Vince Knight - @drvinceknight

@kirstyjean (2 Jun 2017):

Me: sets up flawless heat competition trial, lizards will fight over hot podium, there can only be one winner!
Lizards:
#ALlizards2017

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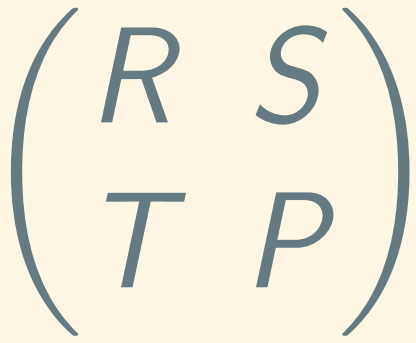


$$\begin{pmatrix} 3 & 0 \\ 5 & 1 \end{pmatrix} \qquad \begin{pmatrix} 3 & 5 \\ 0 & 1 \end{pmatrix}$$

Robert Axelrod

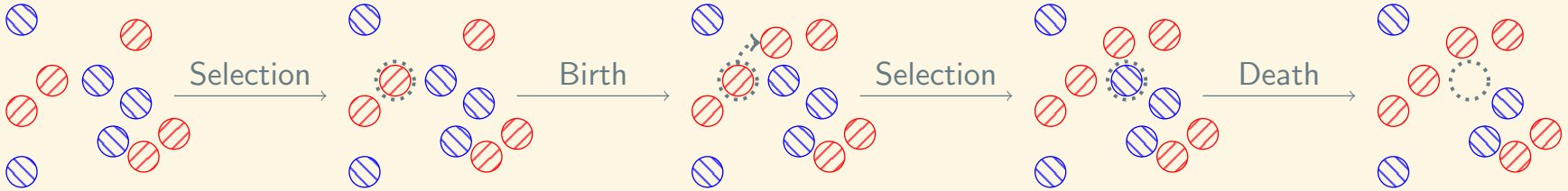
Robert Axelrod

```
>>> import axelrod as axl

>>> players = (axl.TitForTat(),
...            axl.Cooperator())
>>> axl.Match(players, turns=5).play()
[(C, C), (C, C), (C, C), (C, C), (C, C)]

>>> players = (axl.TitForTat(),
...            axl.Defector())
>>> axl.Match(players, turns=5).play()
[(C, D), (D, D), (D, D), (D, D), (D, D)]

>>> players = (axl.TitForTat(),
...            axl.Alternator())
>>> axl.Match(players, turns=5).play()
[(C, C), (C, D), (D, C), (C, D), (D, C)]
```

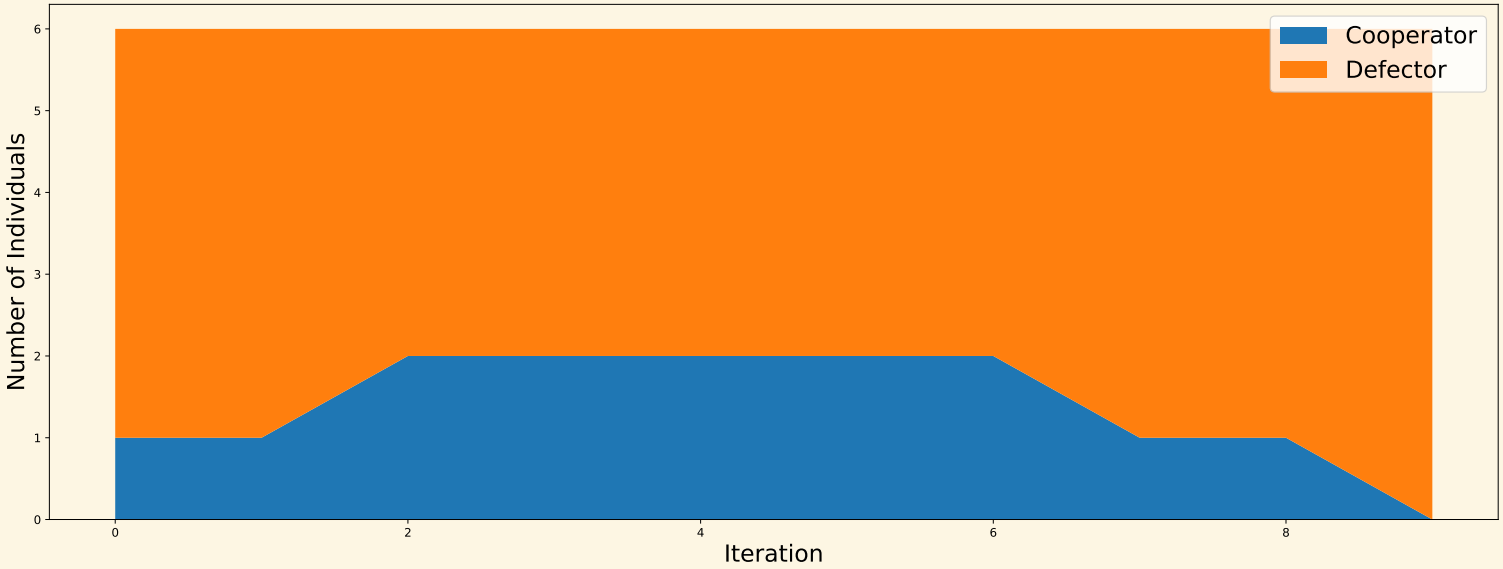
“Simpler is better”

`https://github.com/Axelrod-Python/Axelrod`

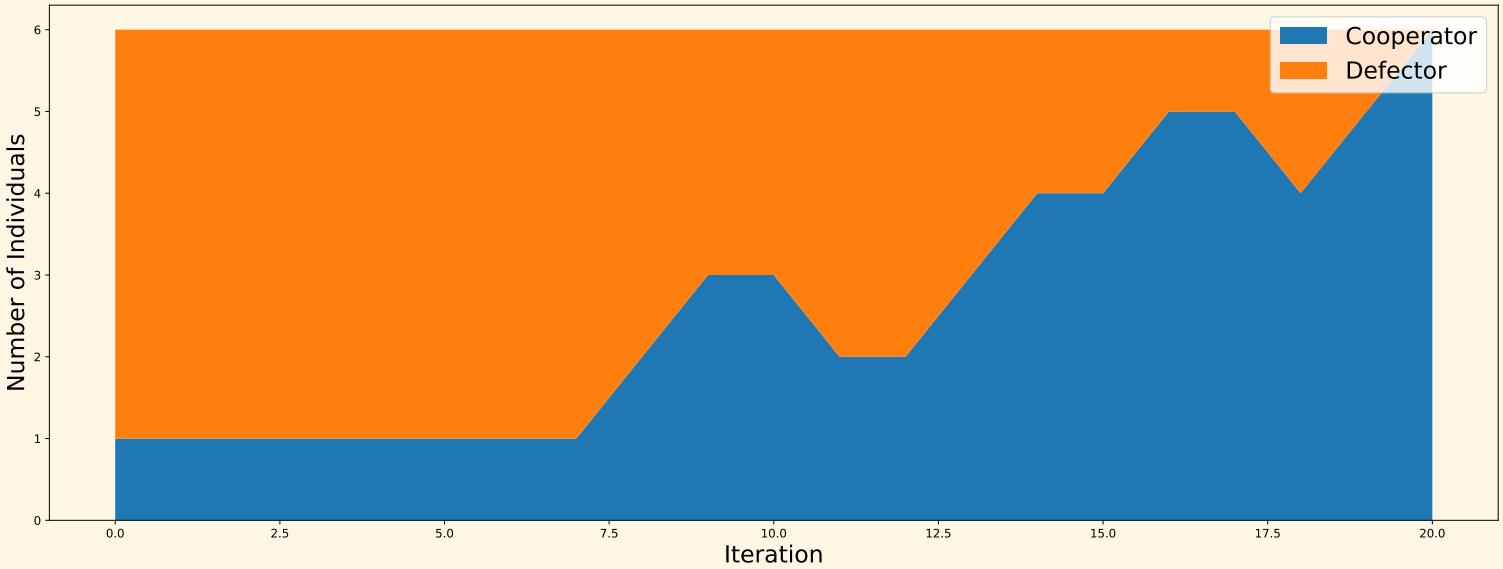
- "An Open Framework for the Reproducible Study of the Iterated Prisoners Dilemma." - 2016 - Journal of open research software
- "Reinforcement Learning Produces Dominant Strategies for the Iterated Prisoner's Dilemma" - 2017 - PLOS One
- "Evolution Reinforces Cooperation with the Emergence of Self-Recognition Mechanisms: an empirical study of the Moran process for the iterated Prisoner's dilemma" - 2018 - PLOS One

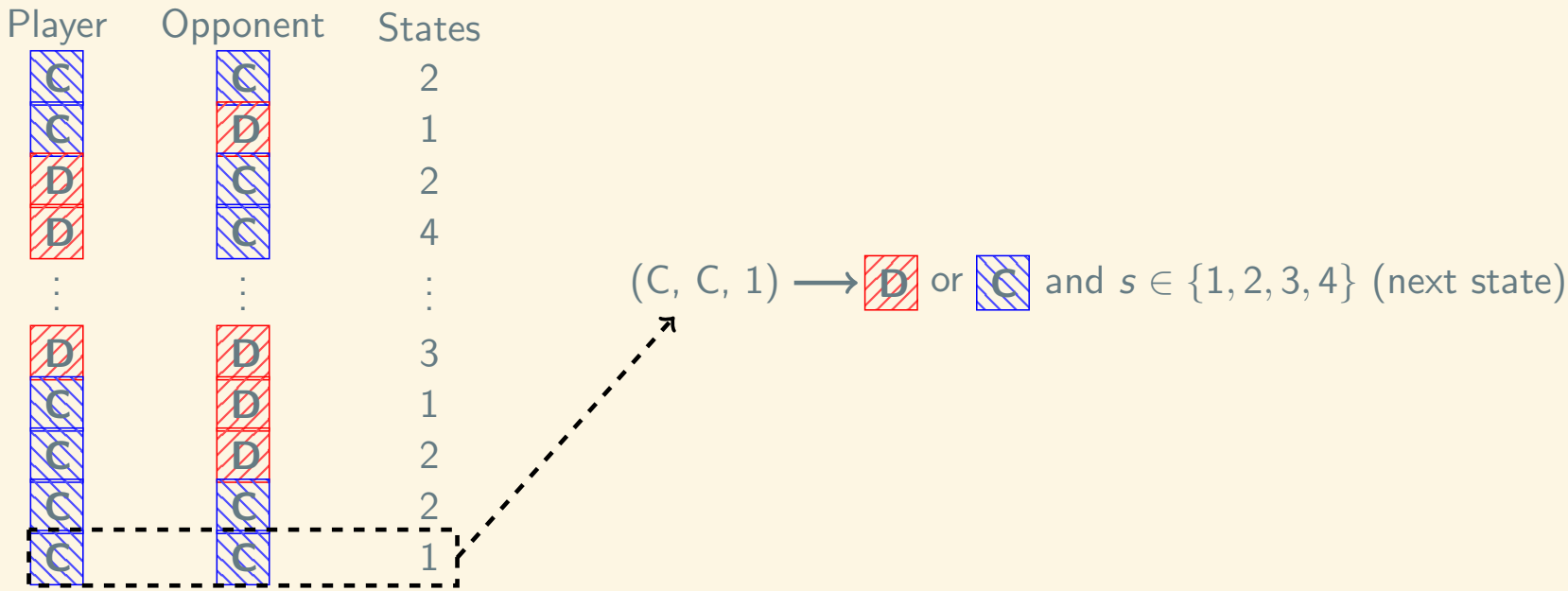

Selection
Birth
Selection
Death

Resistance

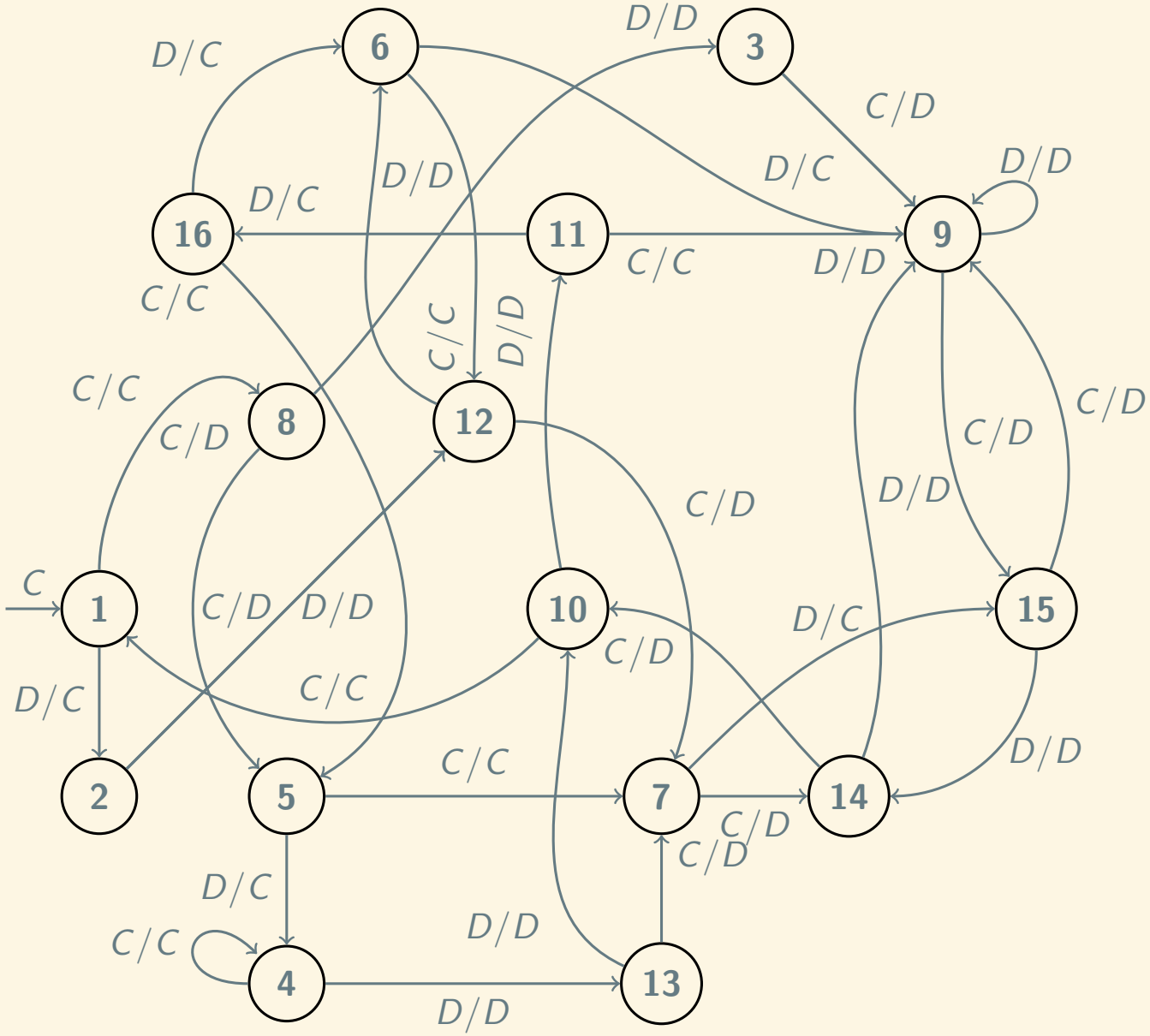


Invasion




Player
Opponent
States
C C 2
C D 1
D C 2
D C 4
D D 3
C D 1
C D 2
C C 2
C C 1
(C, C, 1) ⟶ D or C and $s \in \{1, 2, 3, 4\}$ (next state)

```
import axelrod_dojo
```


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
C
D/C
D/D
C/D
C/C

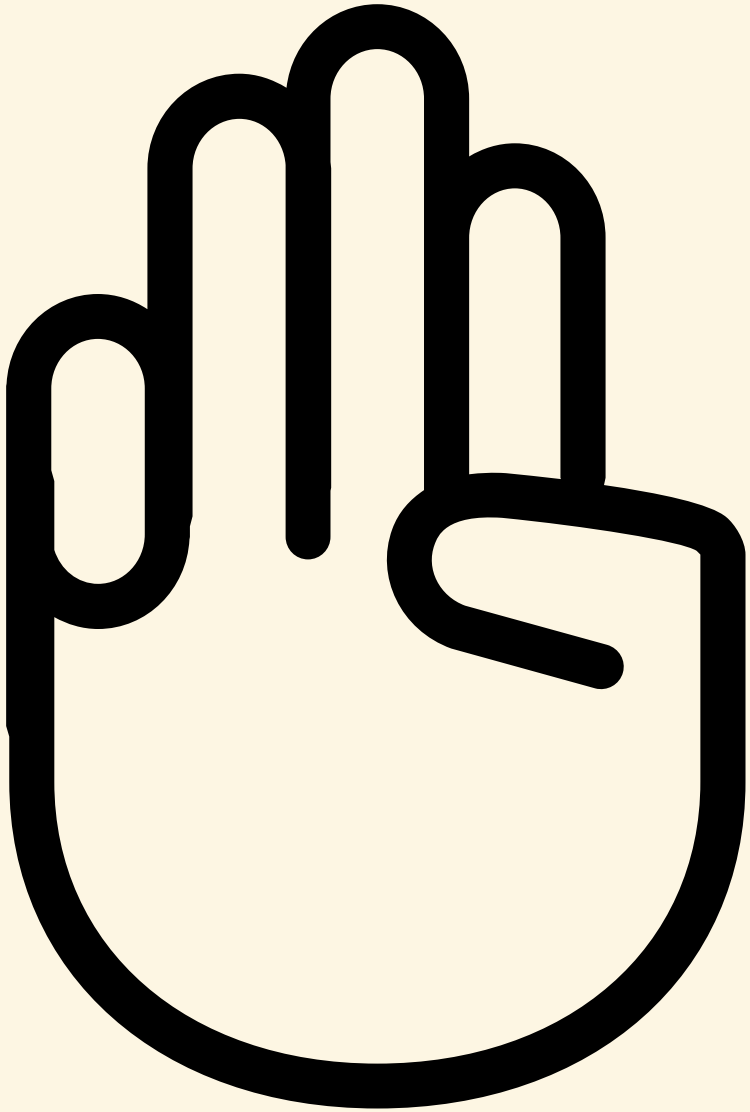
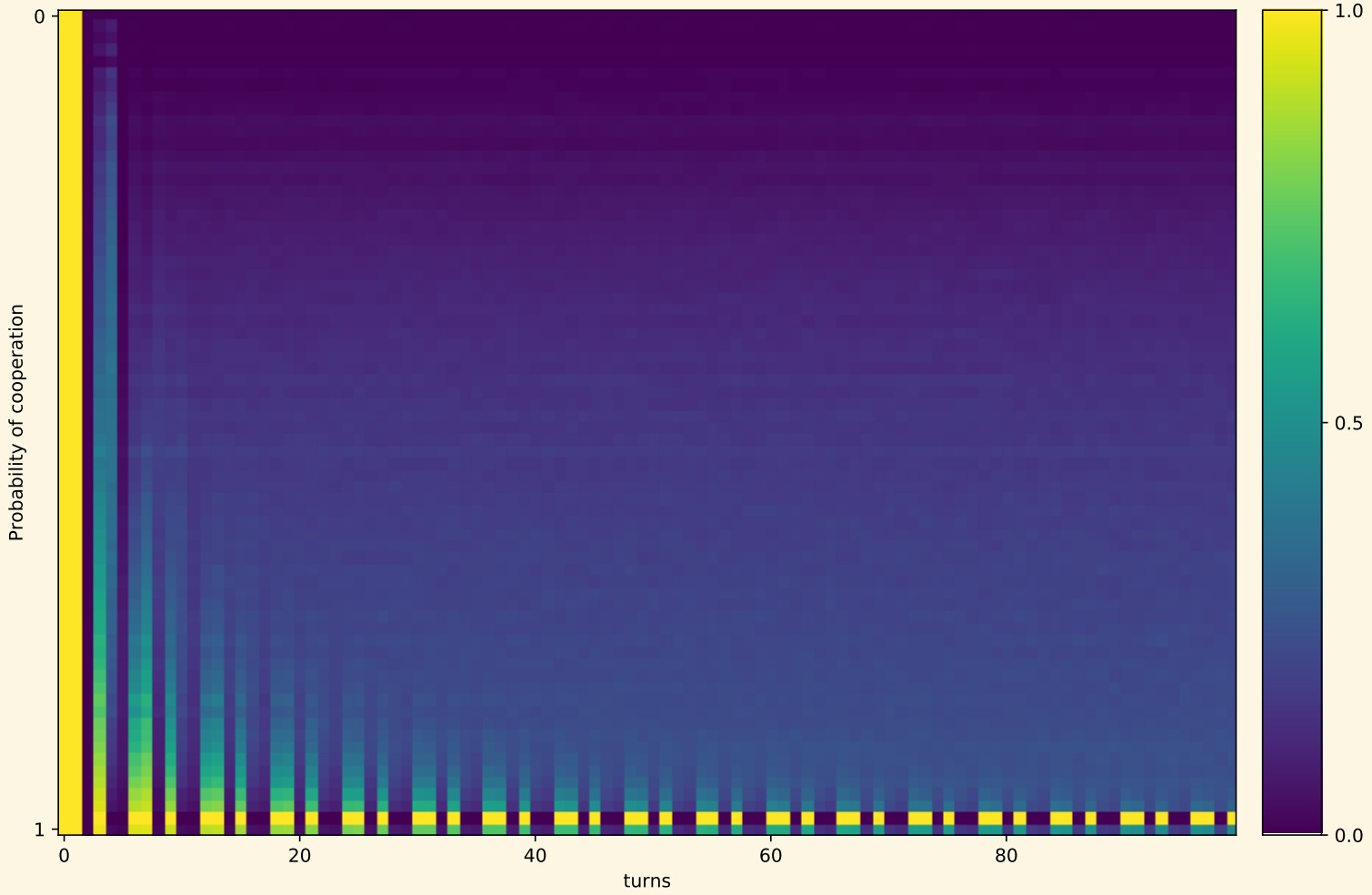
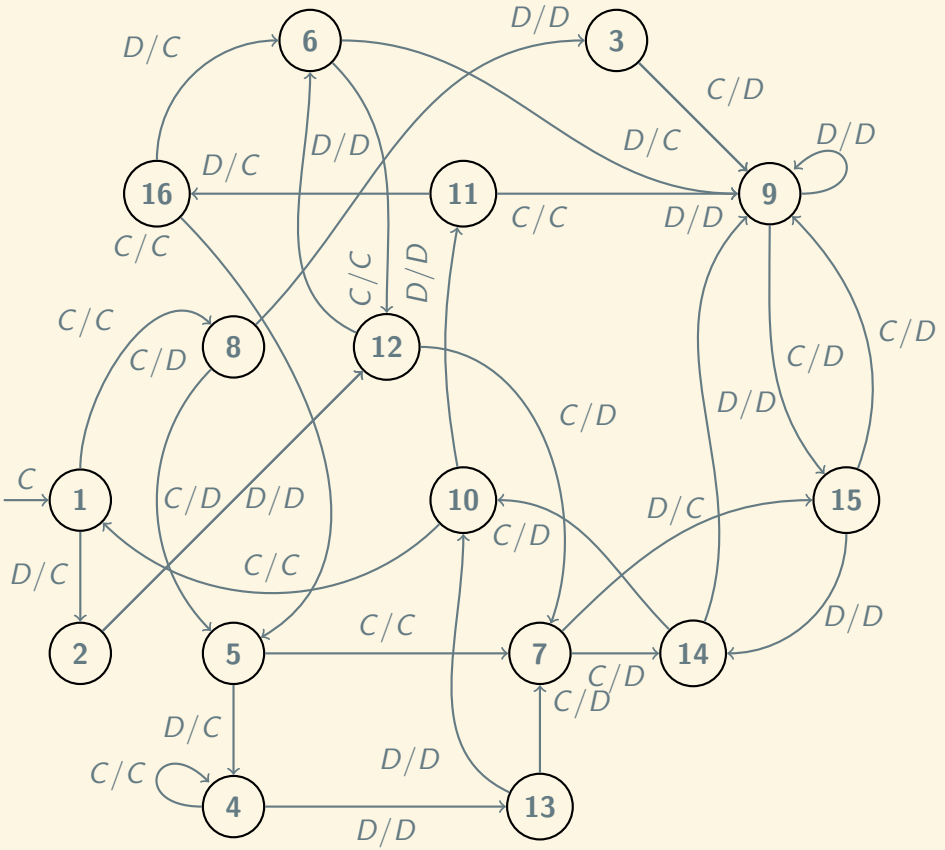


Image made by http://www.freepik.com from https://www.flaticon.com is licensed by CC BY 3.0


0
1
Probability of cooperation
0
20
40
60
80
turns
1.0
0.5
0.0



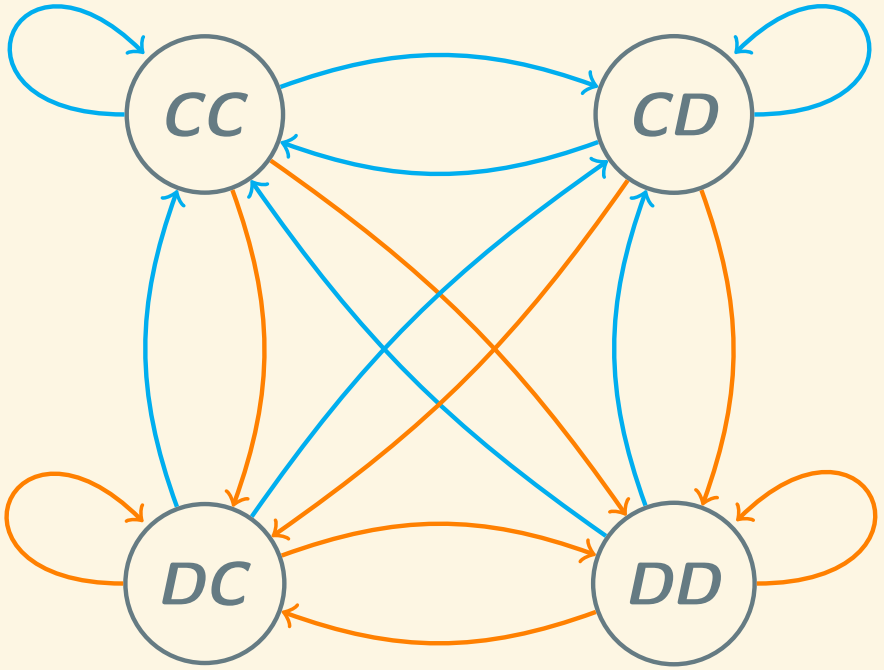
TF1 #1	TF1 #2
1: C	**1: C**
8: C	**8: C**
5: D	**5: D**
4: C	4: C
4: C	4: C
4: C	4: C
4: C	4: C
4: C	4: C

“Don’t trust anyone.”

Press and Dyson 2012: "Iterated Prisoners Dilemma contains strategies that dominate any evolutionary opponent"

"The world of game theory is currently on fire."

MIT Technology Review, 2012


CC
CD
DC
DD

If

$$\tilde{p} = \alpha S_x + \beta S_y + \gamma \tag{1}$$

then:

$$\alpha S_X + \beta S_Y + \gamma = 0 \tag{2}$$

Specifically:

$$S_X = -\frac{\beta}{\alpha} S_Y = \chi S_y \tag{3}$$

“Extortion cannot be beaten.”

$$\tilde{p}_1 = \alpha R + \beta R - P(\alpha + \beta) \tag{4}$$
$$\tilde{p}_2 = \alpha S + \beta T - P(\alpha + \beta) \tag{5}$$
$$\tilde{p}_3 = \alpha T + \beta S - P(\alpha + \beta) \tag{6}$$
$$\tilde{p}_4 = \alpha P + \beta P - P(\alpha + \beta) = 0 \tag{7}$$

with:

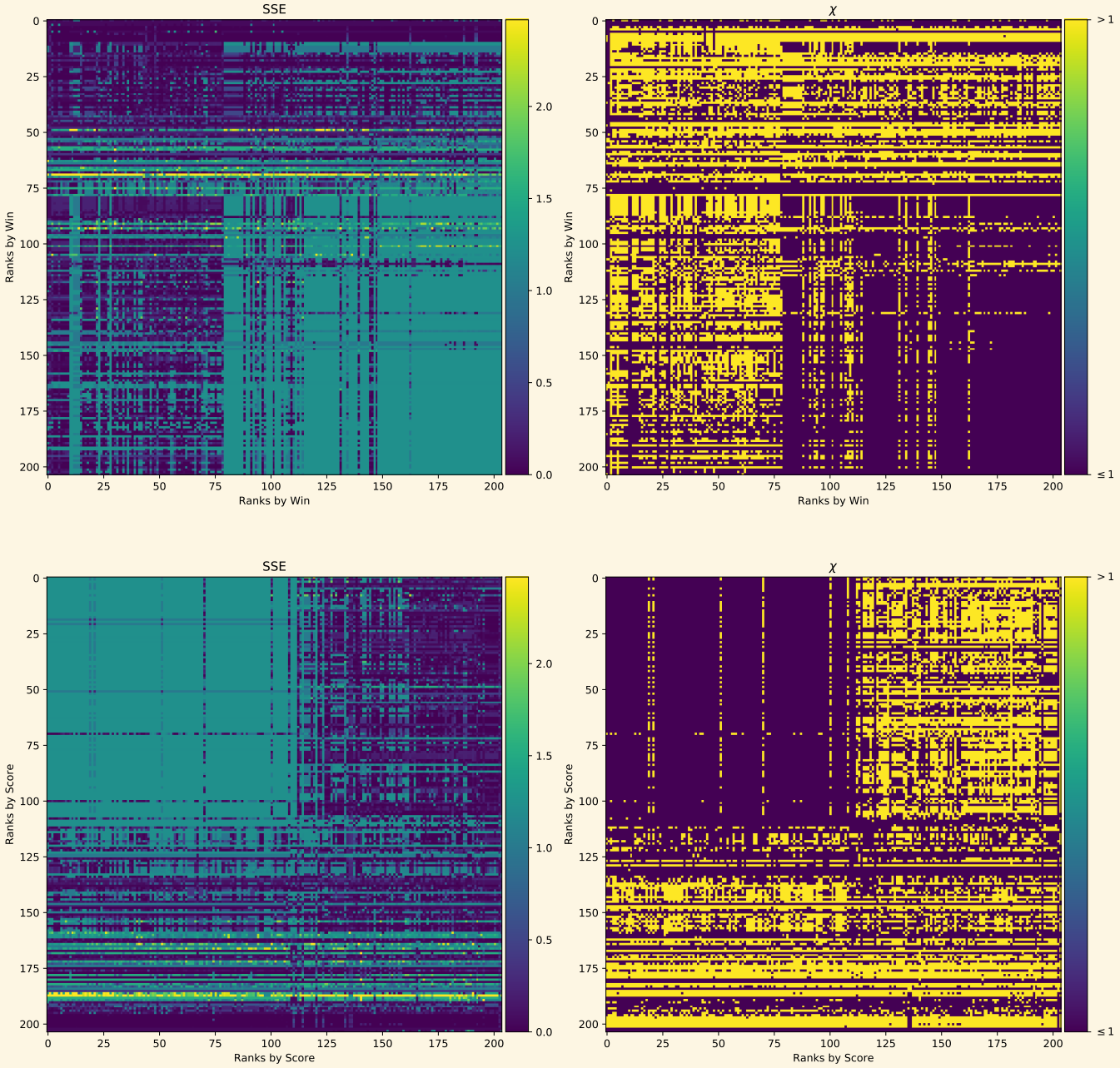
$$\chi = \frac{\tilde{p}_2(P - T) + \tilde{p}_3(S - P)}{\tilde{p}_2(P - S) + \tilde{p}_3(T - P)} \tag{8}$$

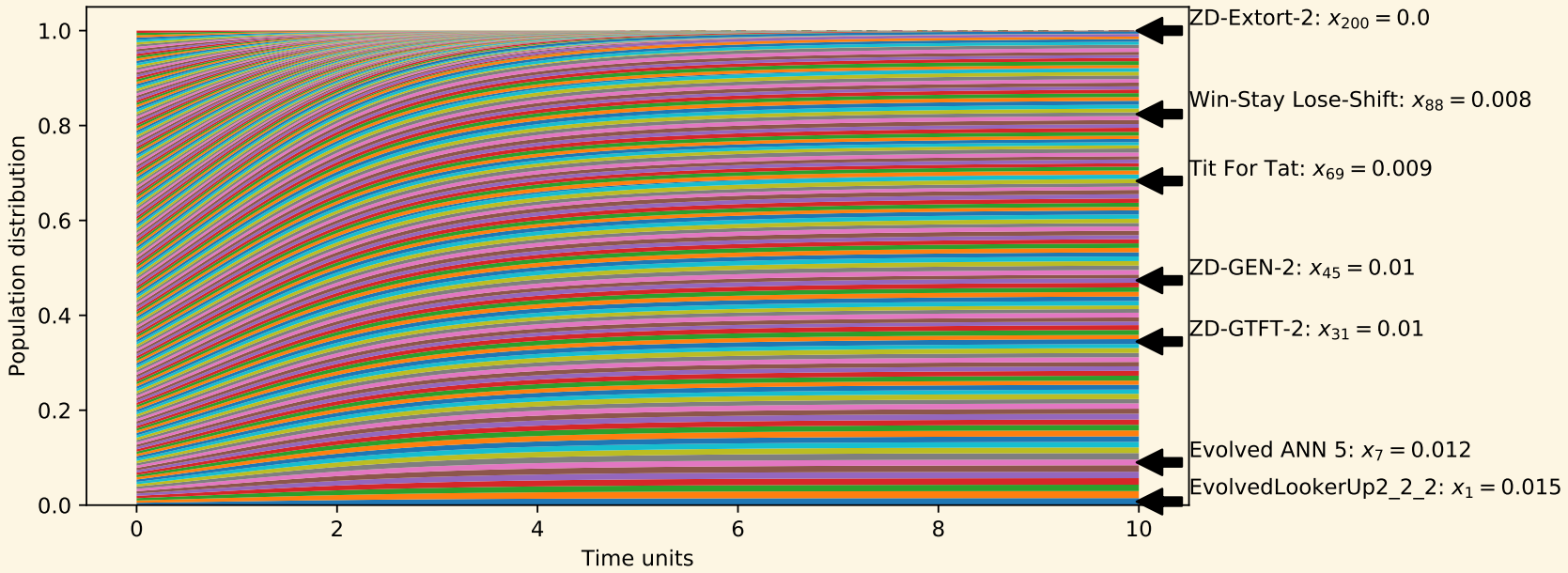
$$Cx = \tilde{p} \tag{9}$$

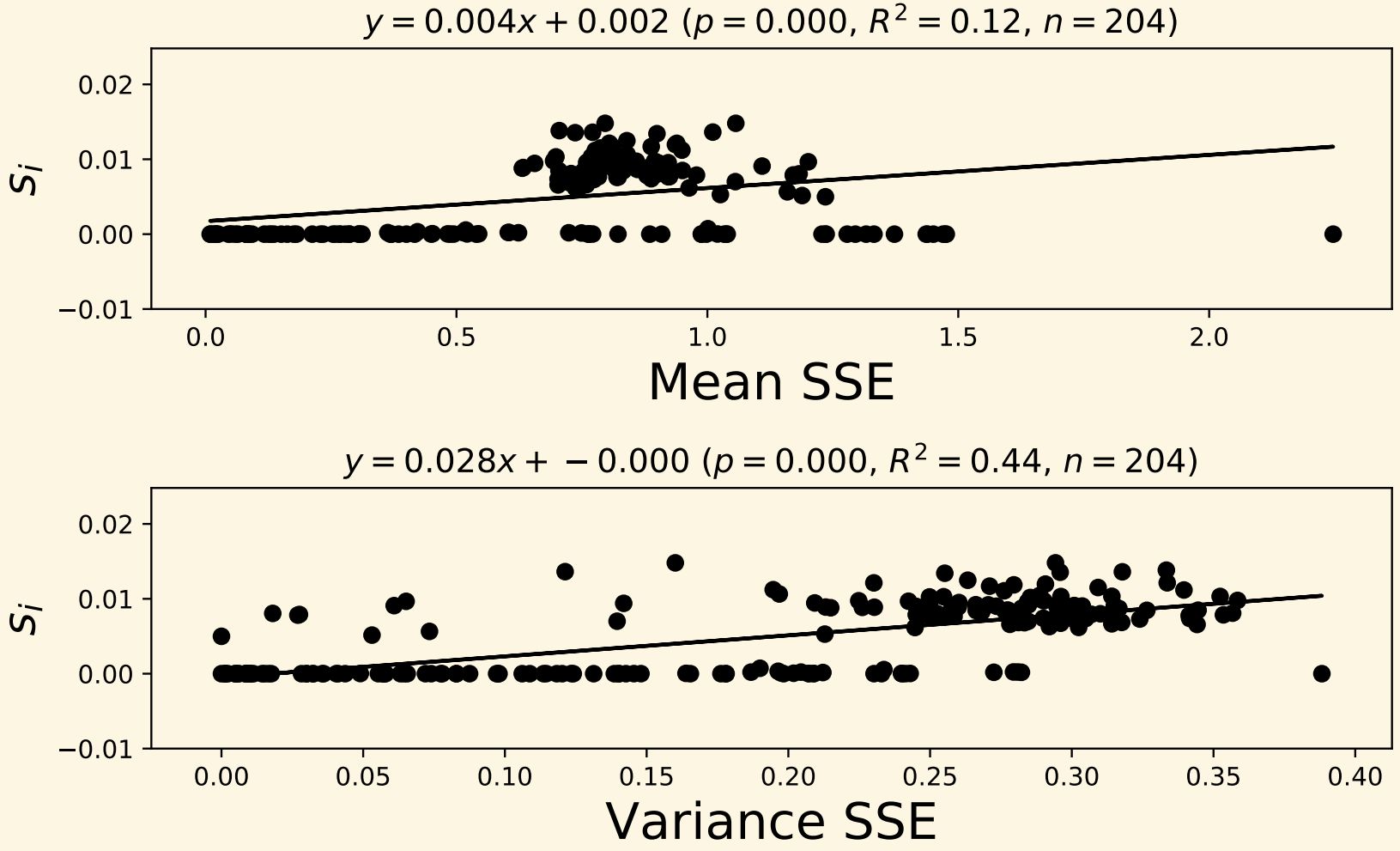
$$C = \begin{bmatrix} R-P & R-P \\ S-P & T-P \\ T-P & S-P \\ 0 & 0 \end{bmatrix} \tag{10}$$

$$x^* = \text{argmin}_{x \in \mathbb{R}^2} \| Cx - p^* \|_2^2 \tag{11}$$

$$\text{SSE} = {p^*}^T p^* - p^* C \left(C^T C \right)^{-1} C^T p^* = {p^*}^T p^* - p^* C x^* \tag{12}$$


SSE
χ
Ranks by Win
Ranks by Score
0
25
50
75
100
125
150
175
200
0.0
0.5
1.0
1.5
2.0
> 1
≤ 1


Population distribution
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
Time units
ZD-Extort-2: $x_{200} = 0.0$
Win-Stay Lose-Shift: $x_{88} = 0.008$
Tit For Tat: $x_{69} = 0.009$
ZD-GEN-2: $x_{45} = 0.01$
ZD-GTFT-2: $x_{31} = 0.01$
Evolved ANN 5: $x_7 = 0.012$
EvolvedLookerUp2_2_2: $x_1 = 0.015$


$y = 0.004x + 0.002$ ($p = 0.000$, $R^2 = 0.12$, $n = 204$)
s_i
0.02
0.01
0.00
−0.01
0.0
0.5
1.0
1.5
2.0
Mean SSE
$y = 0.028x + -0.000$ ($p = 0.000$, $R^2 = 0.44$, $n = 204$)
s_i
0.02
0.01
0.00
−0.01
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Variance SSE

Dep. Variable:	s_i	**R-squared:**	0.667
Model:	OLS	**Adj. R-squared:**	0.662
Method:	Least Squares	**F-statistic:**	133.3
Date:	Mon, 19 Nov 2018	**Prob (F-statistic):**	1.82e-47
Time:	16:09:10	**Log-Likelihood:**	916.43
No. Observations:	204	**AIC:**	-1825.
Df Residuals:	200	**BIC:**	-1812.
Df Model:	3		
Covariance Type:	nonrobust		

	coef	**std err**	**t**	**P>|t|**	**[0.025**	**0.975]**
const	0.0007	0.001	1.351	0.178	-0.000	0.002
('residual', 'mean')	-0.0131	0.001	-9.054	0.000	-0.016	-0.010
('residual', 'median')	0.0136	0.001	11.172	0.000	0.011	0.016
('residual', 'var')	0.0056	0.003	2.163	0.032	0.000	0.011

Omnibus:	13.613	**Durbin-Watson:**	1.697
Prob(Omnibus):	0.001	**Jarque-Bera (JB):**	21.684
Skew:	0.383	**Prob(JB):**	1.96e-05
Kurtosis:	4.401	**Cond. No.**	24.9

"It is not the most intellectual of the species that survives; it is not the strongest that survives; but the species that survives is the one that is able to adapt to and to adjust best to the changing environment in which it finds itself."

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Darwin.

Julie Rymer - @Chadys - (10 May 2017):

> And I really wanted to thank you all, I discovered your project because of a course where we needed to participate in an open source project, and I had the occasion to compare the welcome me and my coworkers received here compared to other people from my class who worked on different project. And I've got to said you are awesome on that part and on the help your provide to newbies I like your project so I'll try to continue to contribute now and then !

- @NikoletaGlyn
- @opcampbell
- marcharper.codes
- Jonathan Gillard

- github.com/Axelrod-Python/Axelrod
- gitter.im/Axelrod-Python/Axelrod
- arxiv.org/abs/1707.06920

@drvinceknight

- vknight.org/gt/

- github.com/drvinceknight/Nashpy