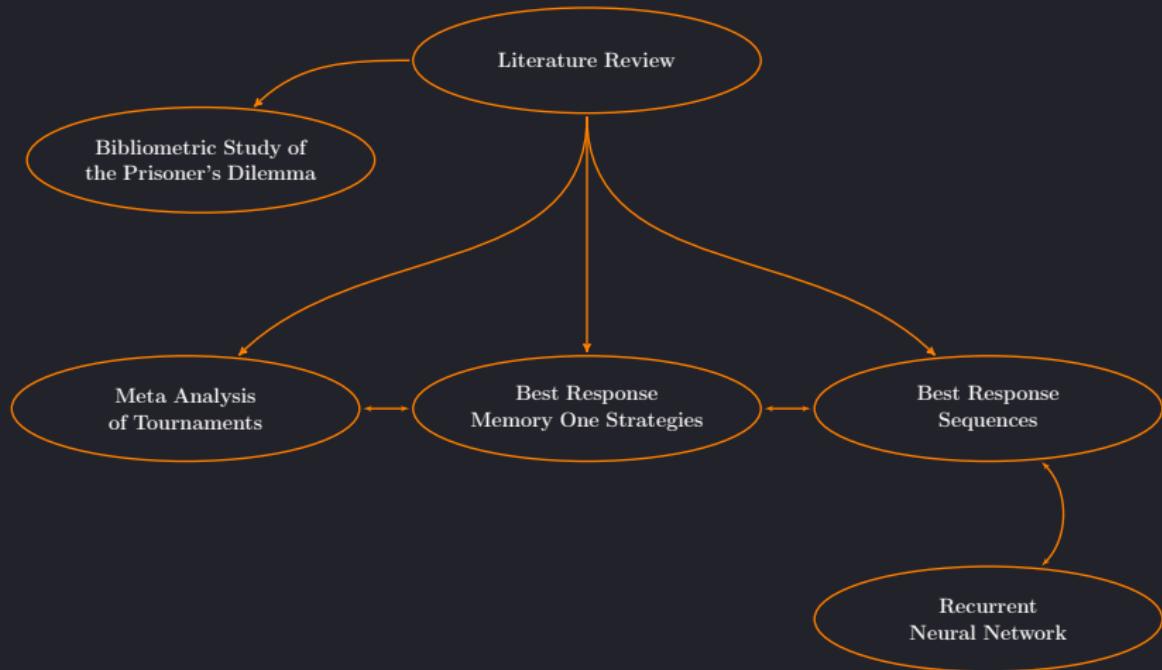


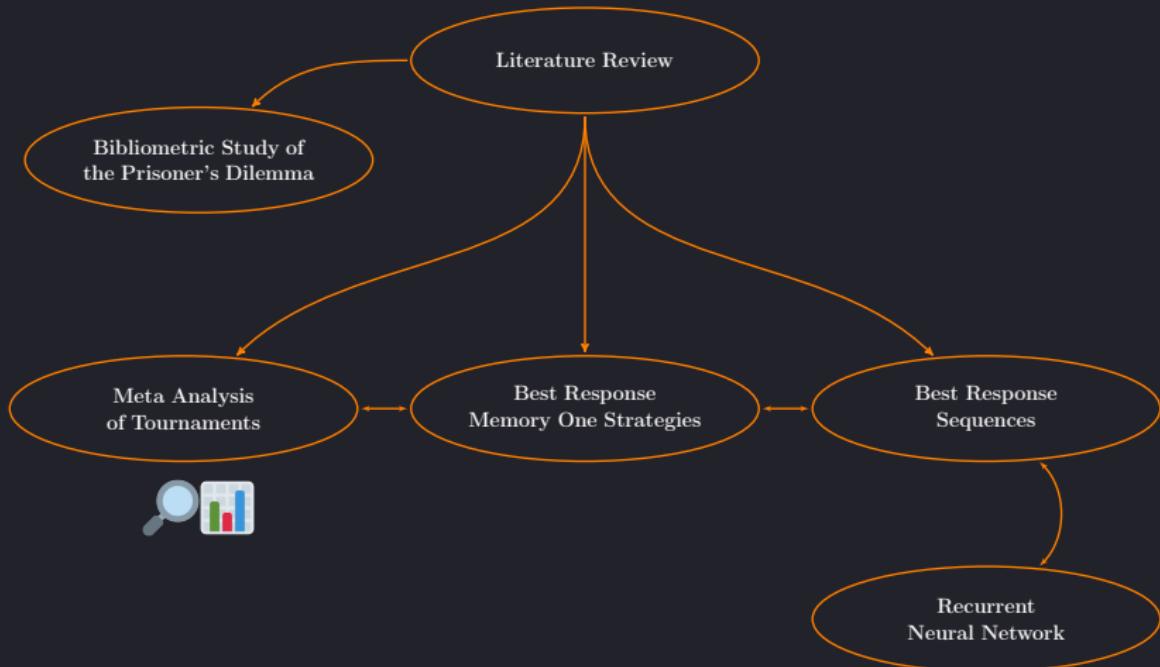


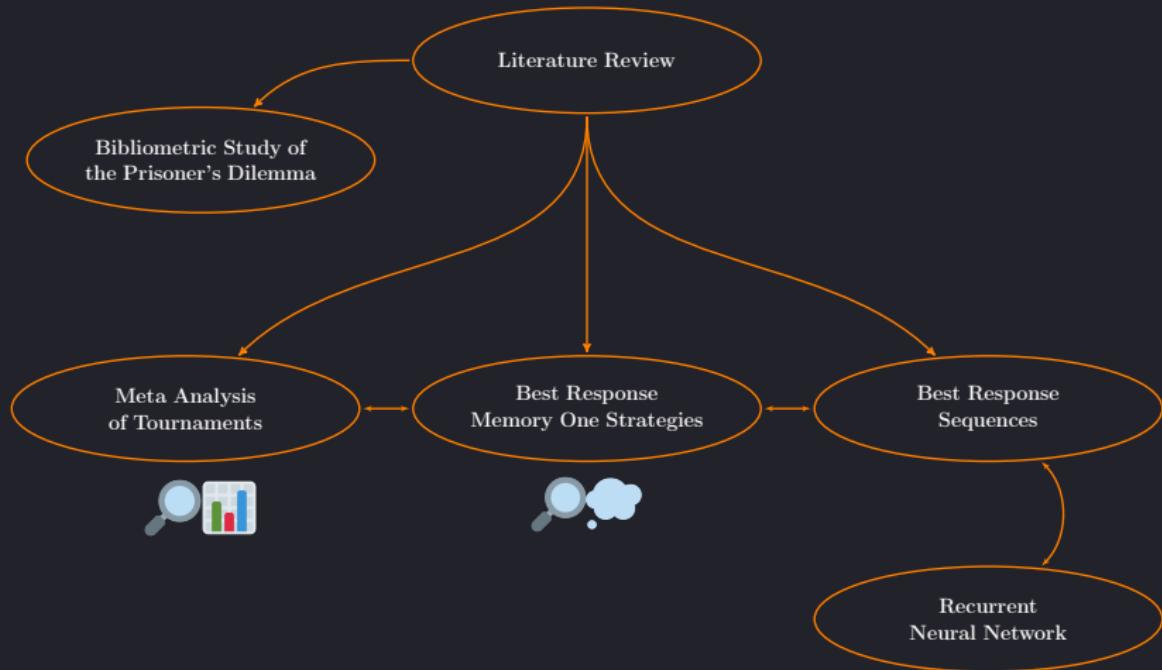


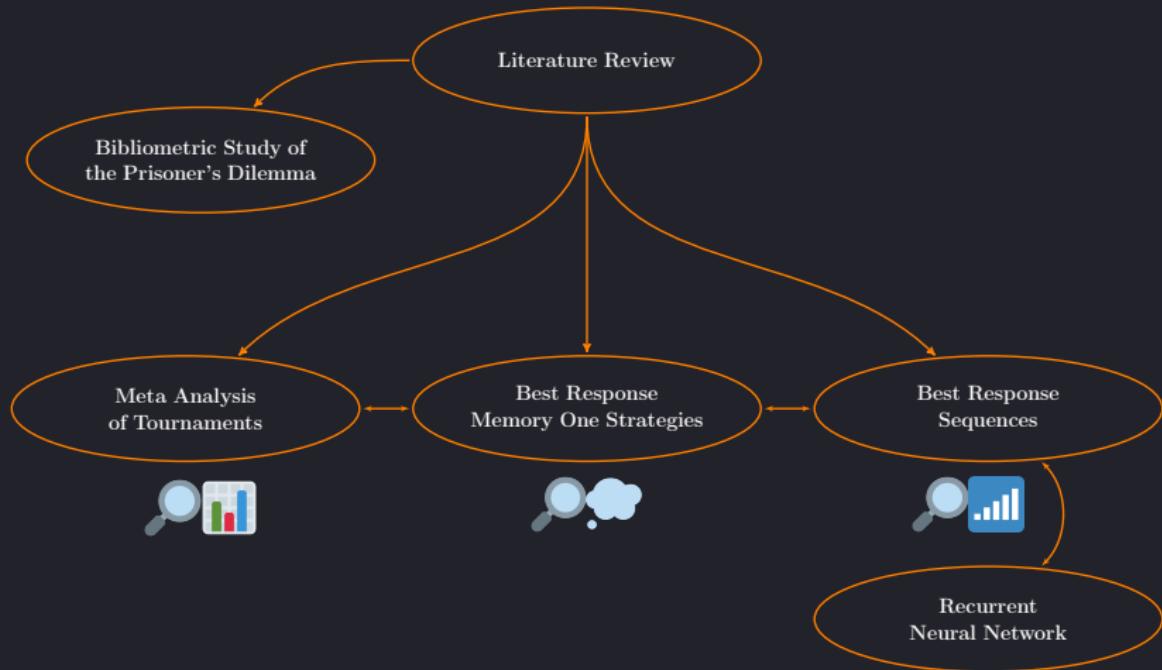
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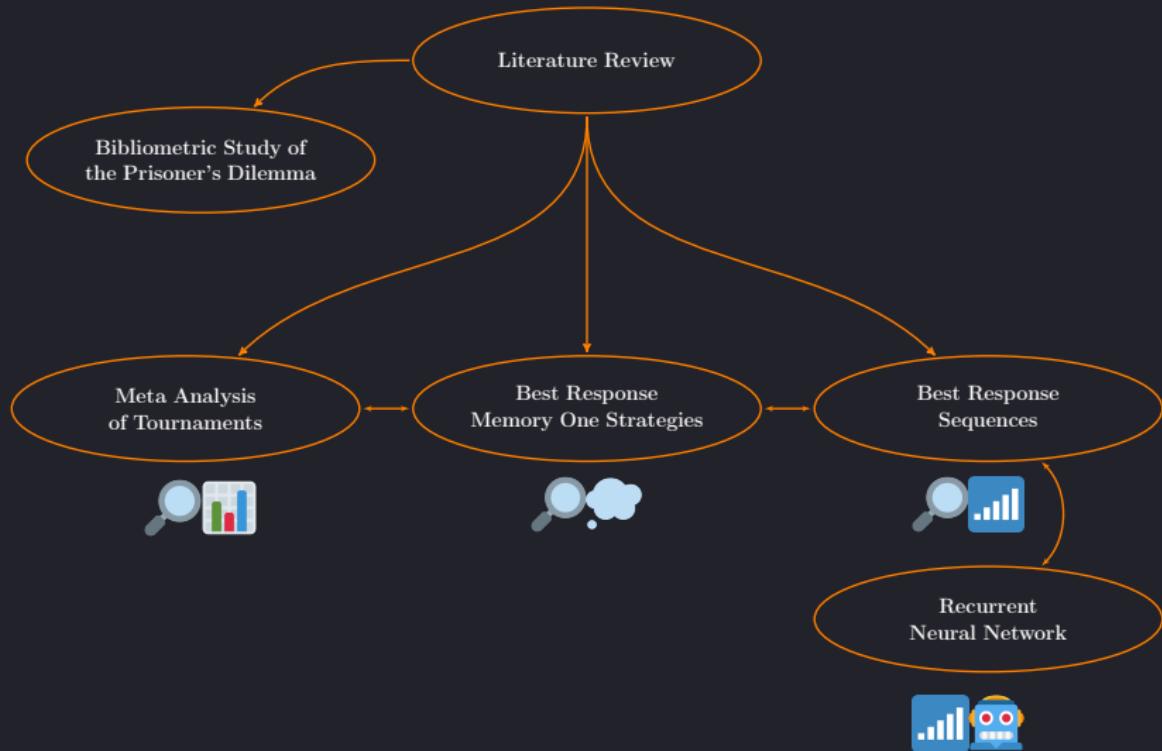


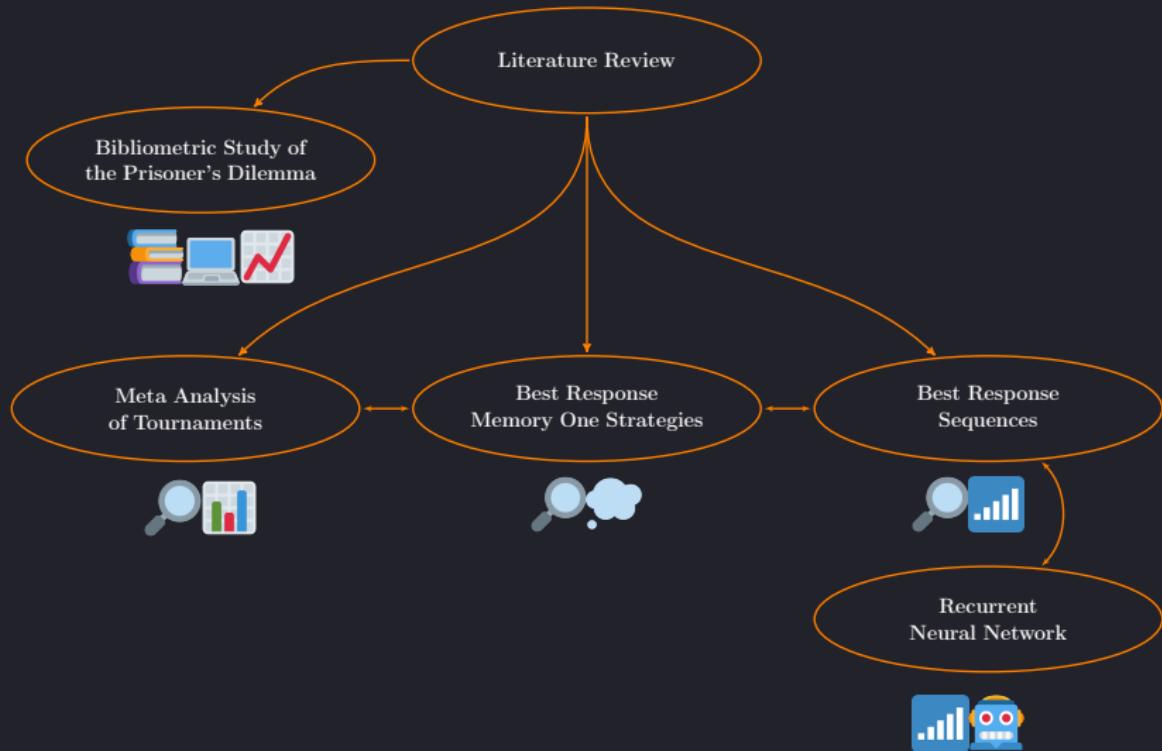












Bibliometric Study of the Prisoner's Dilemma



PLOS

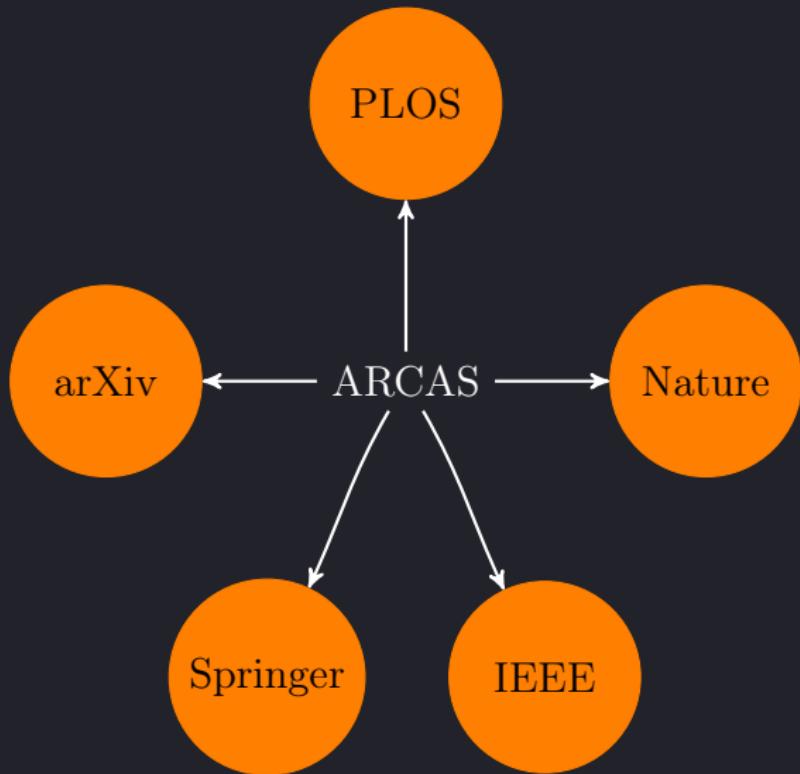
arXiv

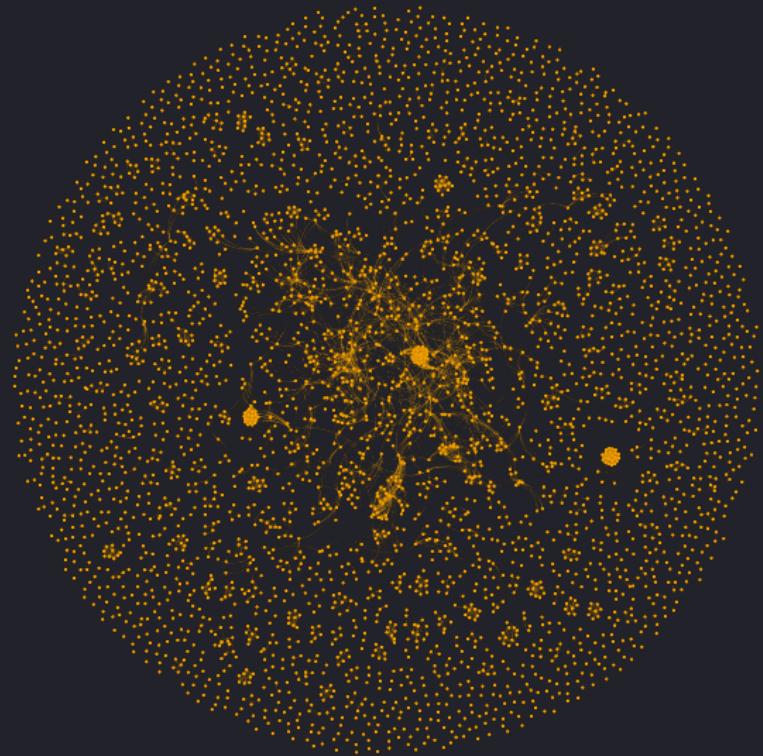


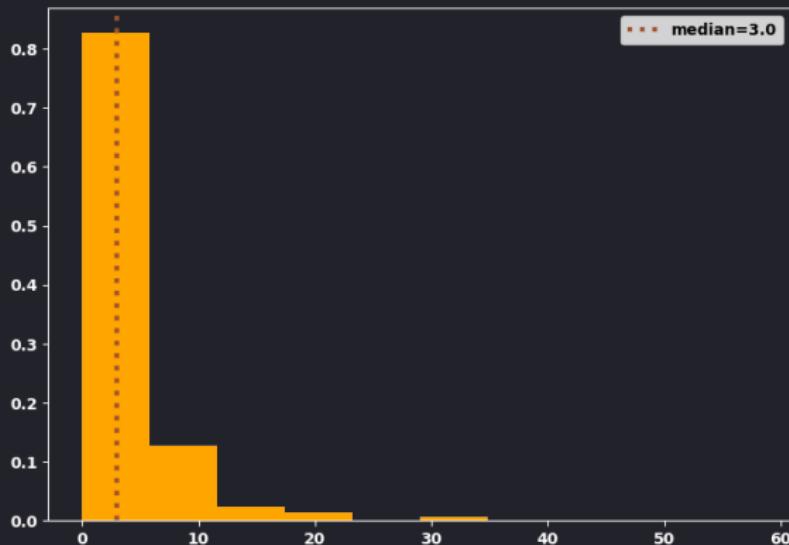
Nature

Springer

IEEE











Natural Language
Processing $\longrightarrow \mathbb{R}^n$



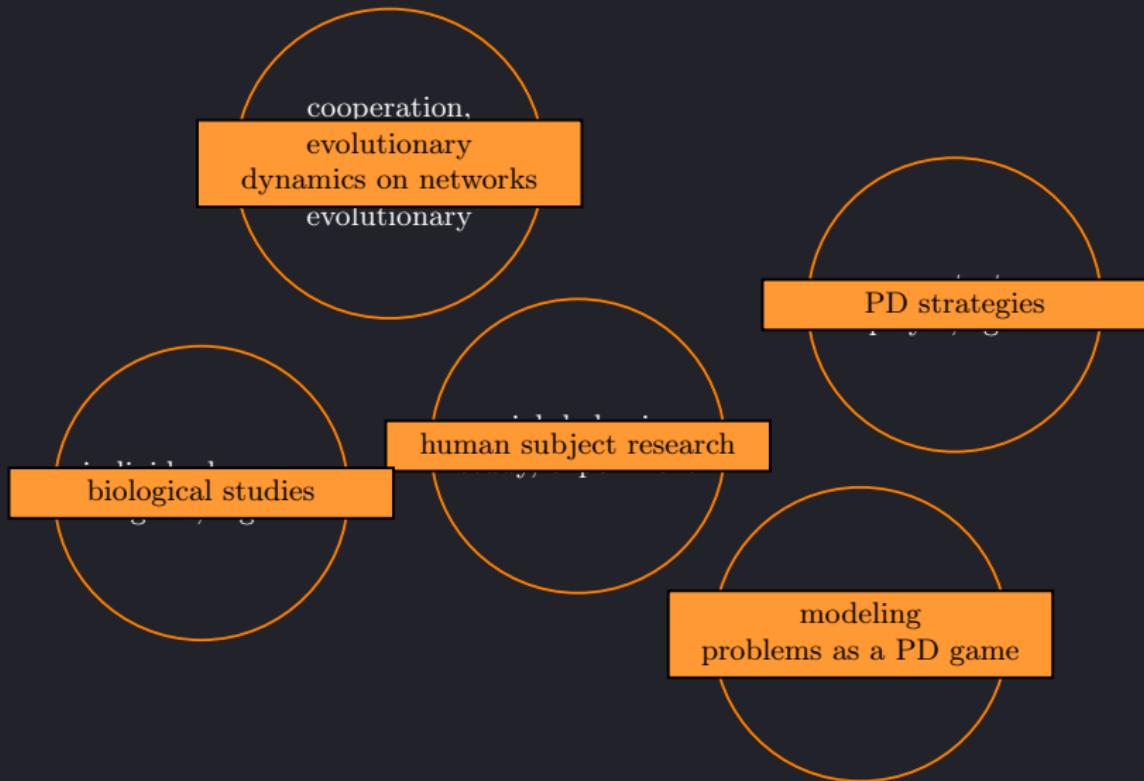
individual, group,
good, high

cooperation,
network,
population,
evolutionary

social, behavior,
study, experiment

model, theory,
system, problem

game, strategy,
player, agent



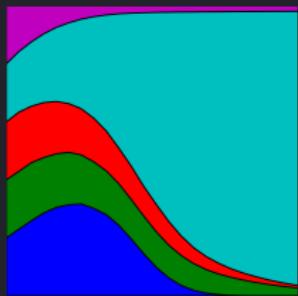
“A bibliometric study of research topics, collaboration and influence in the field of the Iterated Prisoner’s Dilemma”

Nikoleta E. Glynatsi, Vincent A. Knight

arxiv.org/abs/1911.06128

Meta Analysis of Tournaments

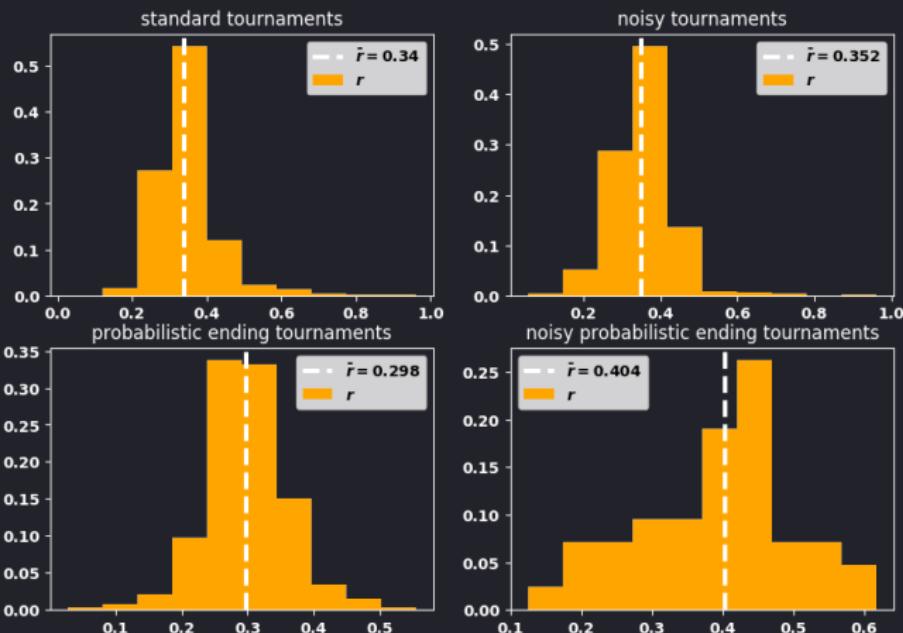




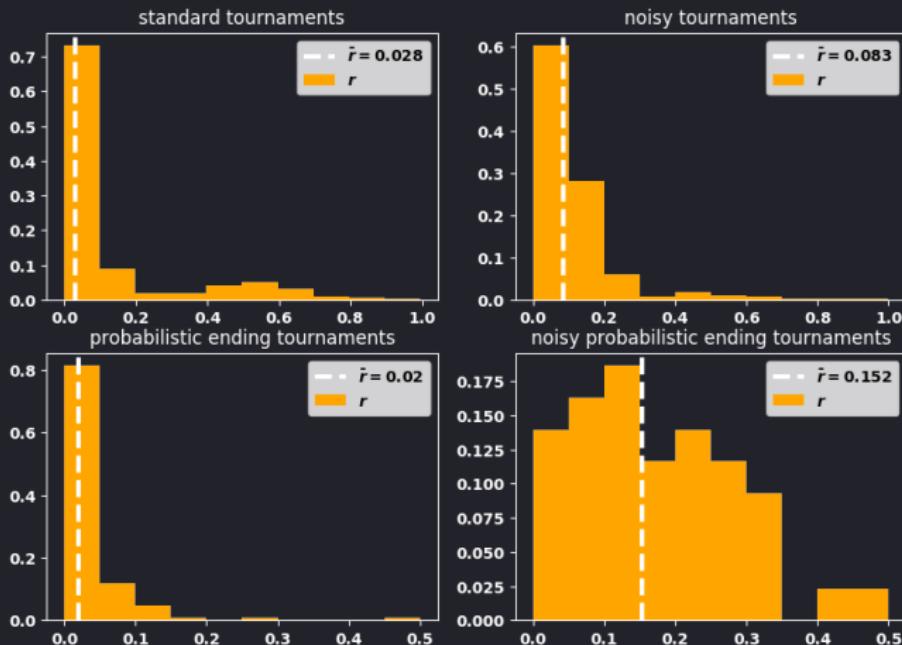
Axelrod-Python

195 strategies in **45686** tournaments

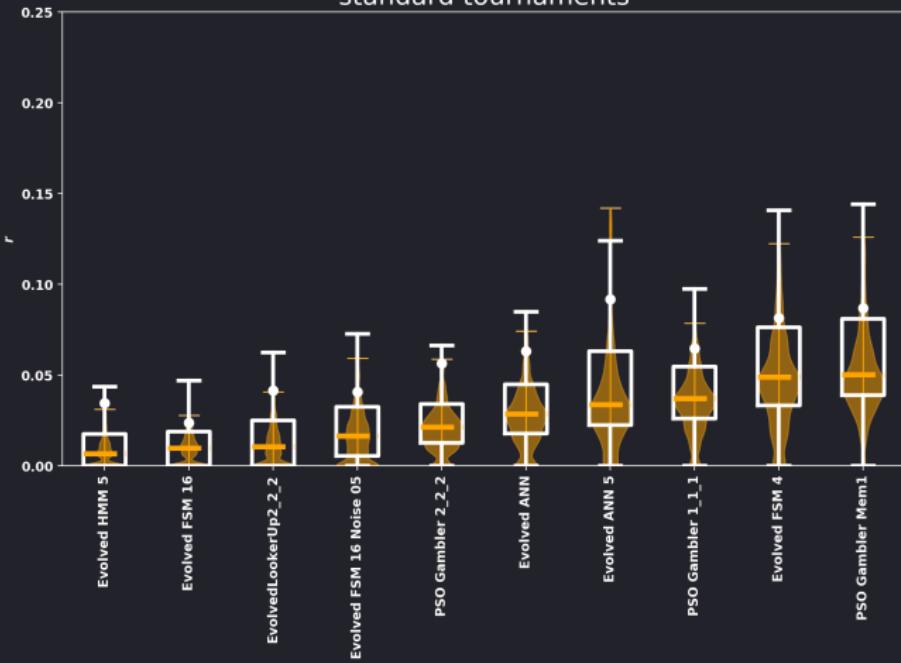
Tit For Tat Normalised Rank

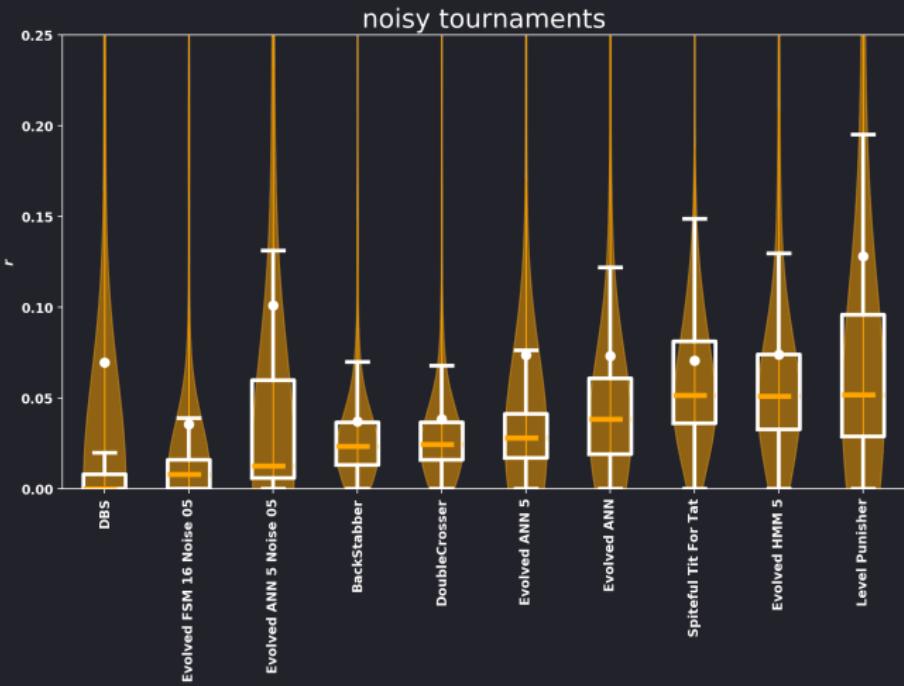


Evolved FSM 16 Normalised Rank

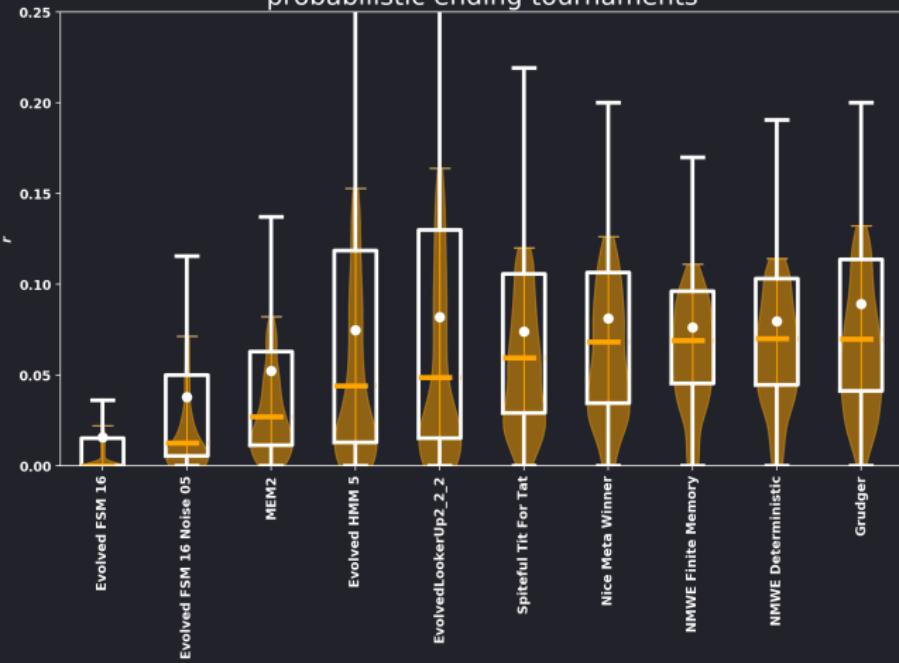


standard tournaments

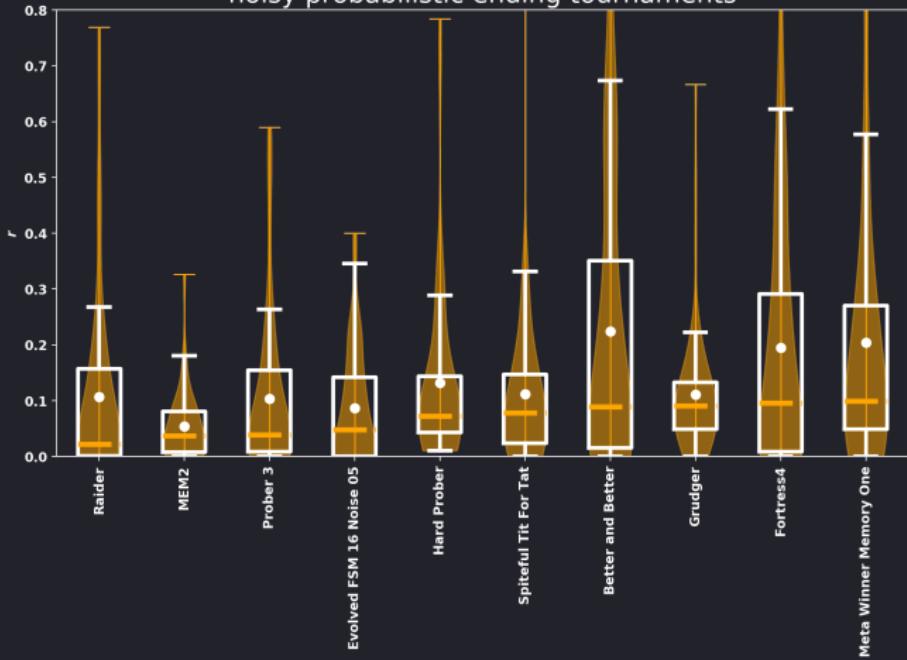




probabilistic ending tournaments

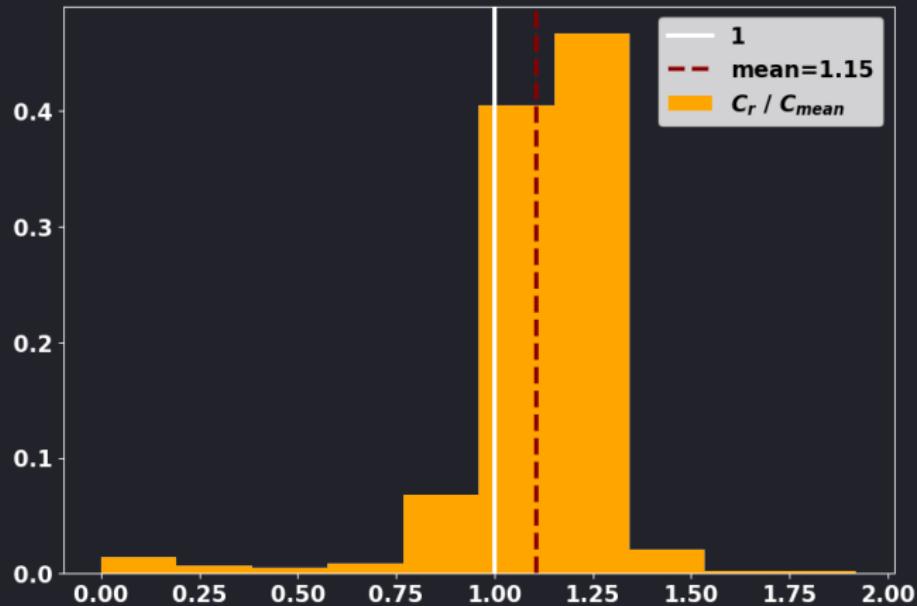


noisy probabilistic ending tournaments



Evolved FSM 16





“A meta analysis of tournaments and an evaluation of performance in the Iterated Prisoner’s Dilemma”

Nikoleta E. Glynatsi, Vincent A. Knight

arXiv:2001.05911

data: DOI:10.5281/zenodo.3516652

Best Response Memory One Strategies





CC



CD



DC



DD

CC

CD

DC

DD

$$p = (p_1, p_2, p_3, p_4)$$

CC

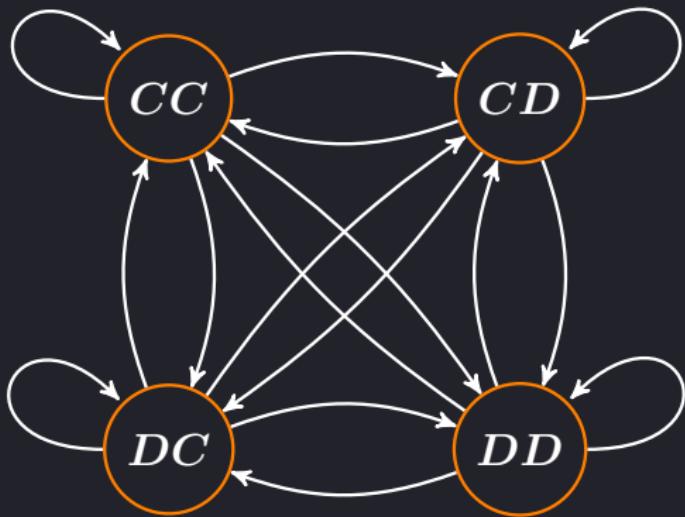
CD

DC

DD

$$p = (p_1, p_2, p_3, p_4)$$

$$q = (q_1, q_2, q_3, q_4)$$



$$p = (p_1, p_2, p_3, p_4)$$

$$q = (q_1, q_2, q_3, q_4)$$

$$u_q(p) = v \cdot (3,0,5,1)$$

$$u_q(p) = v \cdot (3, 0, 5, 1)$$



$$u_q(p) = \frac{\frac{1}{2}pQp^T + cp + a}{\frac{1}{2}p\bar{Q}p^T + \bar{c}p + \bar{a}}$$

$$u_q(p) = v \cdot (3, 0, 5, 1)$$



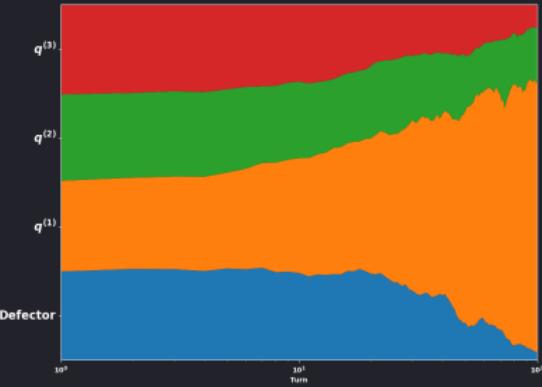
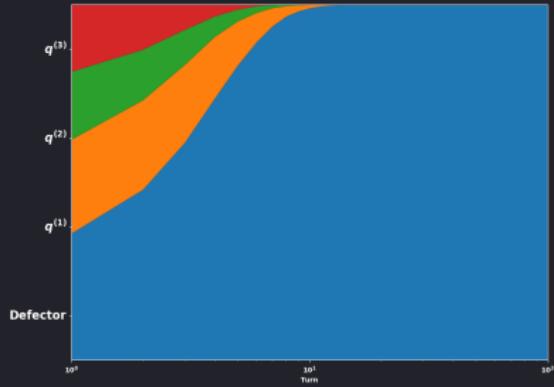
$$u_q(p) = \frac{\frac{1}{2}pQp^T + cp + a}{\frac{1}{2}p\bar{Q}p^T + \bar{c}p + \bar{a}}$$



$$\frac{1}{N} \sum_{i=1}^N u_q^{(i)}(p)$$

$$\sum_{i=1}^N (c^{(i)T}\bar{a}^{(i)} - \bar{c}^{(i)T}a^{(i)}) \leq 0 \Rightarrow \text{Defection}$$

$$\sum_{i=1}^N (c^{(i)T} \bar{a}^{(i)} - \bar{c}^{(i)T} a^{(i)}) \leq 0 \Rightarrow \text{Defection}$$

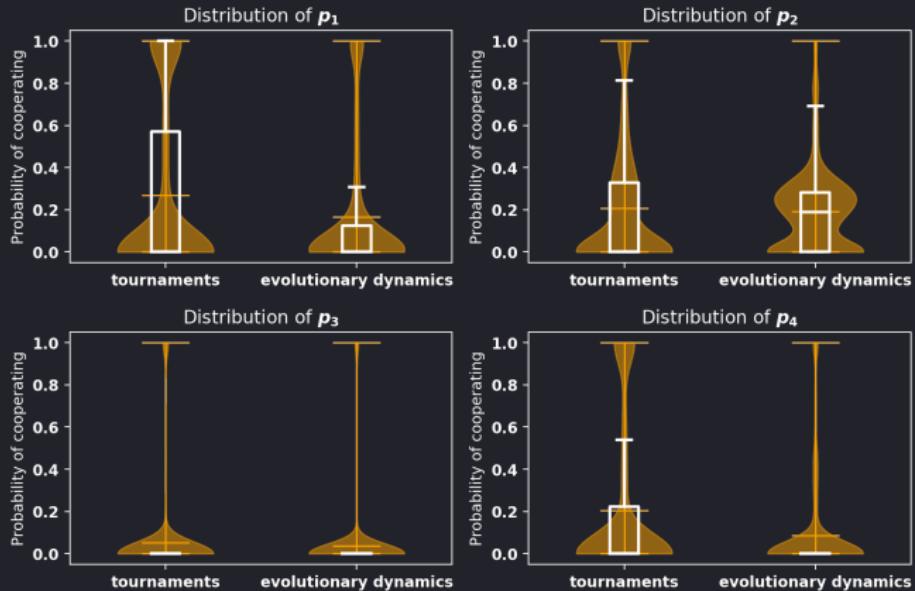


$$\sum_{i=1}^N u_q^{(i)}(p)$$

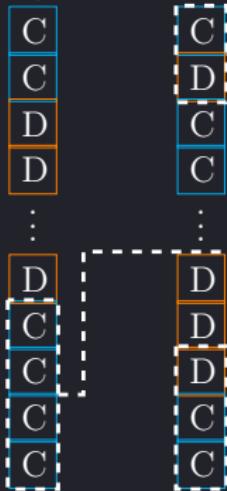
$$\sum_{i=1}^N u_q^{(i)}(p) \xrightarrow{\hspace{1cm}} \max_p : \sum_{i=1}^N u_q^{(i)}(p)$$

$$\sum_{i=1}^N u_q^{(i)}(p) \xrightarrow{\hspace{1cm}} \max_p : \sum_{i=1}^N u_q^{(i)}(p)$$

$$\sum_{i=1}^N u_q^{(i)}(p) + u_p(p) \xrightarrow{\hspace{1cm}} \max_p : \sum_{i=1}^N u_q^{(i)}(p) + u_p(p)$$

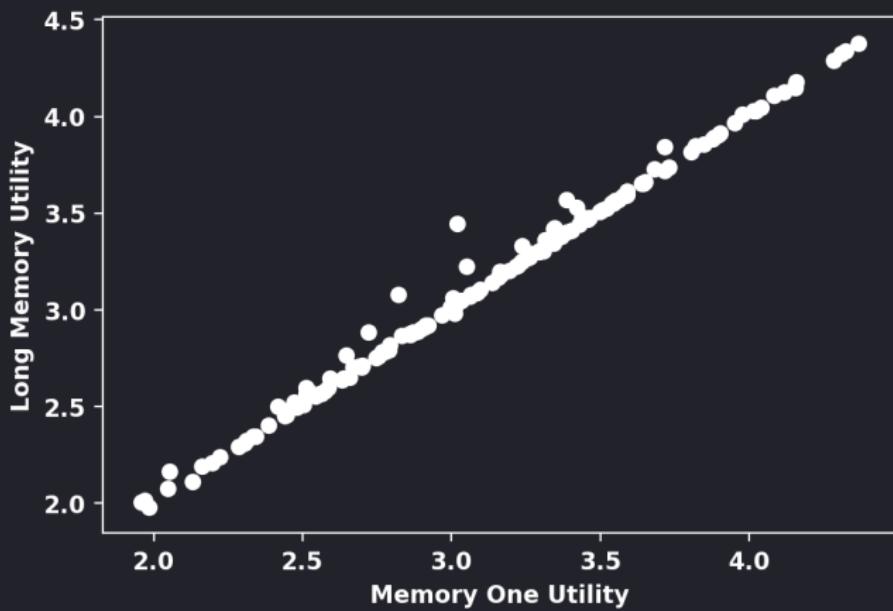


Player Opponent



CD
CCCC
DCC

(p_c, p_d)



“Stability of defection, optimisation of strategies and the limits of memory in the Prisoner’s Dilemma”

Nikoleta E. Glynatsi, Vincent A. Knight

arXiv:1911.12112

Best Response Sequences



1 2 3 4 5 U

Tit For Tat

S

1 2 3 4 5 U

Tit For Tat

S D D D D D

	1	2	3	4	5	U
Tit For Tat	C	D	D	D	D	
S		D	D	D	D	D

	1	2	3	4	5	U
Tit For Tat	C	D	D	D	D	0.8
S		D	D	D	D	1.8

	1	2	3	4	5	U
Tit For Tat	C	D	D	D	D	0.8
S		D	D	D	D	1.8

1 2 3 4 5 U

Tit For Tat

S

	1	2	3	4	5	U
Tit For Tat	C	C	C	C	C	
S						

	1	2	3	4	5	U
Tit For Tat	C	C	C	C	C	
S		C	C	C	C	D

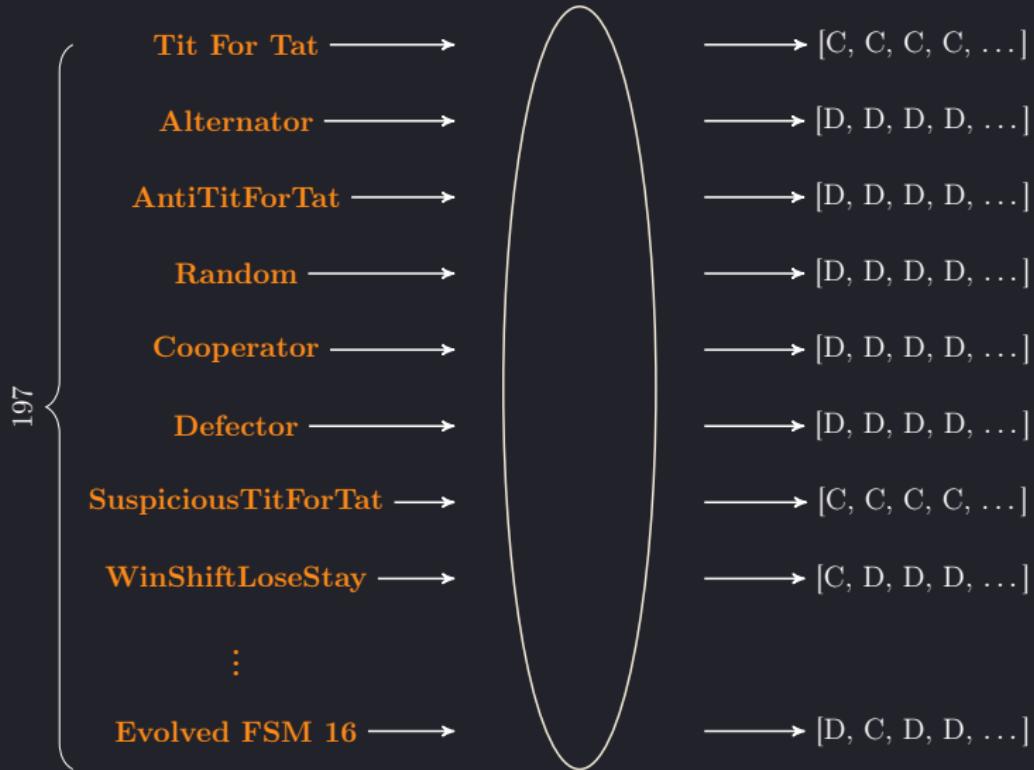
	1	2	3	4	5	U
Tit For Tat	C	C	C	C	C	2.5
S	C	C	C	C	D	3.3

Genetic Algorithm



Genetic Algorithm

S^{205}



Genetic Algorithm

S^{205}

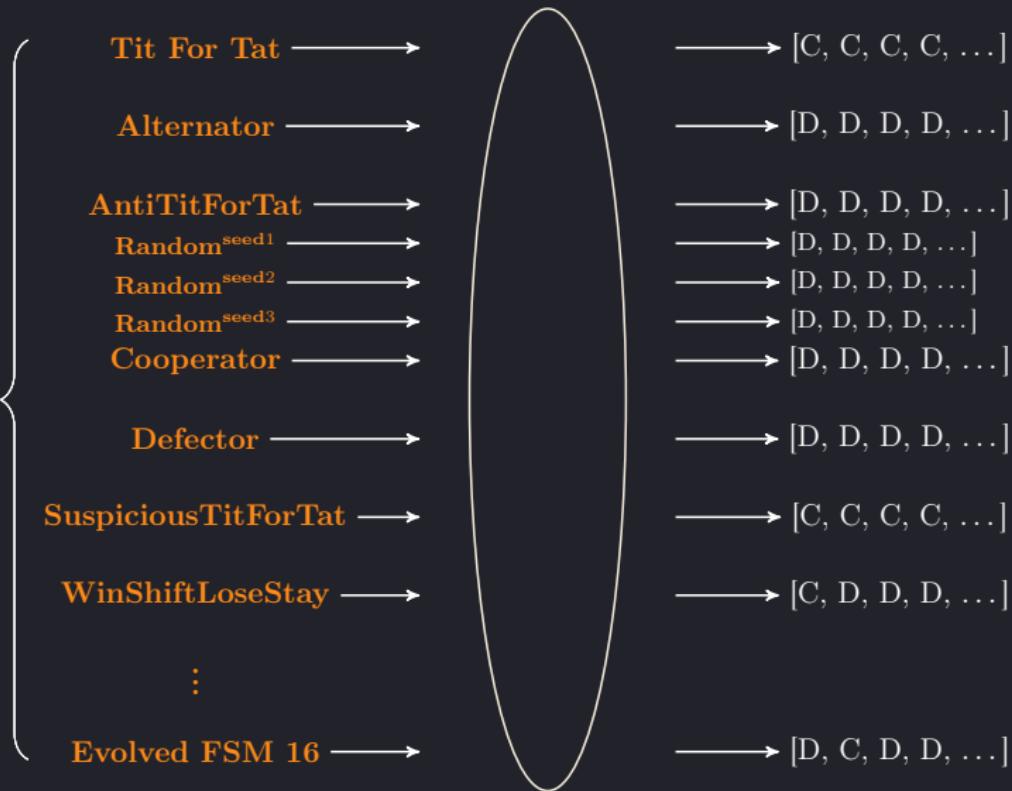
197 {

Tit For Tat →	→ [C, C, C, C, ...]
Alternator →	→ [D, D, D, D, ...]
AntiTitForTat →	→ [D, D, D, D, ...]
Random^{seed1} →	→ [D, D, D, D, ...]
Random^{seed2} →	→ [D, D, D, D, ...]
Random^{seed3} →	→ [D, D, D, D, ...]
Cooperator →	→ [D, D, D, D, ...]
Defector →	→ [D, D, D, D, ...]
SuspiciousTitForTat →	→ [C, C, C, C, ...]
WinShiftLoseStay →	→ [C, D, D, D, ...]
⋮	
Evolved FSM 16 →	→ [D, C, D, D, ...]

Genetic Algorithm

S^{205}

751
197



“Training Recurrent Neural Network strategies for Iterated Prisoner’s Dilemma”

data: DOI:10.5281/zenodo.3685251





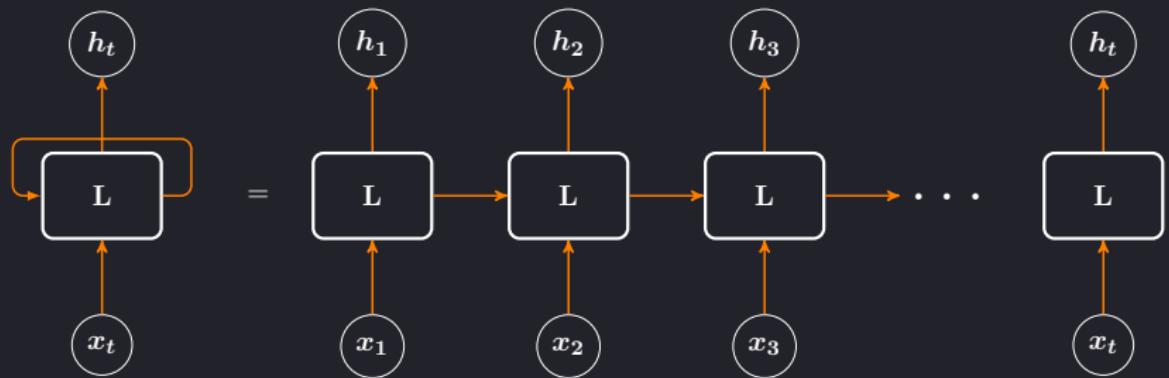
Reinforcement learning produces dominant strategies for the Iterated Prisoner's Dilemma: doi.org/10.1371/journal.pone.0188046

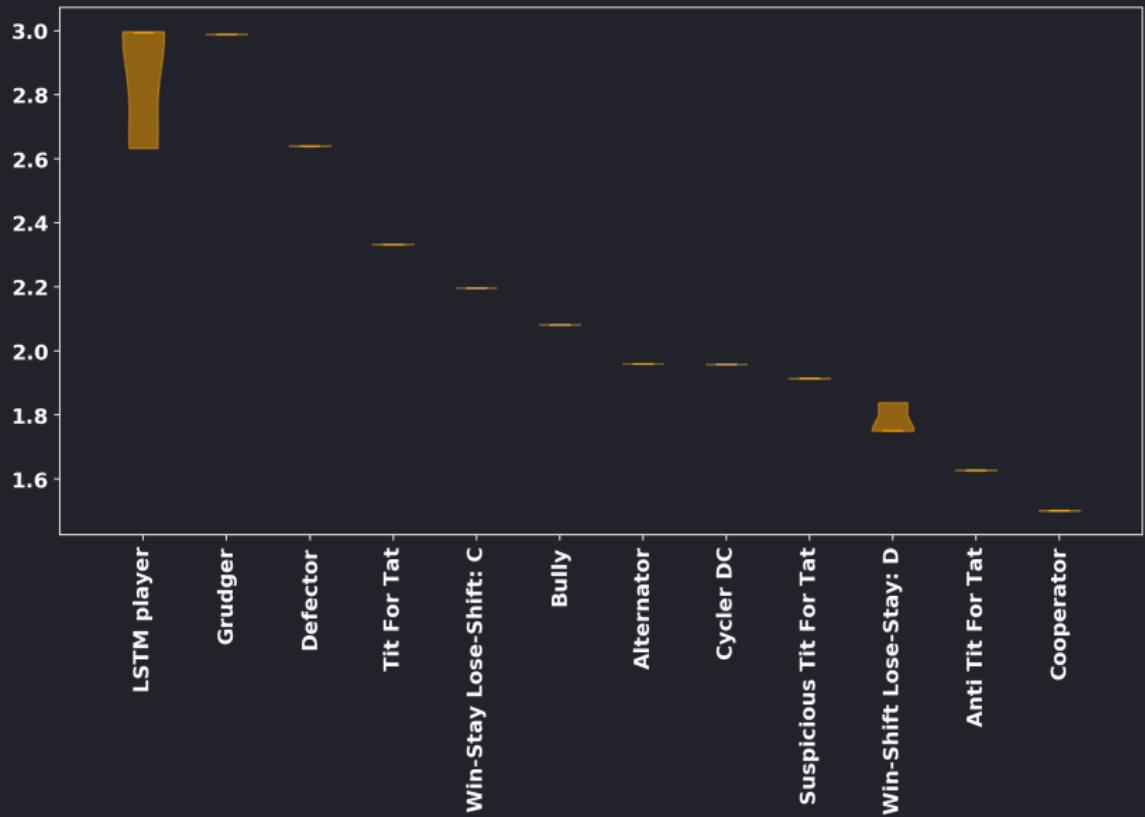


Reinforcement learning produces dominant strategies for the Iterated Prisoner's Dilemma: doi.org/10.1371/journal.pone.0188046

Evolution Reinforces Cooperation with the Emergence of Self-Recognition Mechanisms: doi.org/10.1371/journal.pone.0204981







5 TOPICS & AUTHORS ARE COLLABORATIVE

IDENTIFY THE MEAN COOPERATOR
& ADJUST TO THEM

TO BE ES YOU MUST BE FORGIVING

A LONGER MEMORY IS BENEFICIAL

POSSIBLE TO TRAIN A RECURRENT
NETWORK USING BEST RESPONSE
SEQUENCES

Manager strategies		
Poacher strategies	Horn devalued	Horn intact
Selective		
Indiscriminate		





- nikoleta-v3.github.io
- ⌚ github.com/ArcasProject/Arcas
- ⌚ github.com/Nikoleta-v3/bibliometric-study-of-the-prisoners-dilemma
- ⌚ github.com/Nikoleta-v3/meta-analysis-of-prisoners-dilemma-tournaments
- ⌚ github.com/Nikoleta-v3/Memory-size-in-the-prisoners-dilemma
- arXiv:2001.05911
- arXiv:1911.12112
- arXiv:1911.06128