**Mid-term Exam Corrections**

Dear Pr. Jacob,

This document has been written mainly for educational purposes rather than for “hunting” grades in order to get “A” in Your course. However as my goal is to continue my studies and enroll in PhD it will be irrational from my side to ignore grades. The main reason of my poor performance in the mid-term exam was the lack of time, organization and concentration. I wasted more time on the questions 9,6 than they worth, which led to running out of time and I wasn’t able to dedicate time for the questions 10, 11, and 12. I highly appreciate the given opportunity to get back the lost grades, please kindly find below all the questions that I had missed either partially or totally.

1.) ***Indicate whether each statement is false (i.e., it contains some untruth) or true***

***(otherwise)***

***b. Every normal-form game has at least one Nash equilibrium.***

My error was that I have mistakenly answered that this assumption is false (I imagined that there is the “pure strategy” phrase standing before “Nash equilibrium” :) ). However, there is at least one either mixed or pure strategy Nash equilibrium for every normal-form game.

***d. The Nash bargaining solution is a Pareto optimal solution that maximizes the sum of the players’ payoffs.***

I mistakenly missed this question, as didn’t notice that hadn’t answer to it. Anyway this assumption is wrong because Nash Bargaining solution doesn’t maximize the sum of player’s payoff.

***e. In general-sum games, it is a Nash equilibrium when both players play their maximin strategies.***

My error was that I have mistakenly answered that this assumption is true (I imagined that there is the “best response to each other” phrase instead of “their maximin strategies” :) ). Playing maximin strategy guarantees you to maximize your expected minimum payoff, however the best response to maximin strategy is not necessarily itself.

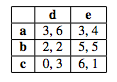
3.) ***What is an agent’s best strategy (with respect to maximizing its own expected payoff) in a one-shot prisoners’ dilemma played against an associate with an unknown strategy? Brieﬂy explain your answer.***

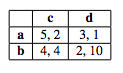
I answered this question correctly, however, because of lack of time, failed to explain my answer. An agent’s best strategy (with respect to maximizing its own expected payoff) in a one-shot prisoners’ dilemma against unknown opponent is to “defect”, as it is strategically dominant, in other words, playing “defect” will assure you higher minimum and maximum expected payoffs than playing “cooperate”.

5.) ***In a repeated prisoners’ dilemma with a discount factor near 1, suppose that the strategy of the ﬁrst agent is to play tit-for-tat, while the strategy of the second agent is to always defect. Is this a Nash equilibrium? Why or why not.***

I answered this question correctly, however, because of lack of time, failed to explain my answer. Anyway, this assumption is wrong because neither TFT nor AD don’t play best response to each other.

10.) ***Consider the following payoff matrix for a two-player normal form game:***



11.) ***For the following repeated matrix game with a high discount factor (near 1)***

a) ***describe a pair of trigger strategies that form a Nash equilibrium of the repeated game in which the row player gets an average payoff (per round) of 3.5 and the column player receives an average payoff (per round) of 6.***

Each player’s trigger strategy is as follows:

*Offer:*  alternate between “a” and “b” (“c” and “d” for the Column player)

*Threat:* play “a” (“d” for the Column player)

b) ***Brieﬂy state why this pair of trigger strategies constitutes a Nash equilibrium.***

Given the Column player strategy, the Row player’s possible options are as follows:

* alternate between “a” and “b” and get an average payoff of 3.5
* play any other strategy, and in the best case get an average payoff of 3

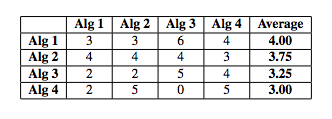
Given the Row player strategy, the Column player’s possible options are as follows:

* alternate between “c” and “d” and get an average payoff of 6
* play any other action, and in the best case get an average payoff of 2

Consequently when both the Column and the Row players play their offers they are giving the best response to each other, which means that this pair of trigger strategies constitutes a Nash Equilibrium.

c) ***Is the average payoff obtained by the agents Pareto optimal?***

12.)  ***The table below shows the results of a round-robin tournament played by four different algorithms. Each cell of the table shows the average payoff of the algorithm listed at the beginning of the row against the algorithm listed at the top of the column in a repeated game. Clearly, Alg 1 is the winner of the round robin tournament. Which algorithm do you think would win an evolutionary tournament run using the replicator dynamic (you don’t need to actually simulate this tournament)? Give reasons for why you think that algorithm would win?***



In order to win in a round robin tournament a strategy needs to gain higher average payoff than all the other strategies, which mainly depends on its performance and how many kingmakers it has among other strategies. Nevertheless, to win an evolutionary tournament a strategy needs to be collectively stable, in other words there doesn’t exist other strategy that performs better against it than it in a self play.

The easiest way to find the collectively stable strategy in the round robin payoff matrix is to draw diagonal, as shown in the figure above, and find a payoff on it that is also the highest in the according column. Alg 4 is collectively stable against other strategies, consequently it will win the evolutionary tournament.