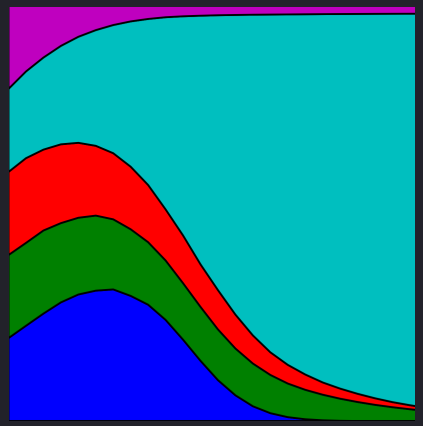
Understanding responses to environments for the Prisoner's Dilemma

Max Planck Institute

@NikoletaGlyn

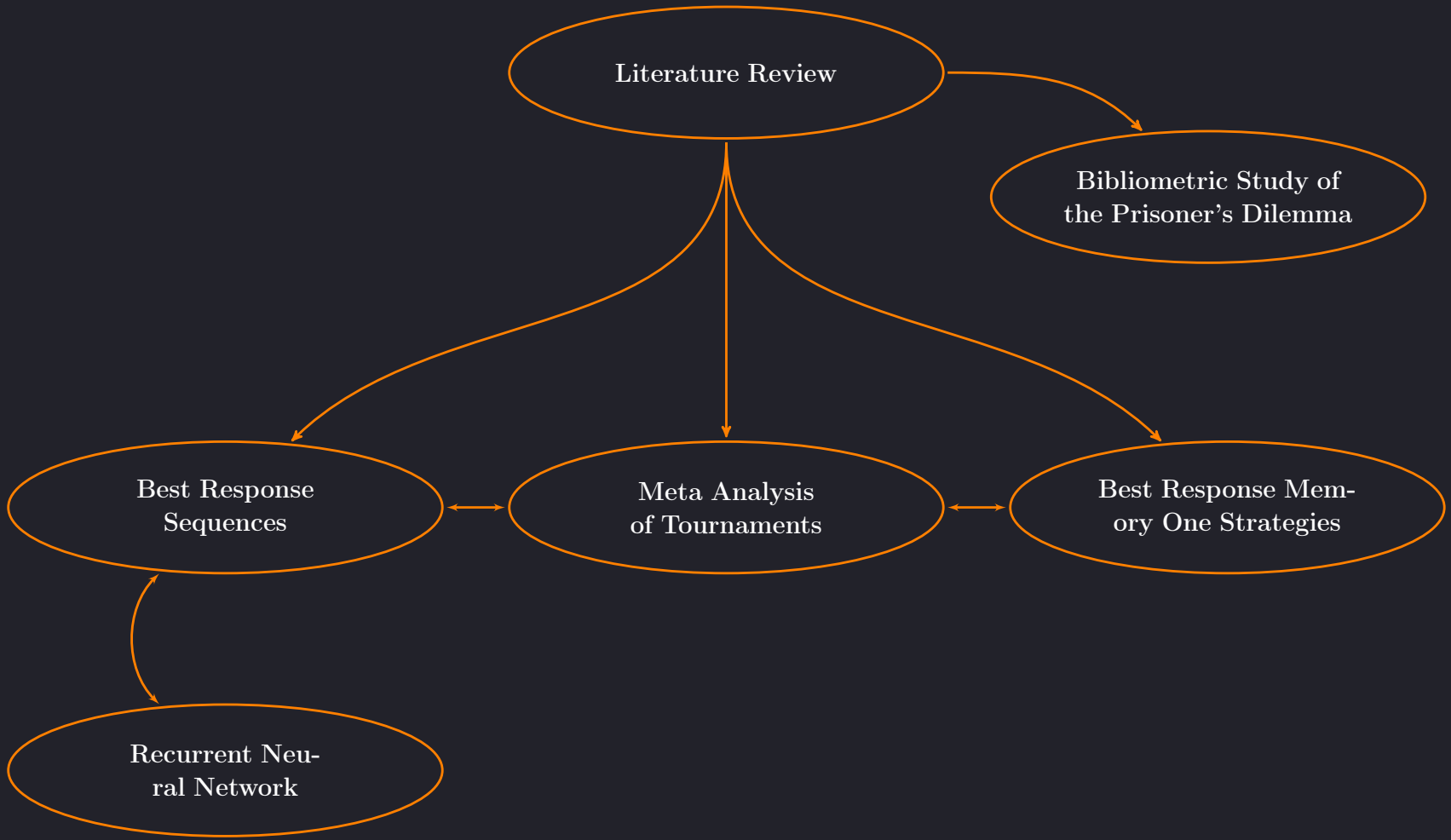


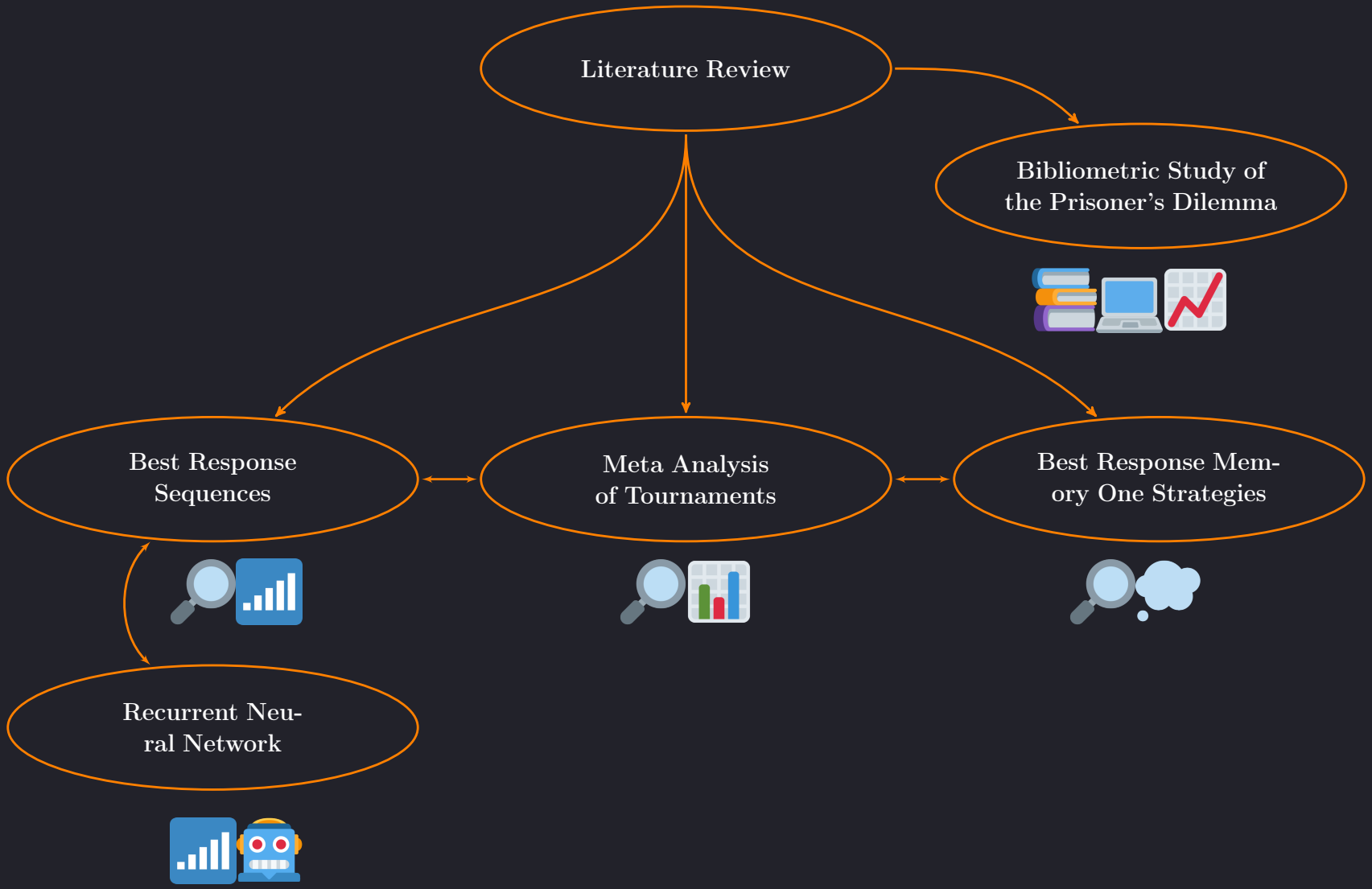
Software
Sustainability
Institute

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

$$S_p = \begin{pmatrix} 3 & 0 \\ 5 & 1 \end{pmatrix} \quad S_q = \begin{pmatrix} 3 & 5 \\ 0 & 1 \end{pmatrix}$$

. . .


Literature Review
Bibliometric Study of the Prisoner's Dilemma
Best Response Sequences
Meta Analysis of Tournaments
Best Response Memory One Strategies
Recurrent Neural Network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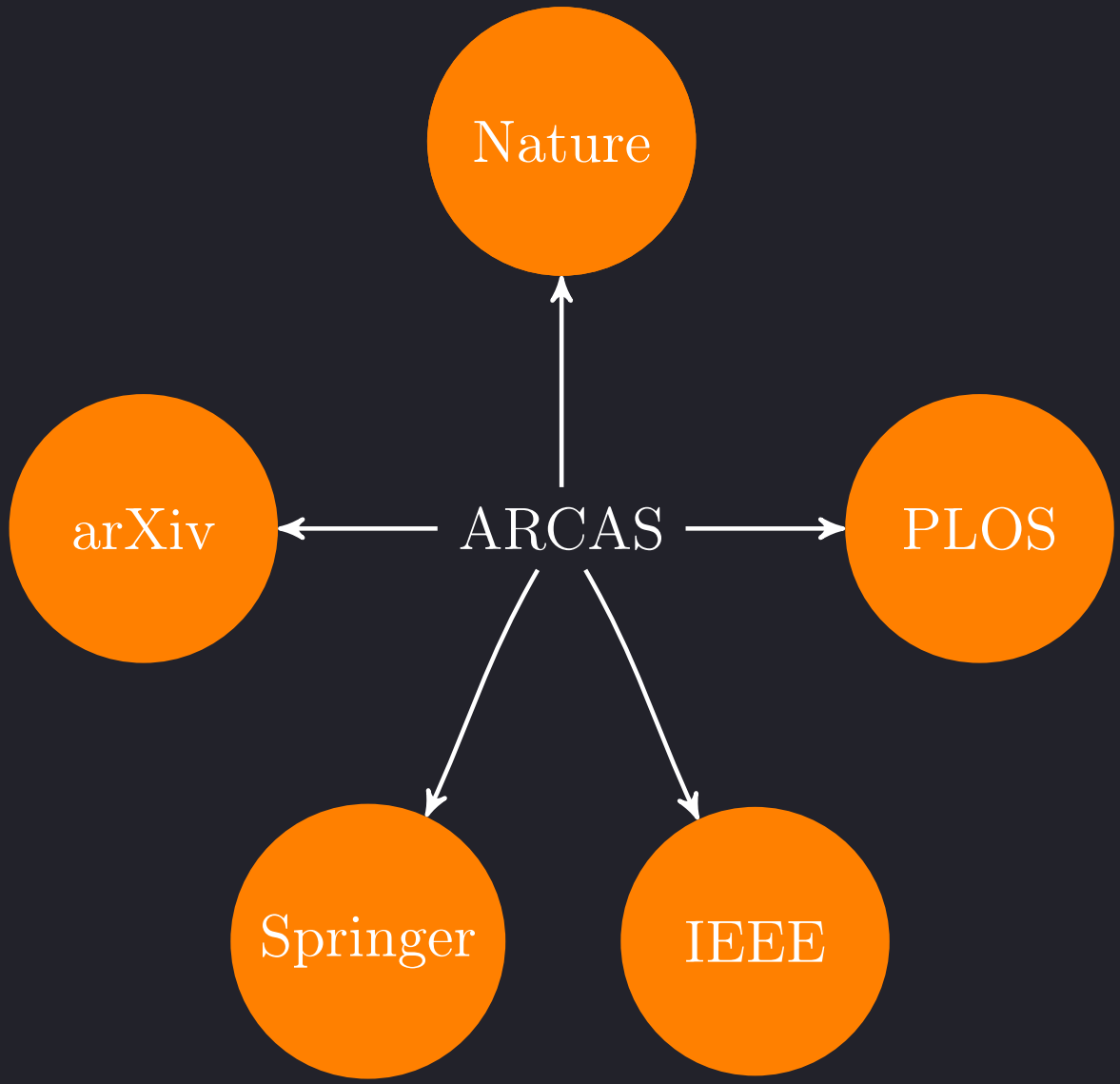
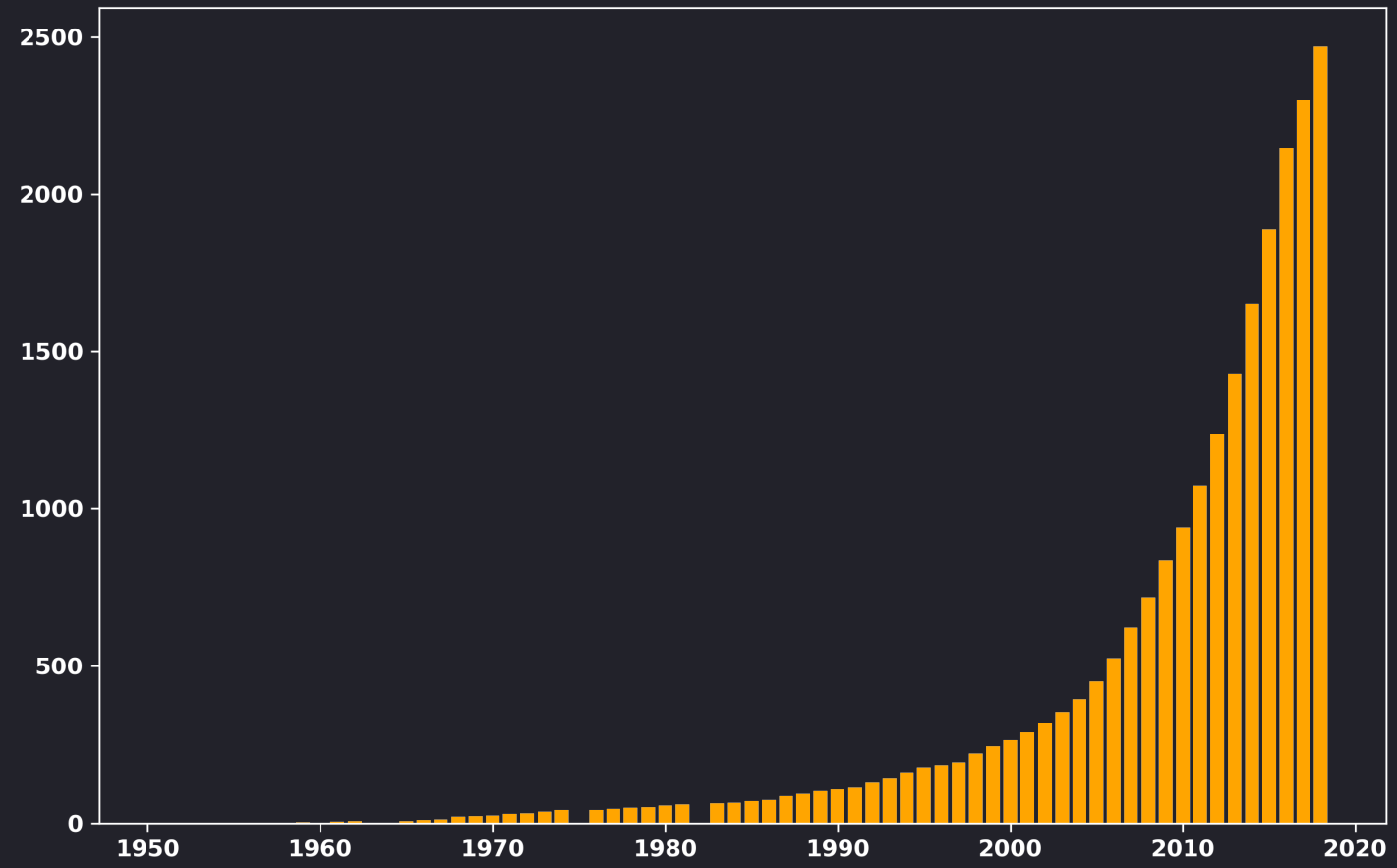
Bibliometric Study of the Prisoner's Dilemma

ARCAS

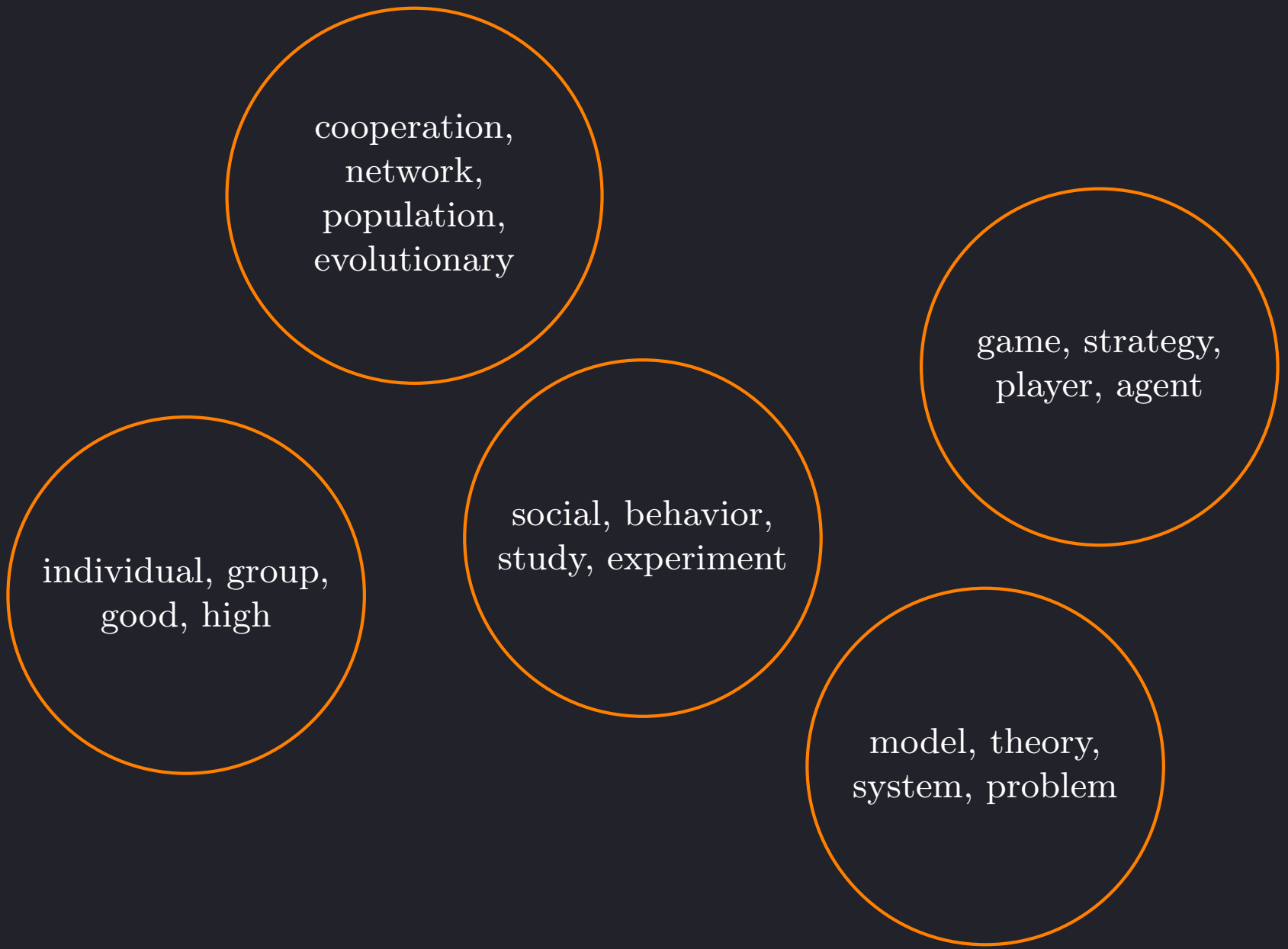
Nature
ARCAS

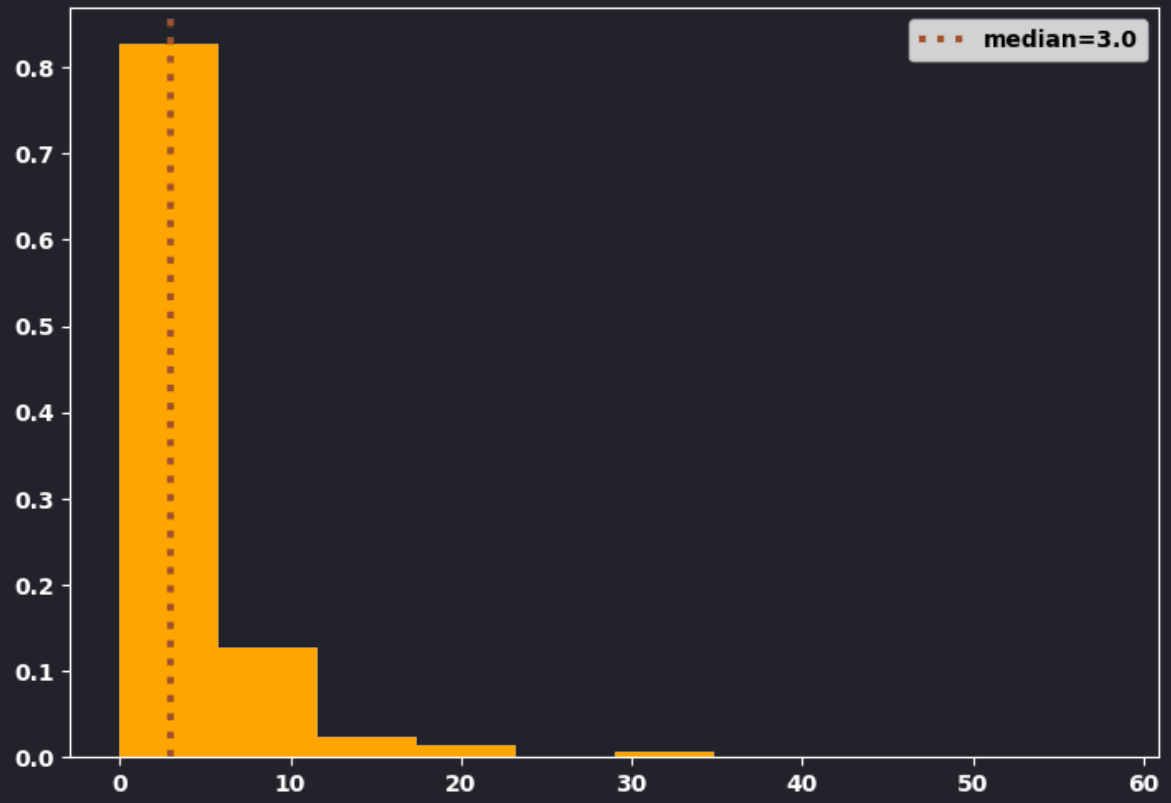

Nature
arXiv
ARCAS
PLOS
Springer
IEEE

title="prisoner's dilemma" OR abstract="prisoner's dilemma"



Natural Language Process
$\mathbb{R}^n$
Topic_i


cooperation, network, population, evolutionary
game, strategy, player, agent
individual, group, good, high
social, behavior, study, experiment
model, theory, system, problem

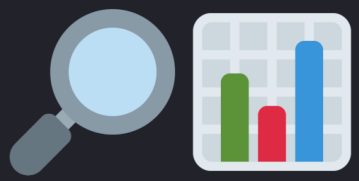

median=3.0
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60

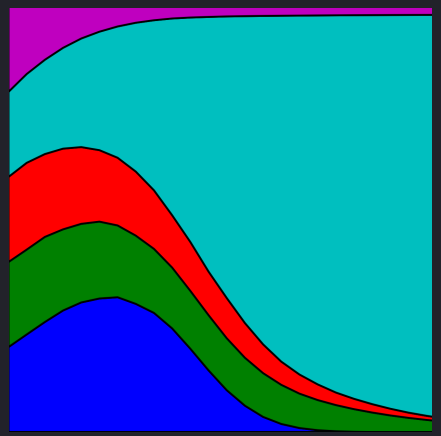
“A bibliometric study of research topics, collaboration and influence in the field of the Iterated Prisoner’s Dilemma"

Nikoleta E. Glynatsi, Vincent A. Knight

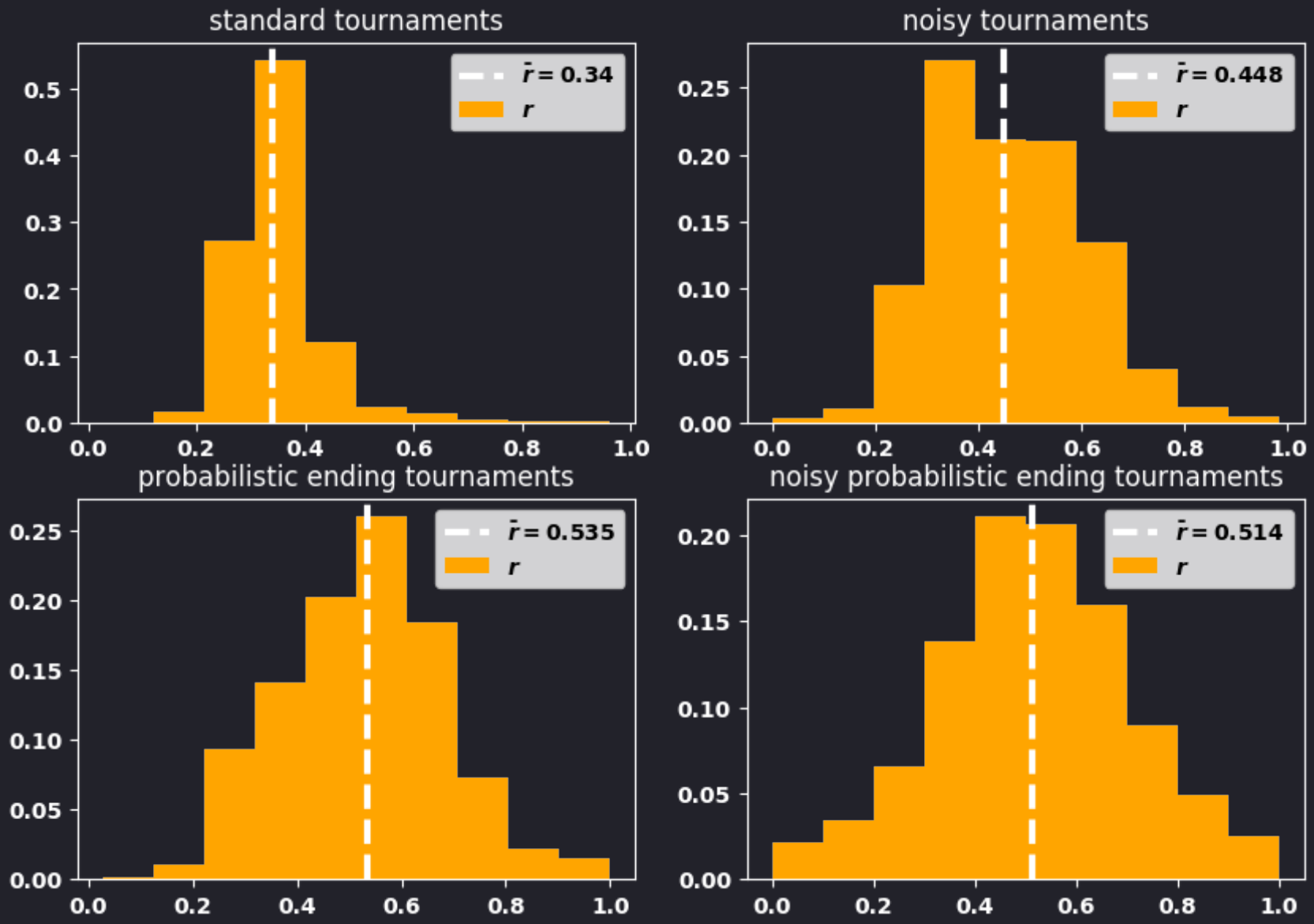
https://arxiv.org/abs/1911.06128

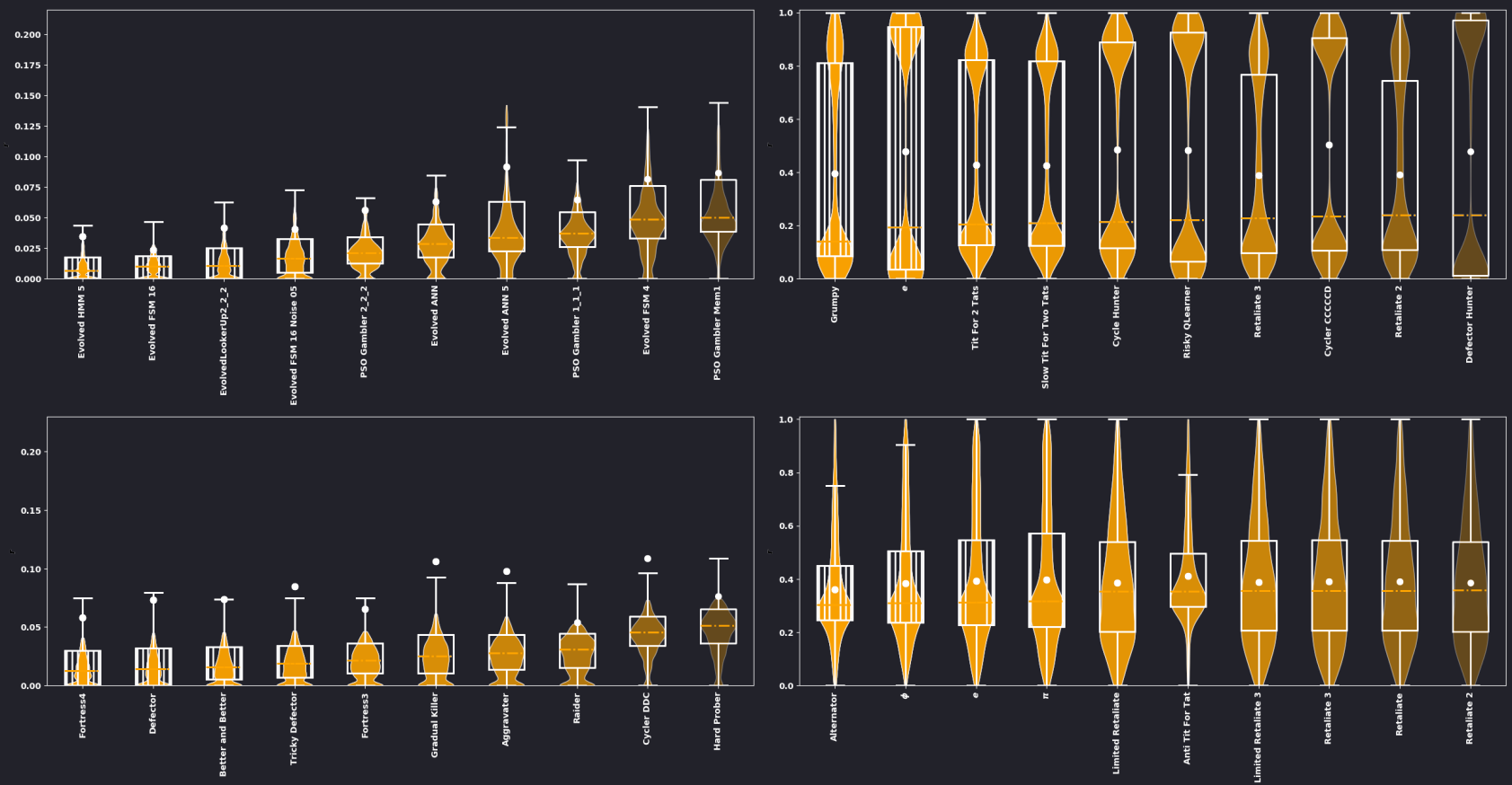
Meta Analysis of Tournaments



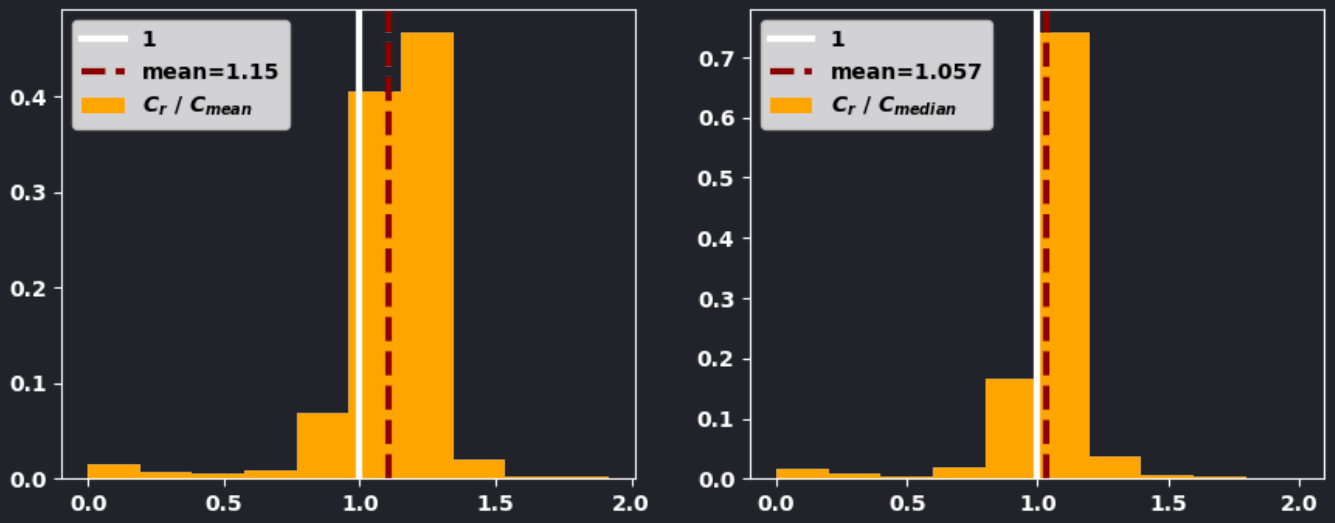


195 strategies in **45686** tournaments


standard tournaments
$\bar{r} = 0.34$
r
noisy tournaments
$\bar{r} = 0.448$
r
probabilistic ending tournaments
$\bar{r} = 0.535$
r
noisy probabilistic ending tournaments
$\bar{r} = 0.514$
r


0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
Evolved HMM 5
Evolved FSM 16
EvolvedLookerUp2_2_2
Evolved FSM 16 Noise 05
PSO Gambler 2_2_2
Evolved ANN
Evolved ANN 5
PSO Gambler 1_1_1
Evolved FSM 4
PSO Gambler Mem1
1.0
0.8
0.6
0.4
0.2
0.0
Grumpy
e
Tit For 2 Tats
Slow Tit For Two Tats
Cycle Hunter
Risky QLearner
Retaliate 3
Cycler CCCCCD
Retaliate 2
Defector Hunter
0.20
0.15
0.10
0.05
0.00
Fortress4
Defector
Batter and Better
Tricky Defector
Fortress3
Gradual Killer
Aggravater
Raider
Cycler DDC
Hard Prober
1.0
0.8
0.6
0.4
0.2
0.0
Alternator
ϕ
e
π
Limited Retaliate
Anti Tit For Tat
Limited Retaliate 3
Retaliate 3
Retaliate
Retaliate 2

Evolved HMM 5 ?


1
mean=1.15
C_r / C_{mean}
0.0
0.1
0.2
0.3
0.4
0.0
0.5
1.0
1.5
2.0
1
mean=1.057
C_r / C_{median}
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.0
0.5
1.0
1.5
2.0

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

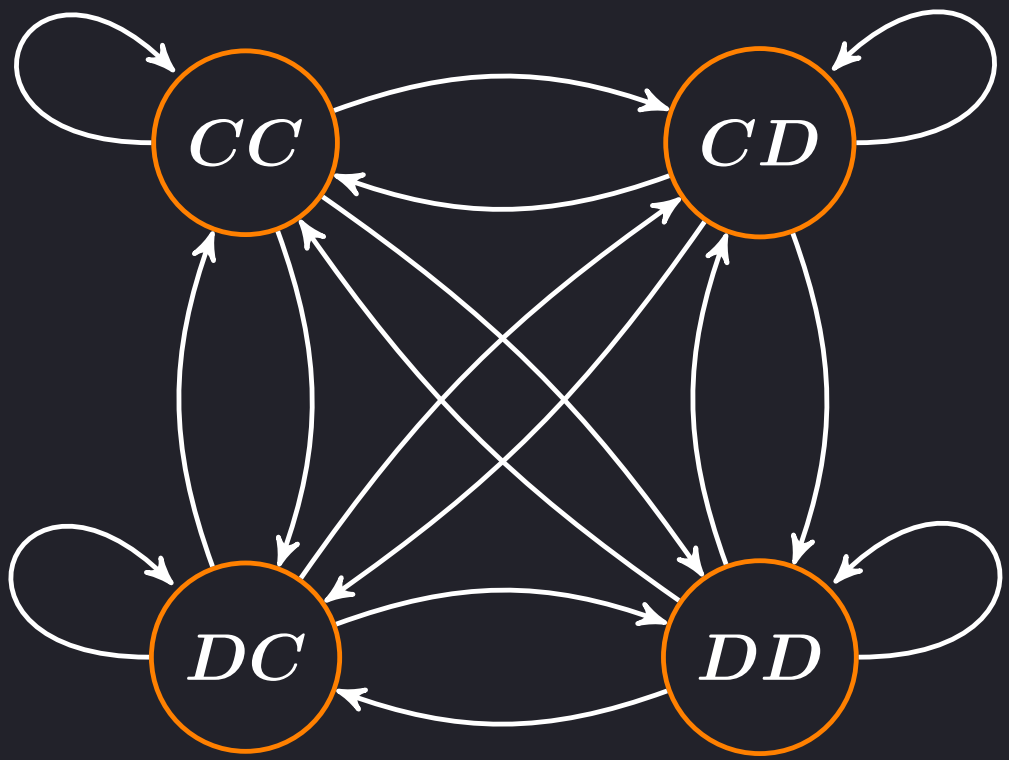
Nikoleta E. Glynatsi, Vincent A. Knight

arXiv:2001.05911

Best Response Memory One Strategies

CC
CD
DC
DD

$$p = (p_1, p_2, p_3, p_4)$$
$$q = (q_1, q_2, q_3, q_4)$$



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

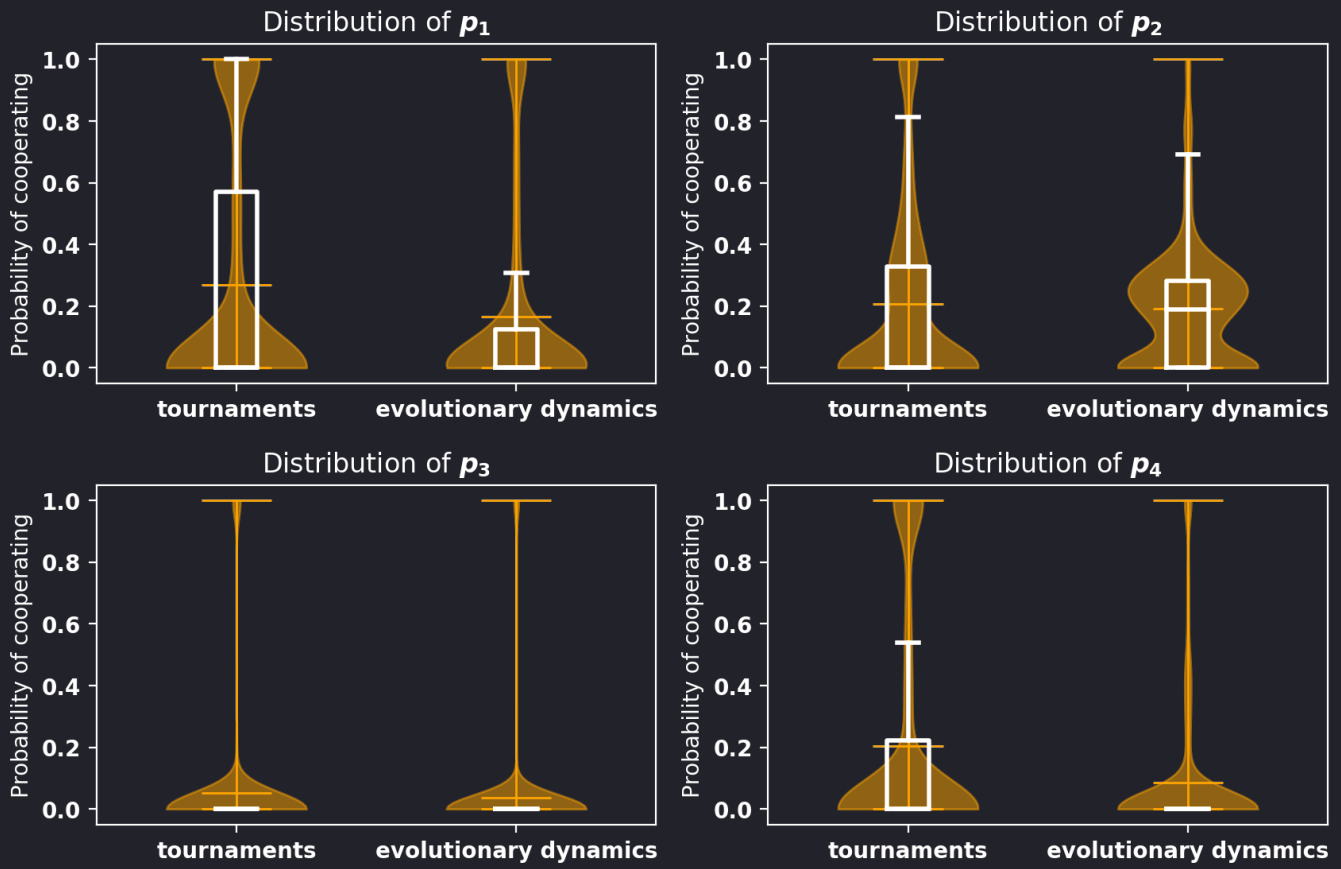
$$q = (q_1, q_2, q_3, q_4)$$

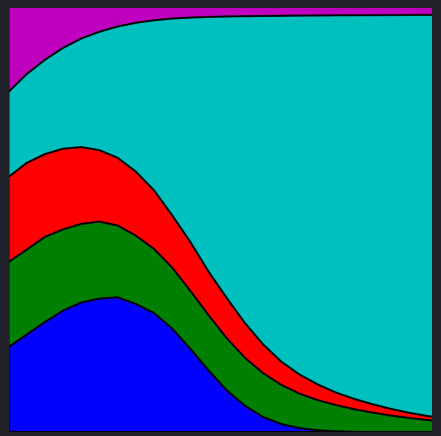
$$\sum_{i=1}^{N} {u_q}^{(i)}(p)$$

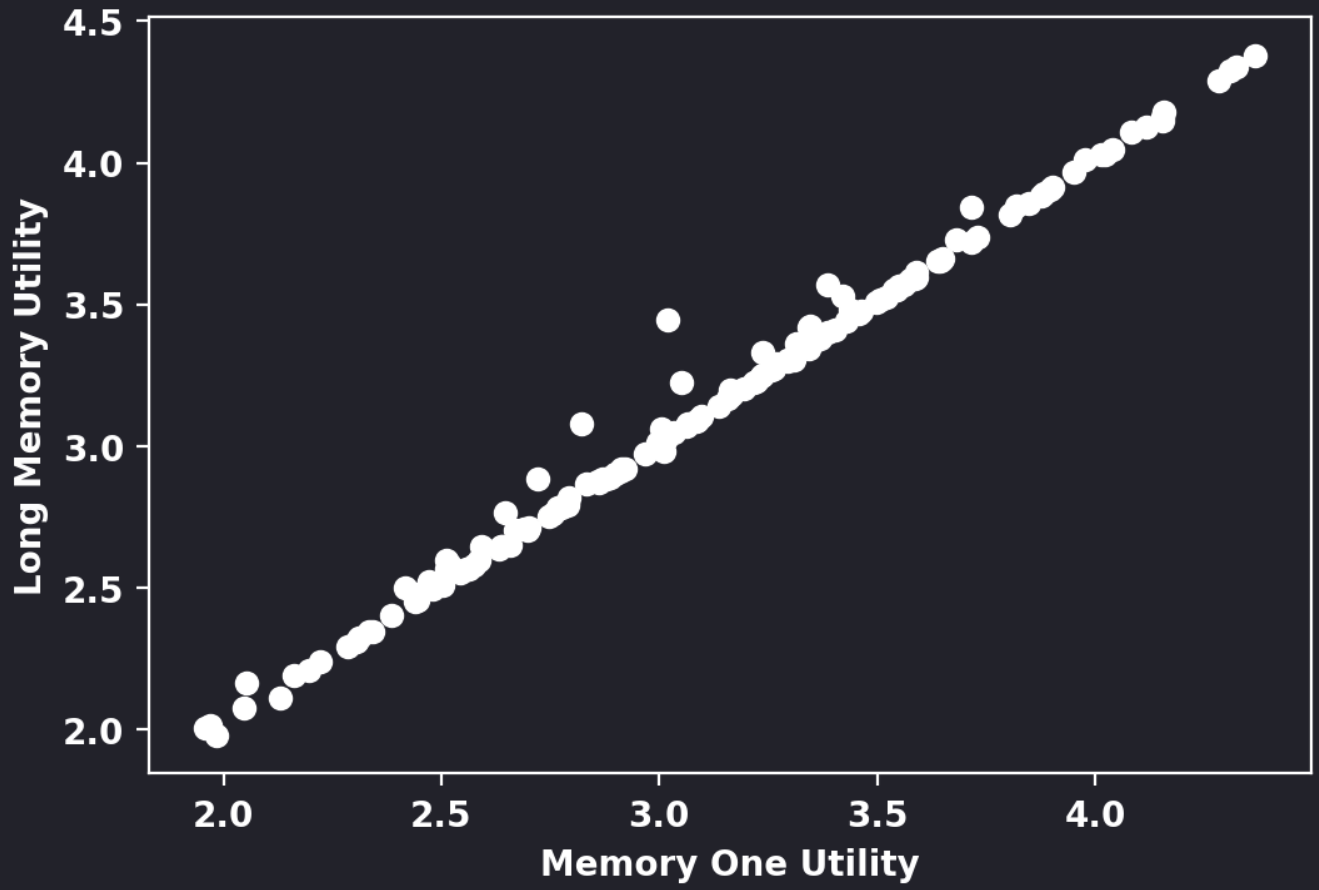
$$\sum_{i=1}^{N} {u_q}^{(i)}(p) \longrightarrow max_p : \sum_{i=1}^{N} {u_q}^{(i)}(p)$$

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

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


Distribution of p_1
Distribution of p_2
Distribution of p_3
Distribution of p_4
Probability of cooperating
1.0
0.8
0.6
0.4
0.2
0.0
tournaments
evolutionary dynamics



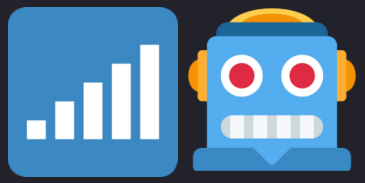

4.5
4.0
3.5
3.0
2.5
2.0
Long Memory Utility
2.0
2.5
3.0
3.5
4.0
Memory One Utility

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

Nikoleta E. Glynatsi, Vincent A. Knight

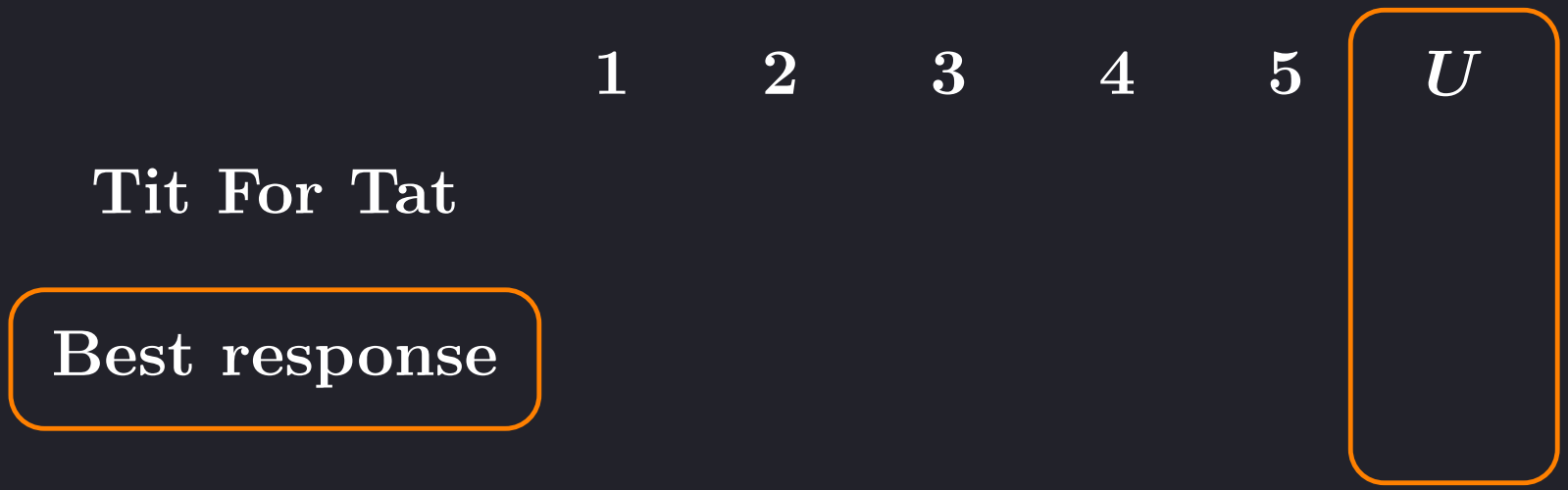
arXiv:1911.12112

Best Response Sequences



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

	1	2	3	4	5	U
Tit For Tat						
Best response						


1
2
3
4
5
U
Tit For Tat
Best response

	1	2	3	4	5	U
Tit For Tat	C	C	C	C	C	3
Best response	C	C	C	C	C	3

Tit For Tat

Alternator

AntiTitForTat

Bully

Cooperator

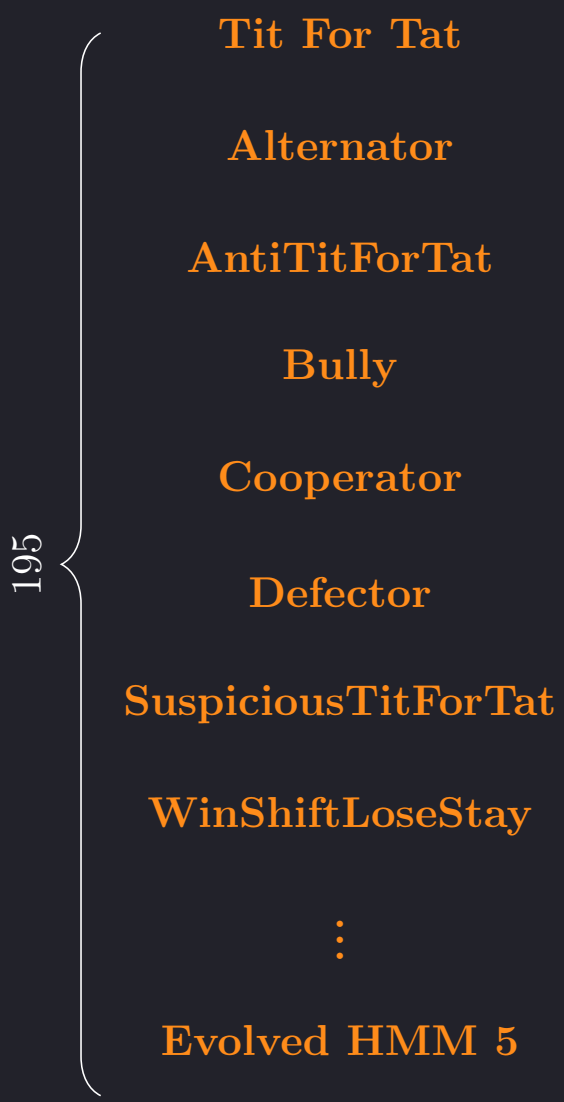
Defector

SuspiciousTitForTat

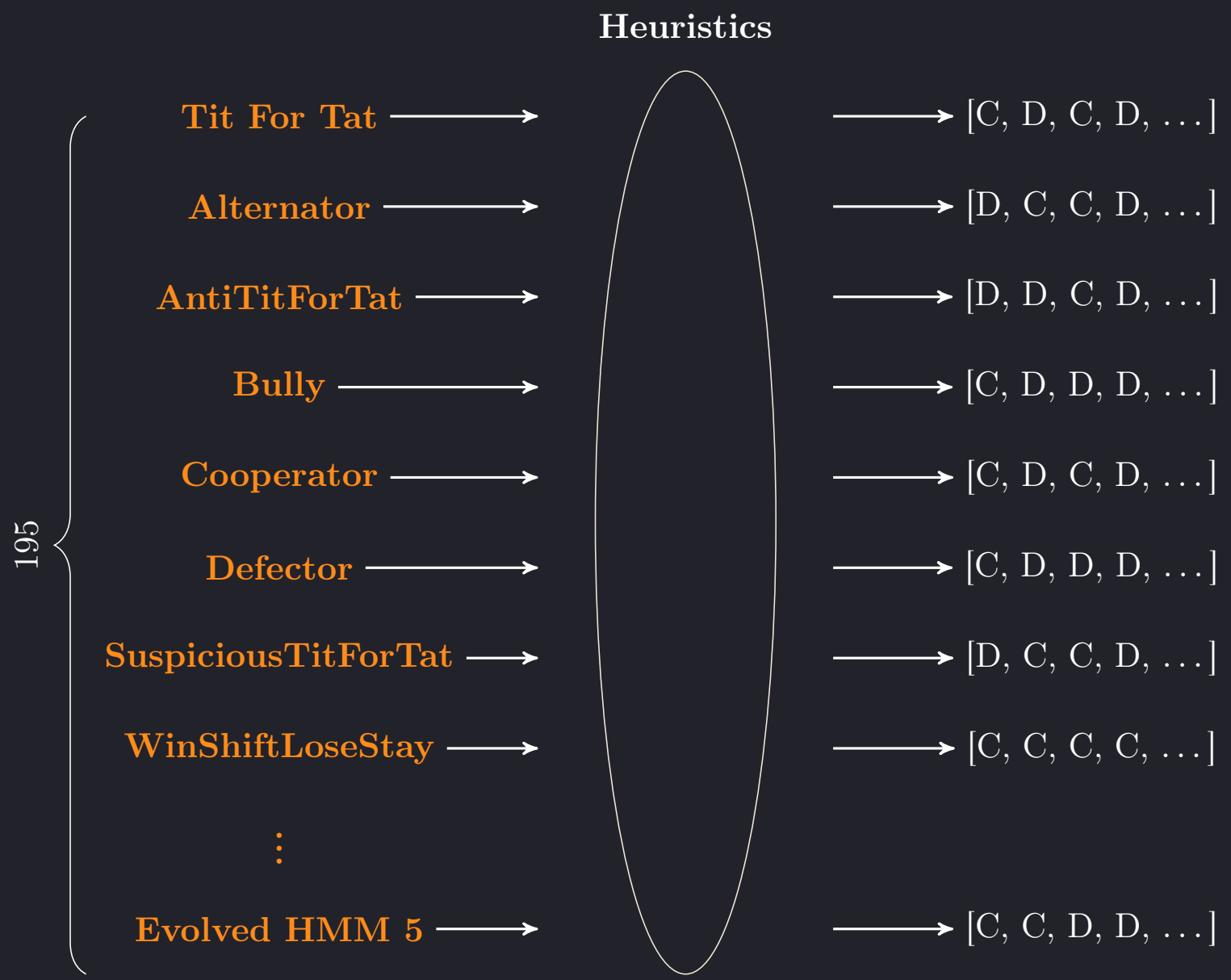
WinShiftLoseStay

⋮

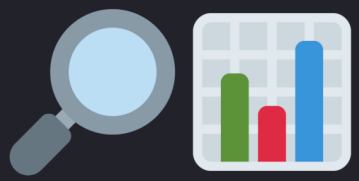
Evolved HMM 5

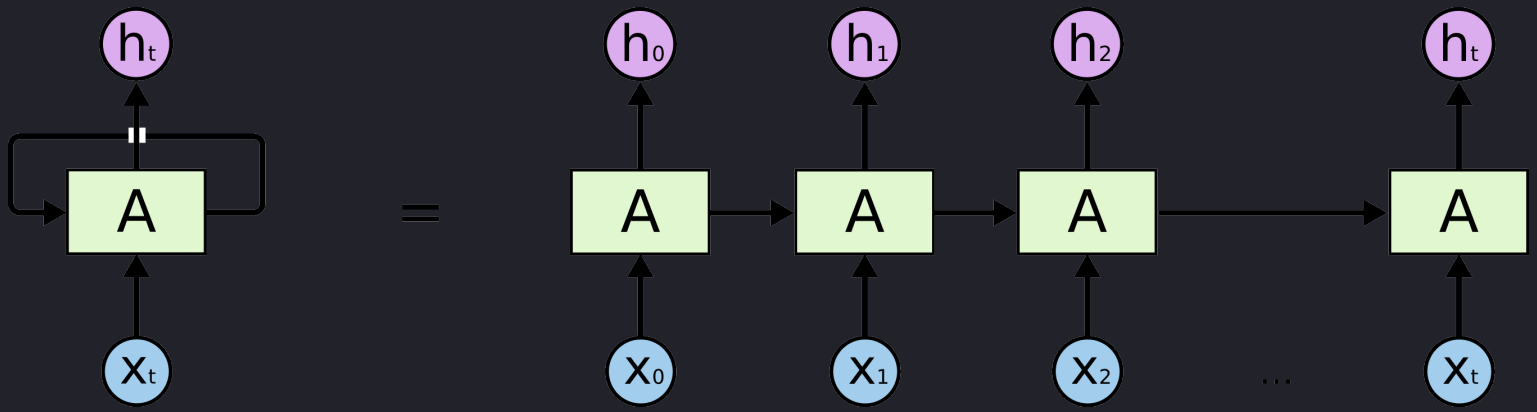

Tit For Tat
Alternator
AntiTitForTat
Bully
Cooperator
Defector
SuspiciousTitForTat
WinShiftLoseStay
Evolved HMM 5
195

Heuristics
Tit For Tat
Alternator
AntiTitForTat
Bully
Cooperator
Defector
SuspiciousTitForTat
WinShiftLoseStay
Evolved HMM 5
195


Heuristics
Tit For Tat
Alternator
AntiTitForTat
Bully
Cooperator
Defector
SuspiciousTitForTat
WinShiftLoseStay
Evolved HMM 5
195
[C, D, C, D, . . .]
[D, C, C, D, . . .]
[D, D, C, D, . . .]
[C, D, D, D, . . .]
[C, D, C, D, . . .]
[C, D, D, D, . . .]
[D, C, C, D, . . .]
[C, C, C, C, . . .]
[C, C, D, D, . . .]

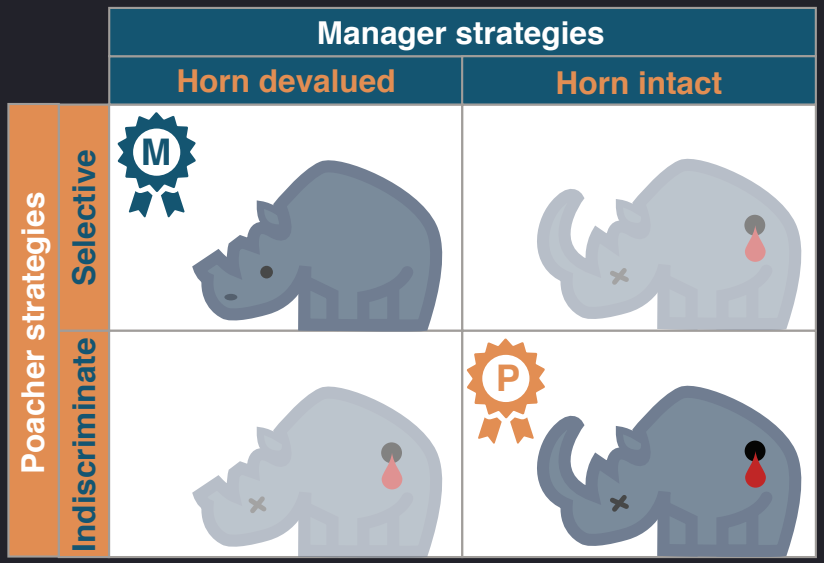
Recurrent Neural Network Player

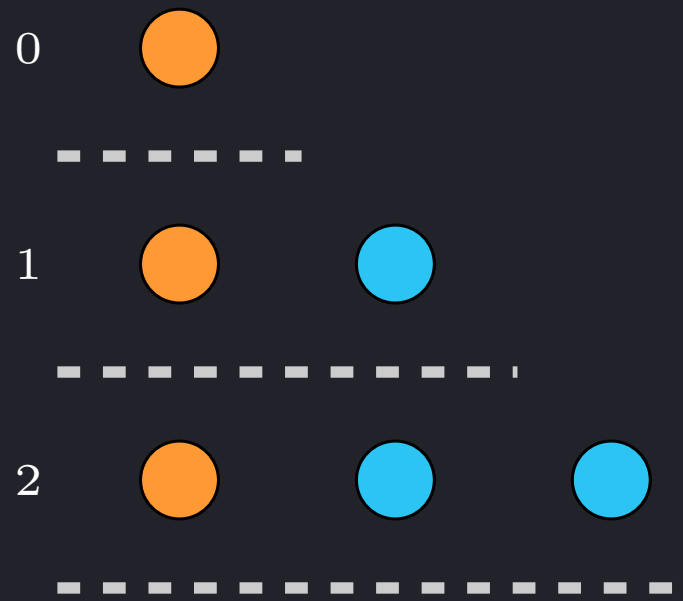



h_t
A
x_t
=
h_0
h_1
h_2
h_t
A
A
A
A
x_0
x_1
x_2
...
x_t

Performance violin plot

- Point 1
- Point 2
- Point 3
- Point 4
- Point 5


Manager strategies
Horn devalued
Horn intact
Poacher strategies
Selective
Indiscriminate
M
P


0
1
2

@NikoletaGlyn

- https://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