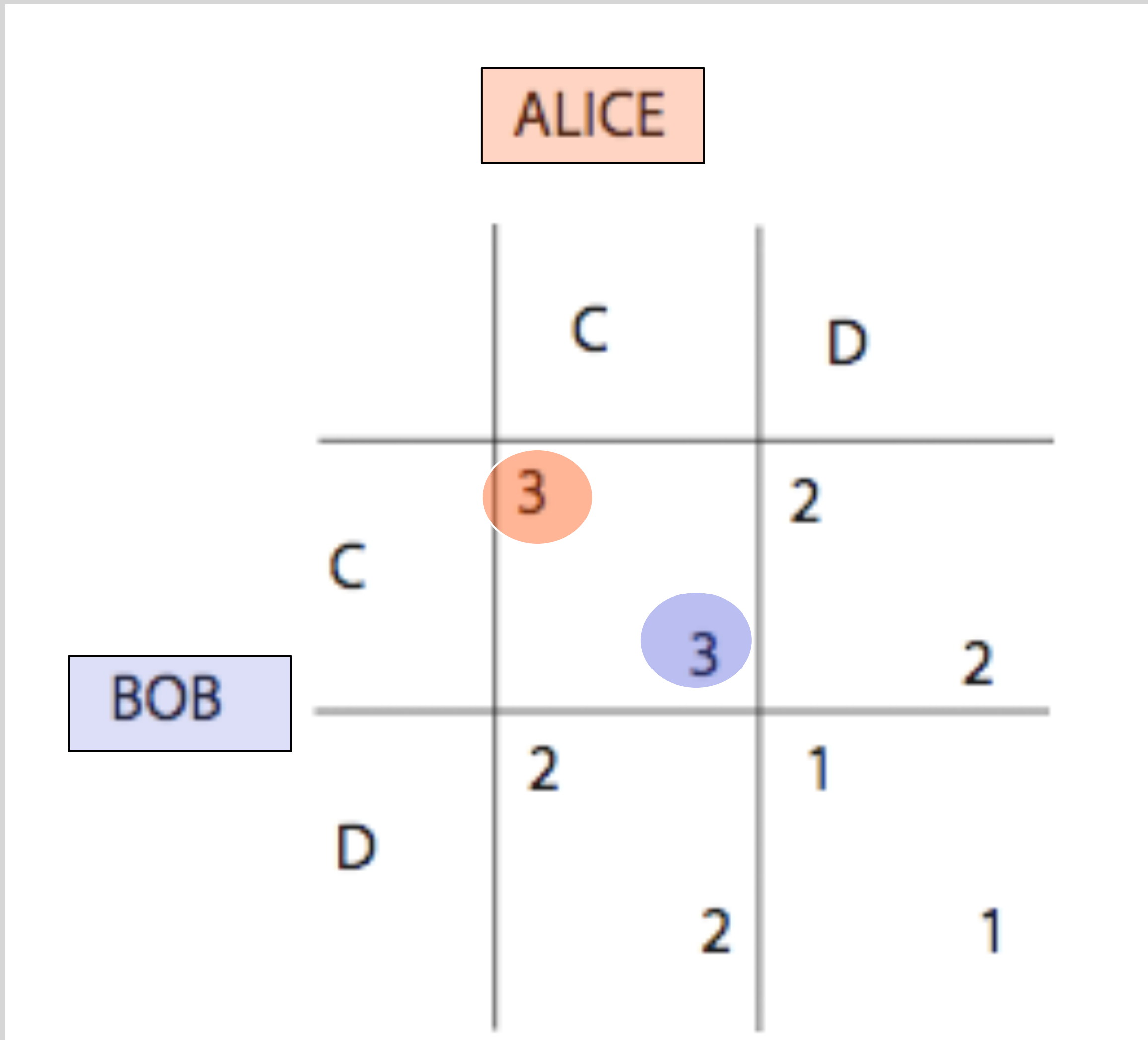
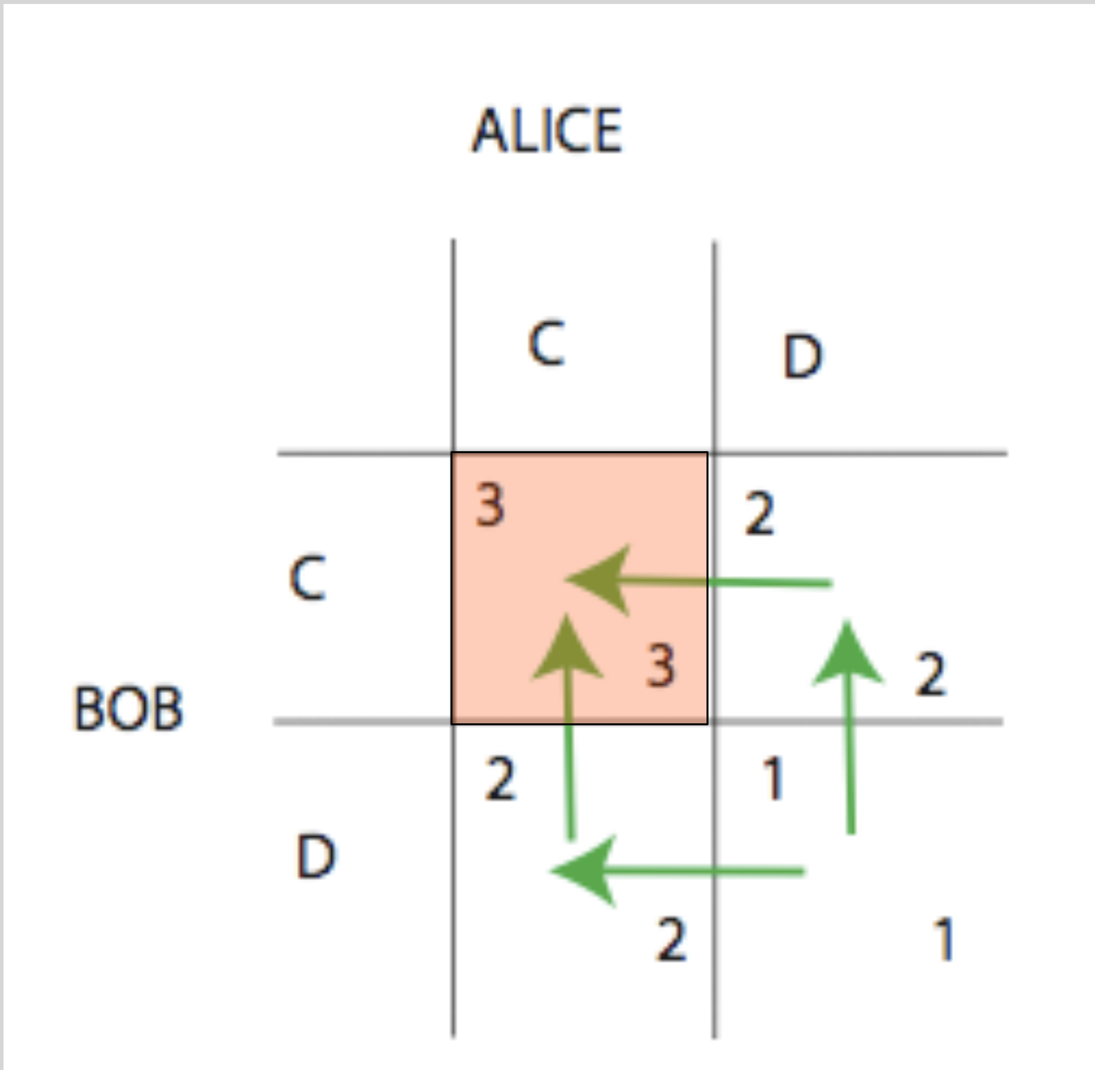
A Simple Game

Alice can pick “cooperate” (C) or “defect” (D)

… so can Bob

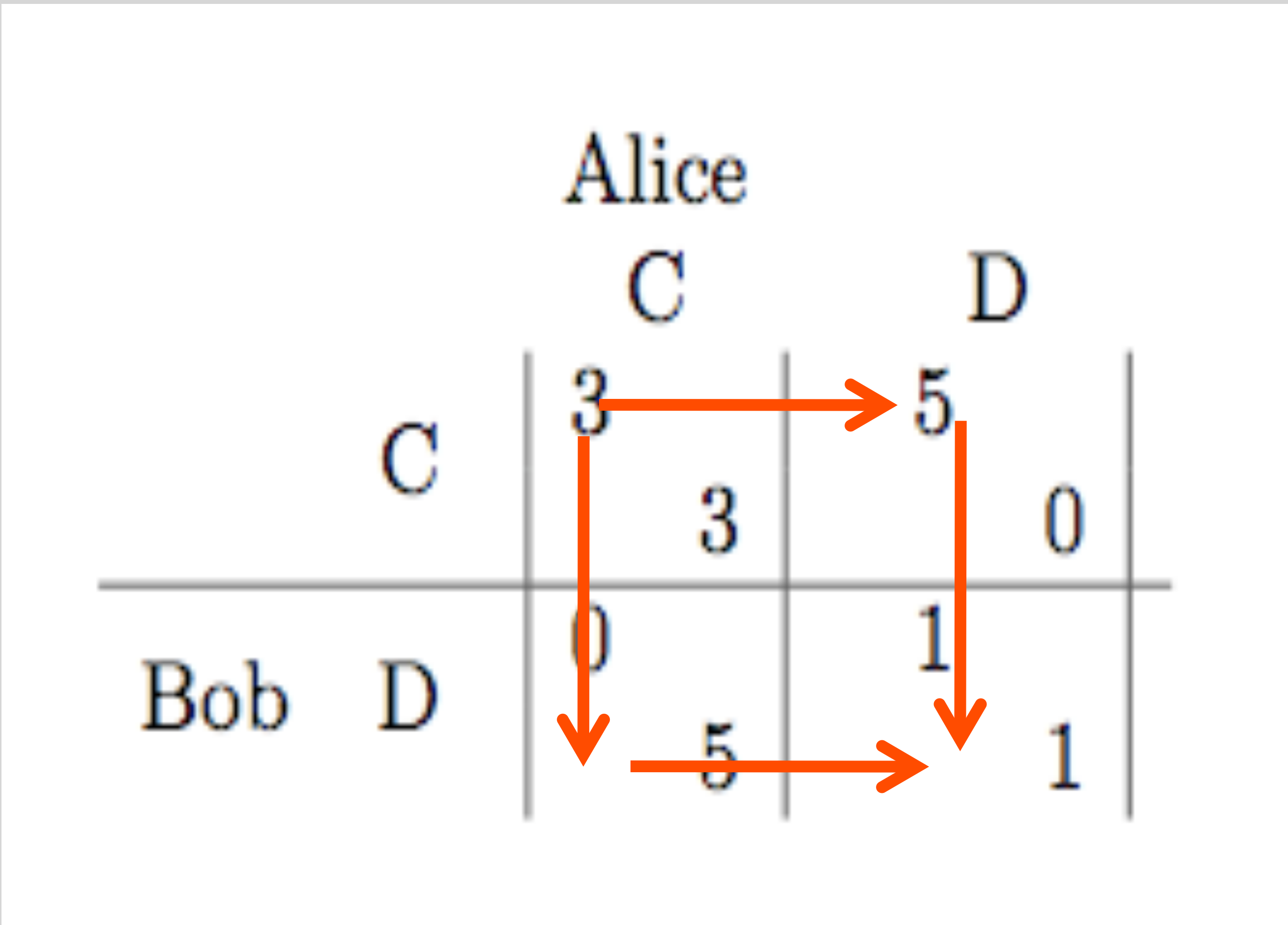


Logic dictates C,C, which is a Nash equilibrium



Prisoner’s dilemma

Reward= years taken off prison sentence



IPD

Previous analyses assume one round of play

Things change if there are ongoing rounds

Scenario A: TFT plays TFT

Scenario B: ALL-D plays TFT

A The cooperator will get

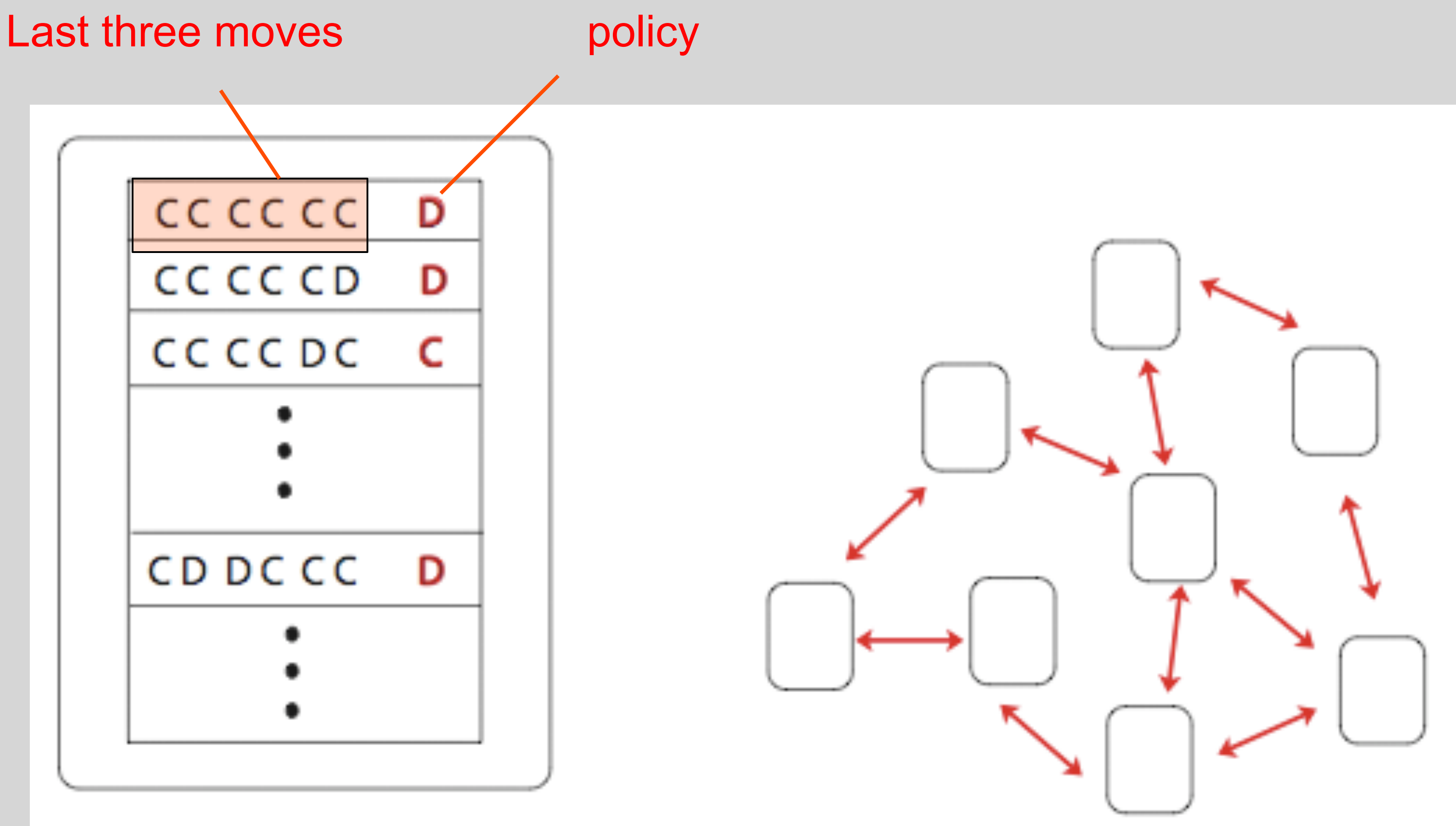
$$3 + 3\gamma + 3\gamma^2 + 3\gamma^3 + \cdots = \frac{3}{1-\gamma}$$

B And the defector will get

$$5 + \gamma + \gamma^2 + \gamma^3 + \cdots = 5 + \frac{\gamma}{1-\gamma}$$

Evolution of Cooperation - Axelrod

A genetic algorithm plays IPD… and wins



Work and Shirk

		Boss	
		Inspect	Don't Inspect
	Work	P-W-I W-E	P-W W-E
Worker	Shirk	-I 0	-W W

Lesson:
Both Boss and Worker should
use probabilistic policies

Hauert: Change the IPD game to allow a third option

N players at a time

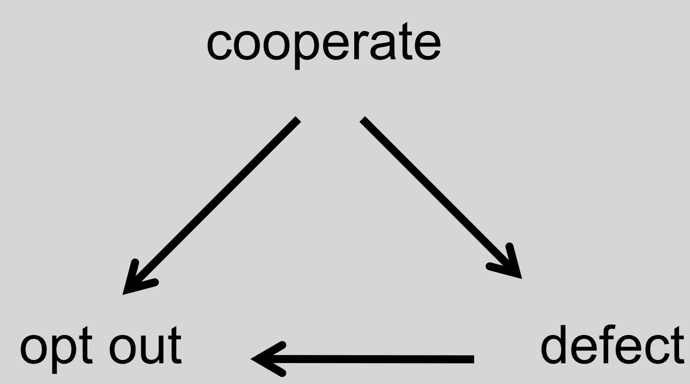
Loners refuse and get a standard payoff $\sigma = 1$

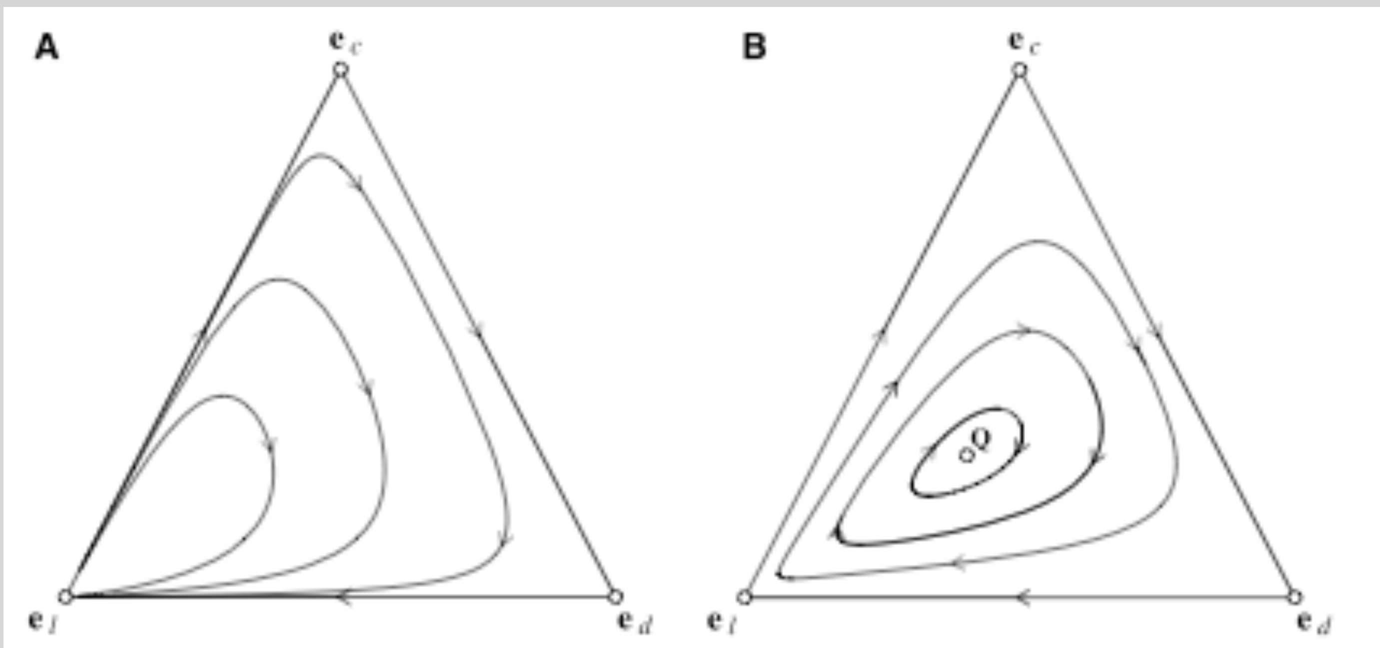
S remaining players consist of n_c *cooperators* and $S-n_c$ *defectors*

If S=1, player has to be a loner

Defectors payoff is: $P_d = r\, n_c/S$

Cooperators payoff is: $P_c = P_d - 1$

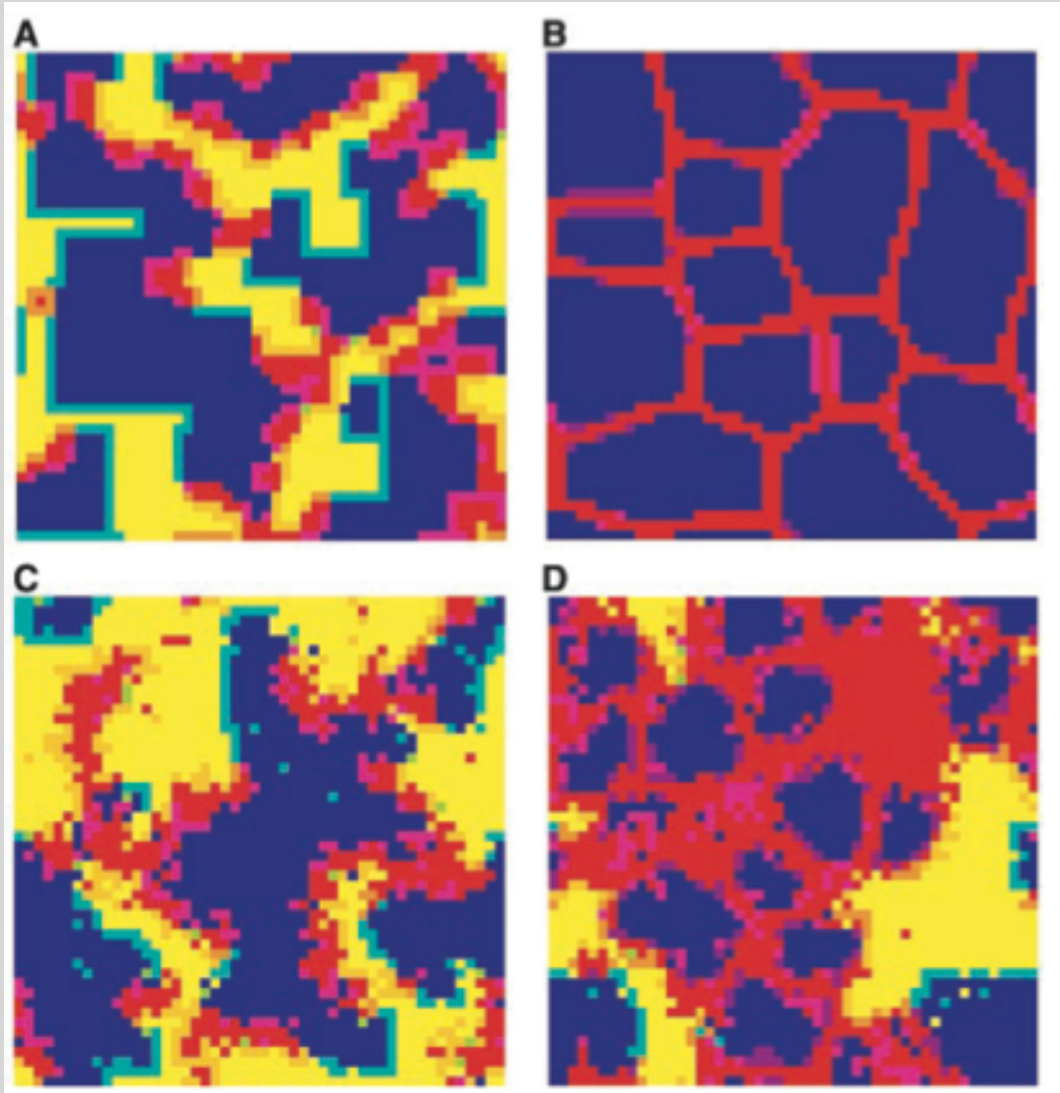




$r < 2$ $r > 2$

Top two panels: adopt the strategy of the best neighbor in 3x3

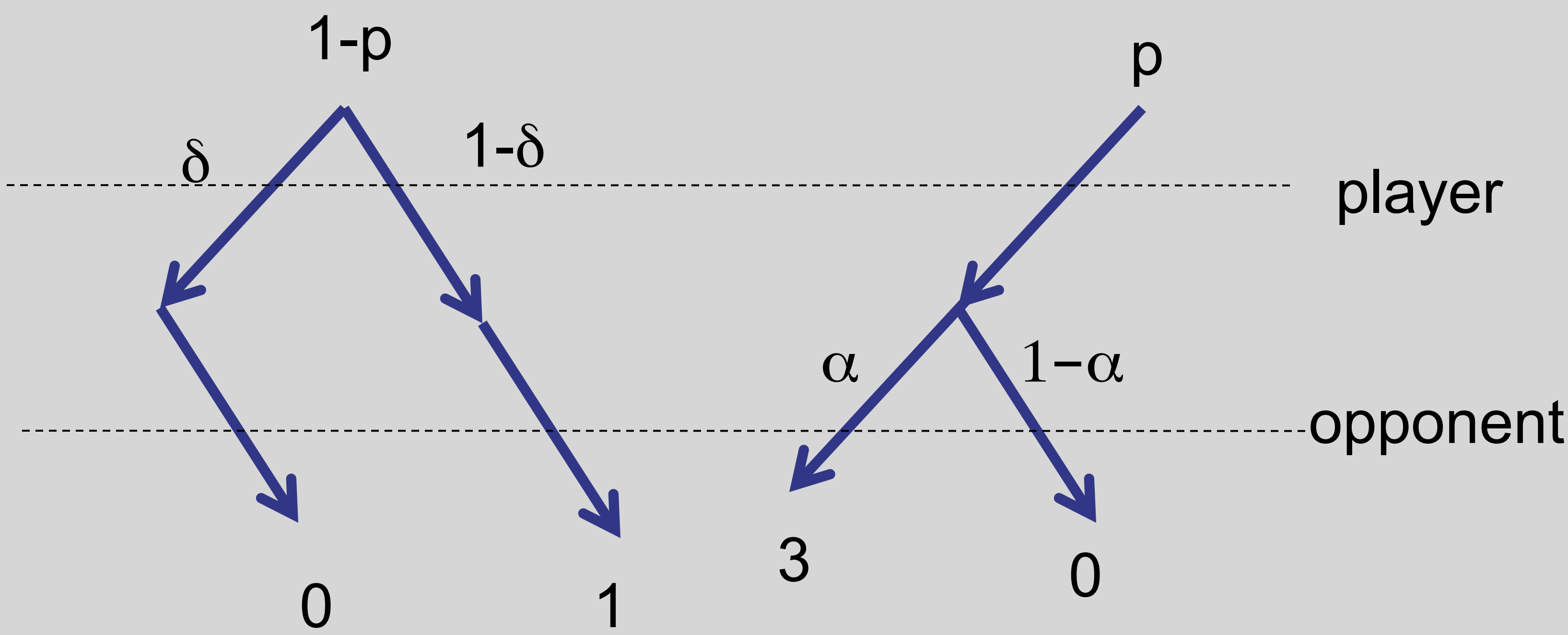
R=2.2



R=3.8

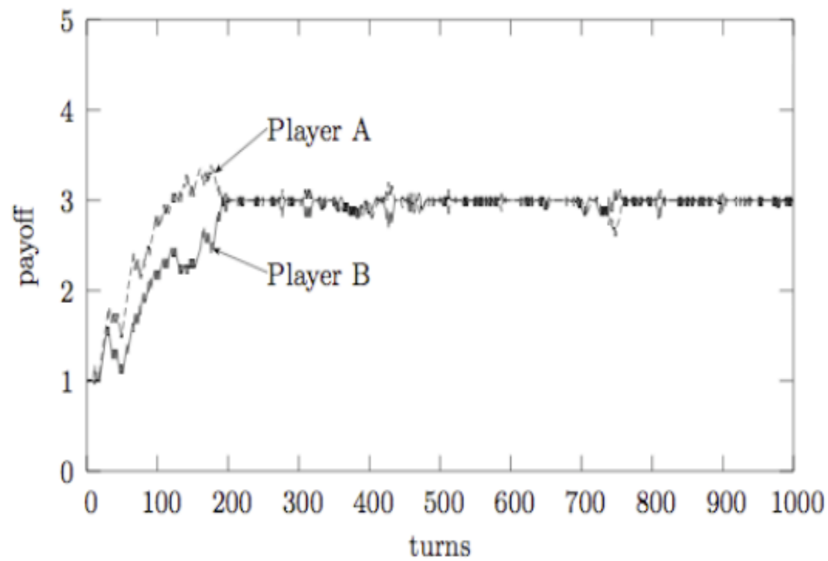
Bottom panels: 80% of sites adopt the strategy of a neighbor w prob. ~ payoff diff.

Another way [Zhu]:
Decide whether to raise the cooperation level in a fractional strategy



$$p = \frac{1}{1 + 3\alpha/(1-\delta)}$$

Opponent is HCE



Opponent is ALL-C