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Computational Logic Group

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Algorithmic Game Theory

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Exercises 9

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Problem 1.
`OneTitForTwoConsecutiveTats` is the following strategy for the repeated Prisoner's Dilemma game: Cooperate in the first stage, and in subsequent stages, defect whenever the other player defected in the two previous stages.

(a) The table below shows what `RandomCooperate(0.4)` might do in a finite repeated Prisoner's Dilemma game with seven stages. Complete the table with the other player's actions and both player's payoffs. Assume that $S = 0$, $P = 1$, $R = 3$, and $T = 5$.

Stage	1	2	3	4	5	6	7	Mean
`RandomCooperate(0.4)`'s Action	D	C	D	D	D	C	C	
`OneTitForTwoConsecutiveTats`'s Action								
`RandomCooperate(0.4)`'s Payoff								
`OneTitForTwoConsecutiveTats`'s Payoff								

(b) Show that in the *random* repeated Prisoner's Dilemma (with continuation probability $0 \leq \delta < 1$), the strategy profile (`OneTitForTwoConsecutiveTats`, `OneTitForTwoConsecutiveTats`) is not a Nash equilibrium.

Problem 2.
Suppose there is a population of beetles that compete with each other for food. We assume that beetles come in two sizes: large and small, where the large beetles are more effective at claiming an above-average share of food when they come upon a food source. This is further illustrated in the following table:

(`Beetle1`, `Beetle2`)	`Small`	`Large`
`Small`	(5, 5)	(1, 8)
`Large`	(8, 1)	(3, 3)

Since the body size of a beetle is not chosen by the beetle itself, it is genetically hard-wired for each beetle to play one of those strategies through its whole lifetime. Thus for simplicity, it suffices to consider pure strategies in this exercise.

Find an evolutionarily stable strategy and one strategy that is not evolutionarily stable. Then, interpret your result.

Problem 3.
The members of a given animal population compete for food, but must also cooperate in order to get it, by hunting in pairs. (They hunt large prey that is impossible to take down for solitary hunters.) Whenever two individuals A1 and A2 hunt together, each single one can choose to be either Passive or Active during that hunt. When both are Passive, neither gets any food. When one is Active and the other is Passive, then cooperation works best (e.g. the Active one drives the prey towards the Passive one lying in wait and they attack together), with the Active animal getting a larger share of the prey. If both are Active, then the cooperation is not as fruitful and both get less (but some) food.

The formalisation is as follows:

(A1, A2)	Passive	Active
Passive	$(0,0)$	$(2,3)$
Active	$(3,2)$	$(1,1)$

Show that this game has an evolutionarily stable strategy.