

CS 4365 Artificial Intelligence

Assignment 5: Game Theory

Due: Thursday, Dec 15th

Instructions:

1. Your solution to this assignment must be submitted via eLearning.
2. For the written problems, submit your solution as a **single PDF** file.
 - Only use **blue or black pen** (black is preferred). Scan your PDF using a scanner and upload it. Make sure your final PDF is **legible**. **Regrades due to non-compliance will receive a 30% score penalty.**
 - Verify that both your answers and procedure are **correct, ordered, clean, and self-explanatory** before writing. Please ask yourself the following questions before submitting:
 - Are my answers and procedure legible?
 - Are my answers and procedure in the same order as they were presented in the assignment? Do they follow the specified notation?
 - Are there any corrections or scratched out parts that reflect negatively on my work?
 - Can my work be easily understood by someone else? Did I properly define variables or functions that I am using? Can the different steps of my development of a problem be easily identified, followed, and understood by someone else? Are there any gaps in my development of the problem that need any sort of justification (be it calculations or a written explanation)? Is it clear how I arrived to each and every result in my procedure and final answers? Could someone describe my submission as messy?
3. **You may work individually or in a group of two.** Only one submission should be made per group. If you work in a group, **make sure to indicate both group members when submitting through eLearning.**
4. **IMPORTANT:** As long as you follow these guidelines, your submission should be in good shape; if not, we reserve the right to penalize answers and/or submissions as we see fit.

0.1 Games I (12 points)

A friend of yours offer to play with you the three games below that involve rolling a single 6-sided die:

Game 1: You pay 3 cents and win in the cent amount on the roll

Game 2: You pay 1 cent and win 2 cents if the roll is odd.

Game 3: You pay 2 cents and win 8 cents if the roll is at least a 5.

Which game is the best in terms of expected payoff, and which game is the worst? Explain your reasoning or show your work.

0.2 Games II (15 points)

Imagine two drivers playing chicken, a game where they drive towards one another with their cars. Each driver has three actions: go straight, turn left, or turn right. For simplicity, we standardize directions according to the perspective of an overhead observer. Thus, if both drivers select the same action, they will crash. At the same time, each driver wants to go straight, to seem tough and fearless. Utilities are given by the following table:

Utility	Turn Left	Straight	Turn Right
Turn Left	-20,-20	-5,10	0,0
Straight	10,-5	-10,-10	10,-5
Turn Right	0,0	-5,10	-20,-20

These are in the format (row player, column player).

1. Does either player have a dominating strategy? If so, identify all of them.
2. What are the pure strategy Nash equilibria of this game?

0.3 Games III (23 points)

Imagine two drivers playing chicken, a game where they drive towards one another with their cars. Each driver has two actions: go straight or turn left. For simplicity, we standardize directions according to the perspective of an overhead observer. Thus, if both drivers select the same action, they will crash. At the same time, each driver wants to go straight, to seem tough and fearless. Utilities are given by the following table:

Utility	Turn Left	Straight
Turn Left	-20,-20	-5,10
Straight	10,-5	-10,-10

These are in the format (row player, column player)

- Does either player have a dominating strategy? If so, identify all of them.
- What are the pure strategy Nash equilibria of this game?
- Does the game have any mixed strategy Nash equilibria? If yes, compute all of them.

0.4 Games IV (24 points)

Suppose that there is a two-player, non-zero-sum game. Each of the two players has three pure strategies: Player A has strategy A1, A2 and A3, and Player B has strategies B1, B2 and B3

- (a) (12 pts) Suppose the game is represented by the following matrix:

	B1	B2	B3
A1	40,40	20,60	0,20
A2	60,20	0,0	0,0
A3	20,0	0,0	0,0

- (a) Are there strictly dominating strategy for each of the two players? If so, identify all of them.

- (b) Identify all the pure strategy Nash equilibria of the game.

- (b) (12 pts) Now suppose the game is represented by the following matrix:

	B1	B2	B3
A1	2,1	0,0	2,1
A2	0,0	1,2	1,1
A3	1,1	1,2	1,1

- (a) Are there strictly dominating strategy for each of the two players? If so, identify all of them

- (b) Identify all the pure strategy Nash equilibria of the game.

0.5 Games V (26 points)

Ryan and Anthony were best friends at UTD, but Ryan recently graduated and moved to another state. Wanting to stay connected, Ryan and Anthony both decide to sign up for cell phone service. However, they both have different preferences:

- Ryan travels a lot and likes AT&T above all else for its extensive network.
- Anthony likes Verizon above all else because of its cell tower conveniently placed above the ECS building
- If at least one of them gets T-mobile, the two could talk for free with the T-mobile Fave-5 plan.
- If both of them get AT&T, the two could talk for free with AT&T's in-Network plan.
- If both of them get Verizon, the two could talk for free with Verizon's in-Network plan.
- If they cannot talk for free, they would rather not have cell phone service at all.

- (a) We can encode their preferences as a game matrix. Draw the payoff matrix for the two of them that reflects their preferences. Encode a person's payoff using one of three values: 0, 1, or 2, with 2 corresponding to the most preferred choice and 0 corresponding to the least preferred choice
- (b) Are there any strictly dominating strategies for either of them? If so, which are they?
- (c) Which strategy should they take? Explain your reasoning.