Course **Artificial Intelligence Techniques (IN4010)**
Part *Game Theory*
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Exercise Sheet **Test 5: Game Theory**
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Name, student id .....

Points, grade ..... of 8 points **grade**:

Exercise 1 (Normal Form Game)**.** Two players choose and display one side of a penny (head or tails). Player 1 wins the penny if they both display the same side, player 2 wins otherwise. The *matching pennies* game looks as follows:

		Player B	
		b_1	b_2
Player A	a_1	(2, 2)	(4, 0)
	a_2	(3, 0)	(1, 1)

Which of the following is a Nash equilibrium in pure strategies?

(A) (a_1, b_1)
(B) (a_1, b_2)
(C) (a_2, b_1)
(D) (a_2, b_2)
(E) there are none

Exercise 2 (We continue Example 1)**.** Which of the following is the maxmin strategy of player A in mixed strategies?

(A) $(a_1 : \frac{1}{3}, a_2 : \frac{2}{3})$
(B) $(a_1 : \frac{3}{4}, a_2 : \frac{1}{4})$
(C) $(a_1 : \frac{1}{2}, a_2 : \frac{1}{2})$
(D) $(a_1 : \frac{1}{4}, a_2 : \frac{3}{4})$
(E) none of the above

Exercise 3 (We continue Example 1)**.** Which of the following is a Nash equilibrium in mixed strategies?

(A) $((a_1 : \frac{1}{4}, a_2 : \frac{3}{4}), (b_1 : \frac{3}{4}, b_2 : \frac{1}{4}))$
(B) $((a_1 : \frac{1}{3}, a_2 : \frac{2}{3}), (b_1 : \frac{3}{4}, b_2 : \frac{1}{4}))$
(C) $((a_1 : \frac{1}{2}, a_2 : \frac{1}{2}), (b_1 : \frac{1}{2}, b_2 : \frac{1}{2}))$
(D) $((a_1 : \frac{3}{4}, a_2 : \frac{1}{4}), (b_1 : \frac{1}{3}, b_2 : \frac{2}{3}))$
(E) none of the above

Exercise 4 (Guessing game)**.** There are two agents a and b in separate rooms. Both agents choose a number from the set $\{2, 3, 4\}$, independently from the other agent. If both agents choose the same number, say, x, then both agents get x EUR. However, if the agents chose different numbers, say x, y, then they have to pay x and y EUR respectively.

Which of the following is a pure strategy profiles is *Pareto optimal*?

(A) Both agents choose 2
(B) Both agents choose 3
(C) Both agents choose 4
(D) All strategies in which both agents show different numbers
(E) there are none

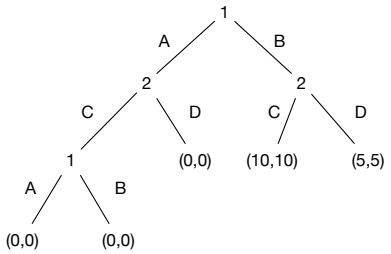
Exercise 5 (We continue Example 4)**.** How many Nash equilibria in pure strategies are there?

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

Exercise 6 (About strategies)**.** Which of the following statements **is wrong**?

A. Every subgame perfect Nash equilibrium is a Nash equilibrium.
B. Every finite extensive form game has a subgame perfect Nash equilibrium.
C. If a subgame perfect Nash equilibrium exists, then it is unique.
D. There are normal form games without a pure Nash equilibrium.
E. There are games in which for a given behavioural strategy there is an outcome equivalent mixed strategy.

Exercise 7 (Extensive form game)**.** Consider the following extensive form game.



Which of the following descriptions represent strategies for each of the players?

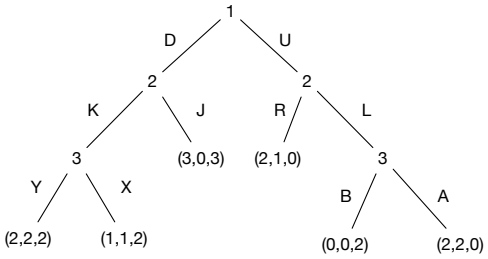
A. Player 1 always plays A. Player 2 plays C everywhere if Player 1 plays A in the initial node; otherwise, Player 2 plays D everywhere.

B. Player 1 always plays A. Player 2 plays C if Player 1 plays A in both of its nodes; otherwise, Player 2 plays always D.

C. Player 1 plays B in the initial node. Player 2 always plays C.

D. In the initial node, Player 1 plays A; in Player 1's node at the bottom, Player 1 plays A if Player 2 plays D. Player 2 always plays D.

Exercise 8 (Subgame perfect Nash equilibrium)**.** Consider the following extensive form game.



Which of the following is a subgame perfect Nash equilibrium? A triple (x, y, z) is supposed to specify the strategy x, y and z for player 1, 2 and 3, respectively.

A. (U, R)

B. (U, R, B)

C. (D, J)

D. $((U, R), B, (K, X))$

E. $(U, (K, R), (X, B))$