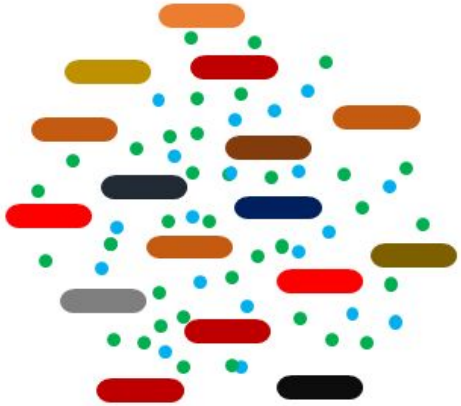
Survival of the Fittest or survival of the Nicest?

With applications in Economics, Biology, Computer Science and Aesthetics!

Governed by “survival of the fittest”, how can cooperation exist?



Common resource

Secrete and share essential nutrients as common goods.

Selective allocation of resources.

Greater overall fitness, as compared to the selfish case.

Population liable to invasion by ‘cheaters’.

The dilemma –
How can stable cooperating populations exist, when cheating or defecting renders an advantage over the ones who cooperate.

Survival Games and Prisoner's Dilemma

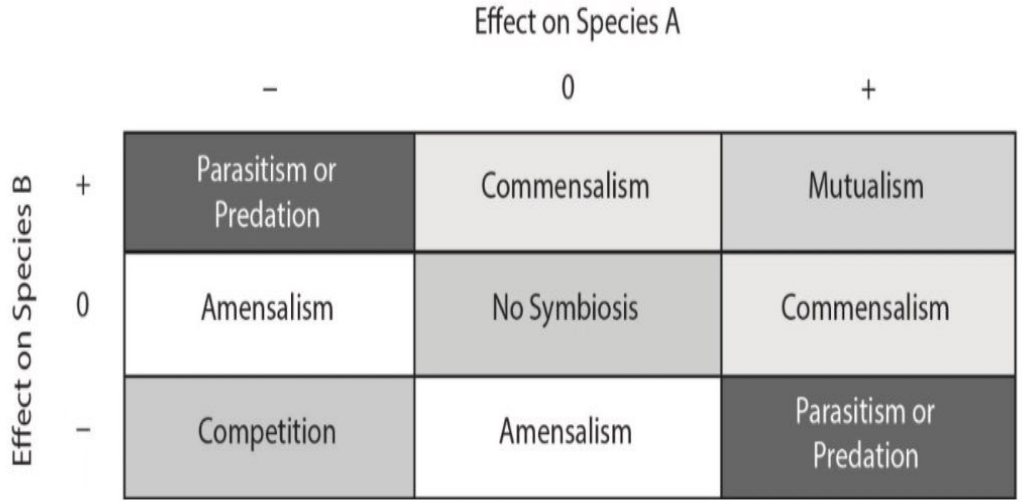
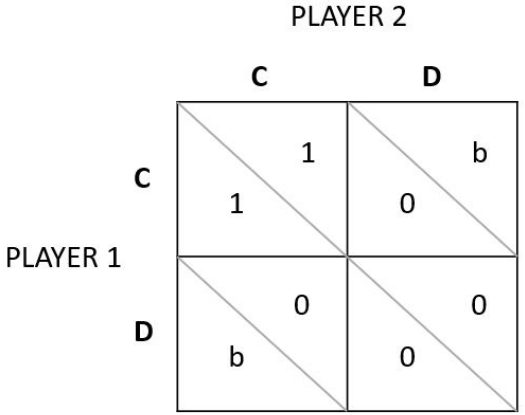


Figure 6.2. Species interactions are categorized based on the effect of two species on each other.

Ref: http://eebweb.arizona.edu/animal_behavior/lycaenids/lycaen2.htm



Payoff Matrix

Model: Games on a 2D square grid

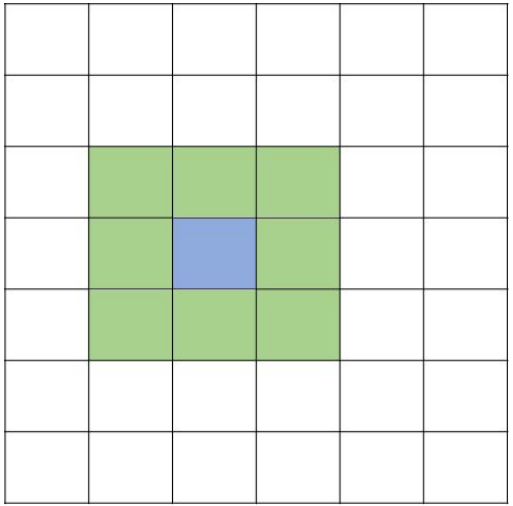
Game played with all neighbours and itself.

Score = normalized sum of payoffs of all games.

$$s_i = \frac{\Sigma P_{ij}}{n_i}$$

At each time step:

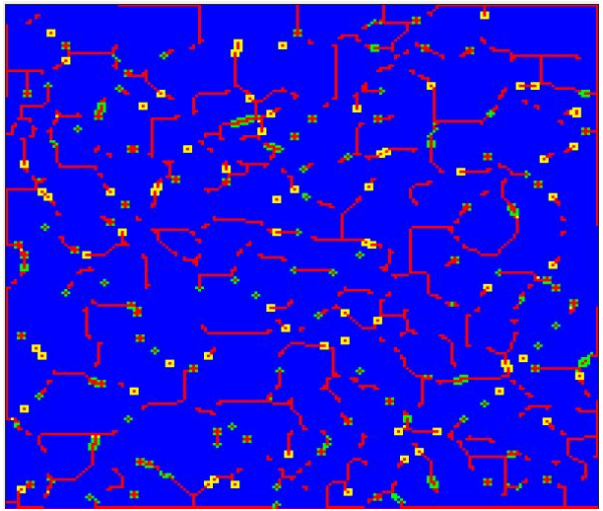
Site occupied by player with highest score among original occupant and neighbours.



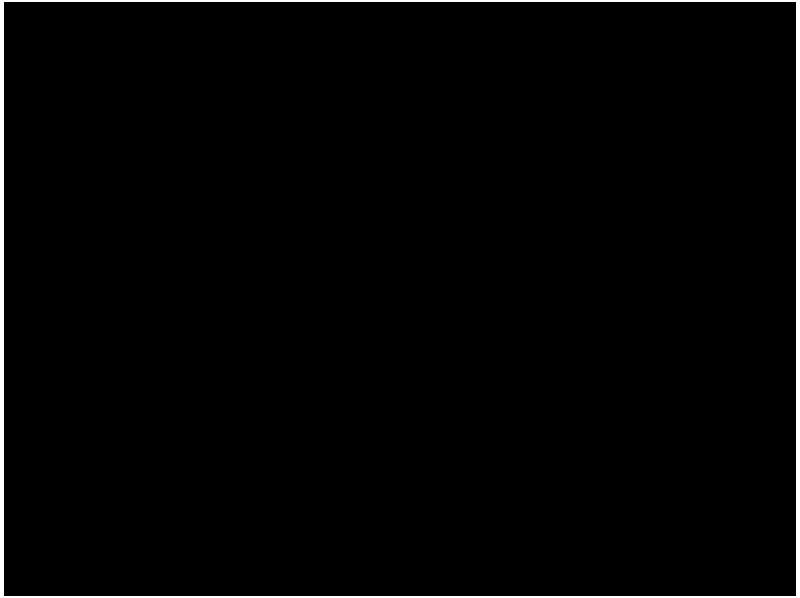
Parameter regime

b < 9/8	Only C
9/8 <b <1.75	D as blinkers
1.75 < b < 1.8	D as lines
1.8 <b < 2	Chaotic
2 < b	Only D

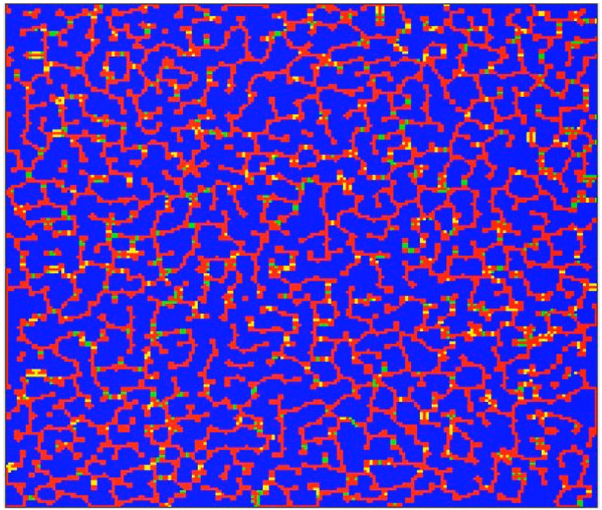
9/8 < b < 1.75



D Blinkers



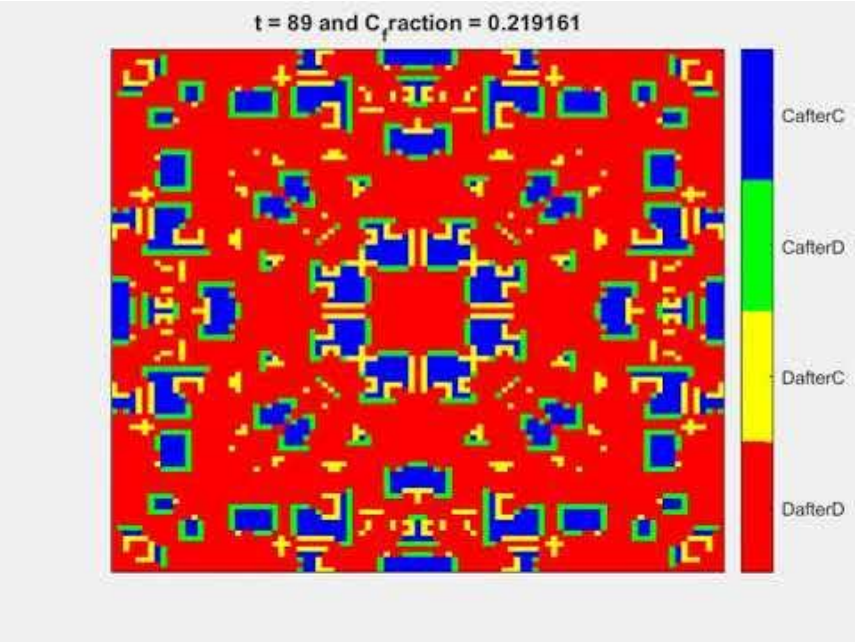
$1.75 < b < 1.8$



D Lines

1.8 < b < 2

Symmetric IC



Chaos

Asymmetric IC

Conclusion

The simple model, with a single varying parameter, enables the population to exhibit a diverse set of long-term behaviours!

Open questions –
How do the results change, when some of the assumptions are relaxed, is an intriguing question?

1. Complex strategies based on memory, predictions, and relatedness.
2. Higher-order games.
3. Non-deterministic selection.