

Multiagent Systems

Course code : INFOMAS Date : 9 April 2020 Time : 13:30-16:30

Question 1

Consider the following game with players A and B . The outcome $X \backslash Y$ indicates that the A 's payoff is X and the B 's payoff is Y .

$A \backslash B$	β_1	β_2	β_3
α_1	$5 \backslash 6$	$0 \backslash 8$	$9 \backslash 5$
α_2	$8 \backslash 1$	$7 \backslash 7$	$8 \backslash 4$
α_3	$10 \backslash 10$	$1 \backslash 8$	$10 \backslash 3$

- (a) What are the maxmin (security level) and minmax values for players A and B in this game?
- (b) What are the Pareto efficient outcomes?
- (c) What are the pure and mixed strategy (Nash) equilibria of this game? Provide the calculation of the mixed strategy.
- (d) What is the expected utility of the players for the mixed strategy equilibrium?
- (e) Is the declaration to play β_3 by player B a self-committed utterance? Is it a self-revealing utterance? Motivate your answer.
- (f) Is the declaration to play α_3 by player A a self-committed utterance? Is it a self-revealing utterance? Motivate your answer.

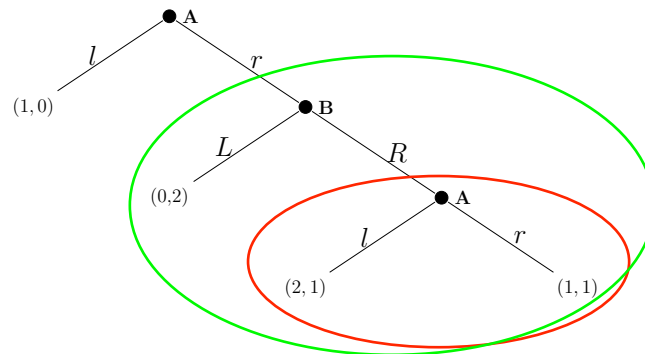
Question 2

Three players go to an all-you-can-eat restaurant. They can go to the restaurant individually or as a group. Because of their age, if they go individually player 1 has to pay €25, player 2 €30, and player 3 €35. The price for a group of two persons is €50 and for a group of three persons is €70.

- (a) Model this scenario as a cooperative game (N, v) where v specifies the payment (not utility).
- (b) Is the core of this game empty? If not, give two outcomes that are in the core.
- (c) Determine the marginal contribution $u_i(S)$ for each player i and each coalitions S . Provide the calculation of the marginal contributions.
- (d) Determine the Shapley value sh_i for each player i . Provide the calculation of the Shapley values.

Question 3

Consider the following extensive game with players A and B . The outcome (X, Y) indicates that the payoff of player A is X and the payoff of player B is Y .



- (a) Enumerate the strategies of players A and B ?
- (b) What are the Nash equilibria of this game?
- (c) What are the dominant strategies of players A and B ?
- (d) What are the subgame-perfect Nash equilibria?

Question 4

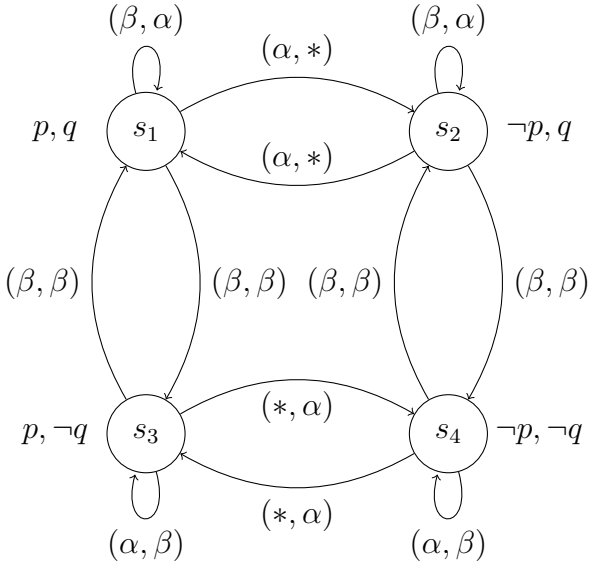
Consider the following voting scenario.

5	3	2	3
a	d	b	c
d	a	a	d
c	b	d	a
b	c	c	b

- Give the winners according to the plurality, majority, Condorcet, and Borda voting systems.
- Which candidate is the winner according to the method of Plurality with Elimination? Explain why.
- Are these preferences single-peaked? If yes, show the order of the candidates.
- Which candidate is the winner of the median voting rule? Explain why.

Question 5

Consider the concurrent game structure M shown below on the left side. Considering the memoryless strategies of the two players, indicate for each statement on the right side whether it is true or false. If a statement is true, give the memoryless strategy of the players.



- $M, s_1 \models \langle\langle\{1\}\rangle\rangle \Box q$
- $M, s_2 \models \langle\langle\{1\}\rangle\rangle X \langle\langle\{1, 2\}\rangle\rangle \Box \neg q$
- $M \models \langle\langle\{2\}\rangle\rangle \Diamond \neg q$
- $M, s_4 \models \langle\langle\{1, 2\}\rangle\rangle X \langle\langle\{2\}\rangle\rangle \Diamond (p \wedge q)$
- $M, s_3 \models \langle\langle\{2\}\rangle\rangle \Diamond (\neg p \vee q)$