

Multiagent Systems

Course code : INFOMAS Date : 15 April 2021 Time : 19:00-22:00

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	$1 \backslash 2$	$3 \backslash 2$	$4 \backslash 4$
α_2	$1 \backslash 4$	$2 \backslash 2$	$1 \backslash 4$
α_3	$3 \backslash 3$	$4 \backslash 1$	$2 \backslash 1$

- (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 for each player in the mixed strategy equilibrium?
- (e) Is the declaration to play α_2 by player A a self-committed utterance? Is it a self-revealing utterance? Motivate your answer.
- (f) Is the declaration to play β_1 by player B a self-committed utterance? Is it a self-revealing utterance? Motivate your answer.

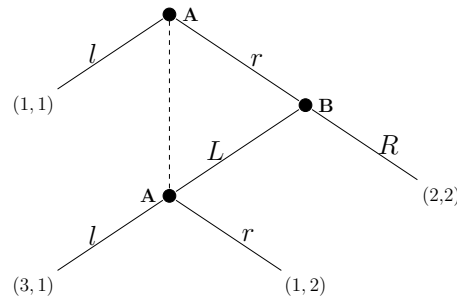
Question 2

There are three parties a , b , and c with respectively 50, 30, and 20 votes. A 65% vote is required to pass a €100 bill. A coalition of parties with a minimum of 65 votes can thus divide the €100 bill.

- (a) Model this scenario as a cooperative game (N, v) .
- (b) Is the core of this game empty? If yes, explain why. If not, give an outcome that is in the core.
- (c) Determine the Shapley value for each party. Provide the calculation of the Shapley values.

Question 3

Consider the following imperfect-information 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) What are the Nash equilibria of this extensive game?
- (b) What are the subgame-perfect Nash equilibria of this extensive game?
- (c) Transform this extensive game to a normal-form strategic game and determine the dominant strategies of players A and B .

Question 4

Consider the following voting scenario.

4	5	2	4
<i>d</i>	<i>c</i>	<i>b</i>	<i>a</i>
<i>a</i>	<i>d</i>	<i>a</i>	<i>d</i>
<i>b</i>	<i>a</i>	<i>d</i>	<i>c</i>
<i>c</i>	<i>b</i>	<i>c</i>	<i>b</i>

- (a) Give the winners according to the plurality, majority, Condorcet, approval and Borda voting systems. For the approval voting assume that each voter gives one vote to his/her first two candidates.
- (b) Which candidate is the winner according to the method of Plurality with Elimination? Explain why.
- (c) Investigate whether different comparison orders of the candidates in this voting scenario result in different winners using the pairwise elimination method.
- (d) Are these preferences single-peaked? If yes, show the order of the candidates.
- (e) Which candidate is the winner of the median voting rule? Explain why.

Question 5

An indivisible object O should be assigned to one of the five rational players a , b , c , d , and e . The true independent private values of these players for O are respectively 210€, 230€, 205€, 235€, and 233€.

- (a) How should these players bid in the Vickrey auction? Who is the winner in this auction and how much should the winner pay?
- (b) What is the Nash equilibrium of the players in the first-price sealed-bid auction?