UNIVERSITY OF SOUTHAMPTON COMP6203W1

SEMESTER 1 EXAMINATION 2019 - 2020

INTELLIGENT AGENTS

DURATION 120 MINS (2 Hours)

This paper contains 7 questions

You must answer a total of FIVE questions as follows:

You must answer all THREE Questions in Section A.

You must answer TWO of the FOUR Questions in Section B.

Each question is worth 20 points

An outline marking scheme is shown in brackets to the right of each question.

University approved calculators MAY be used.

A foreign language dictionary is permitted ONLY IF it is a paper version of a direct Word to Word translation dictionary AND it contains no notes, additions or annotations.

8 page examination paper.

SECTION A - Answer ALL Questions

Question A1.

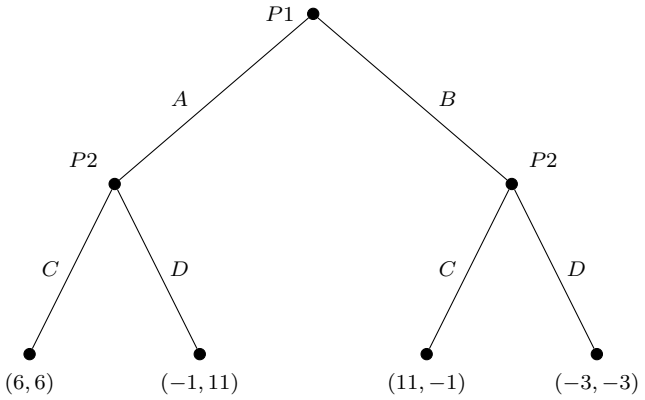
(a) Point out the main differences between auctions and negotiations as approaches for resolving conflicts of interest between agents. [4 marks]

(b) Give and briefly describe 4 notions of fairness in terms of negotiation outcomes. [8 marks]

(c) Explain the ultimatum game and how self-interested, rational agents will behave. Discuss an alternative negotiation protocols which could arguably improve the outcome of the negotiation. Discuss why and in what way this improves the outcome. [8 marks]

Question A2.

Consider the following extensive-form game:



(a) Compute the subgame perfect equilibria.

[3 marks]

(b) Compute the pure strategy Nash equilibria.

[4 marks]

(c) Compute the fully mixed strategy Nash equilibria using the Indifference Principle.

[7 marks]

(d) Compute the fully mixed strategy Nash equilibria using the best response method.

[6 marks]

You must show your computations.

TURN OVER

Question A3.

(a) Give the formal definition of a weighted majority game

[4 marks]

(b) Give the formal definition of the Shapley value and explain the difference compared to the Banzhav index

[7 marks]

(c) Let

$$G = \langle \{P_1, P_2\}, S_1, S_2, u_1, u_2 \rangle$$

be a two-person strategic-form game. If $(s_1, s_2) \in S_1 \times S_2$ is the result of iterated elimination of strictly dominated strategies then (s_1, s_2) is also a Nash equilibrium. Prove or disprove this claim.

[9 marks]

SECTION B - Answer TWO Questions

Question B4.

Consider the following private-value auction setting for a single item. There are 2 agents, A and B, wanting to buy the item being auctioned. Agent A values the item at $v_A = 30$ pounds, and B at $v_B = 50$ pounds. Agents can only place bids in full pounds (e.g. they can bid 25 pounds, but not 25.5 pounds). Ties are broken randomly. For this setting, answer the following questions:

(a) Considering a **first-price** sealed bid auction:

(i) Compute the utility of the agents when both agents bid truthfully.

(ii) Is the resulting outcome envy free? Explain.

(iii) Is bidding truthfully in this setting a Nash equilibrium? If yes, argue why. If not, explain and give a pair of bids which form a pure-strategy Nash equilibrium. Discuss why this is a Nash equi-librium and compute the (expected) utility of the Nash equilibrium for both agents (if applicable).

[10 marks]

(b) Considering a **second-price** sealed bid auction:

(i) Compute the utility of the agents when both agents bid truthfully.

(ii) Is the resulting outcome envy free? Explain.

(iii) Is bidding truthfully in this setting a Nash equilibrium? If yes, argue why. If not, explain and give a pair of bids which form a pure-strategy Nash equilibrium. Discuss why this is a Nash equi-librium and compute the (expected) utility of the Nash equilibrium for both agents (if applicable).

[10 marks]

TURN OVER

Question B5.

Consider the following rank aggregation setting. There are 5 candidates, a, b, c, d and e, and 5 voters with the following preferences:

$$\begin{array}{|l|}\hline a \succ c \succ e \succ d \succ b \\ a \succ d \succ c \succ b \succ e \\ b \succ a \succ e \succ d \succ c \\ b \succ a \succ d \succ e \succ c \\ e \succ b \succ a \succ c \succ d \\ \hline \end{array}$$

(a) Determine the aggregated ranking using Borda count. [8 marks]

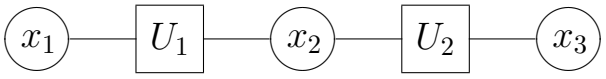
(b) Determine the aggregated ranking using Copeland. [8 marks]

(c) Explain what a Condorcet winner is, and whether Borda and Copeland are Condorcet consistent. Use the setting above to illustrate your answer.

[4 marks]

Question B6.

(a) Consider the constraint graph shown below:



The variables (x_1, x_2 and x_3) may take values $\{\mathrm{Red}, \mathrm{Blue}\}$ and the utility functions (U_1 and U_2) are given as below:

U_1		x_1	
		Red	Blue
x_2	Red	1	2
	Blue	4	6

U_2		x_2	
		Red	Blue
x_3	Red	1	6
	Blue	8	2

Present a worked example that shows how the max-sum algorithm can be used to find the state of the variables that maximises the sum of the utility functions in this constraint graph. In your description denote the message from variable x_n to utility function U_m as $Q_{n\to m}(x_n)$ and that from utility function U_m to variable x_n as $R_{m\to n}(x_n)$, and calculate the value of these messages at each step of the algorithm. Finally, show how the optimal state of the variables is determined, and find the total utility of the system at this optimum.

[12 marks]

(b) Discuss why the max-sum algorithm is not optimal on cyclic graphs, and describe three approaches that attempt to overcome this problem, discussing the advantages and disadvantages of each.

[8 marks]

TURN OVER

Question B7.

(a) Discuss three challenges, with respect to communication and coordination, of agents acting as team members.

[6 marks]

(b) In simple proof dialogues between two agents, one acts as proponent (P) of some thesis or claim, and the other acts as opponent (O). P initiates the dialogue by claiming that some argument is "in", whereas O can question whether an attacking argument is "out".

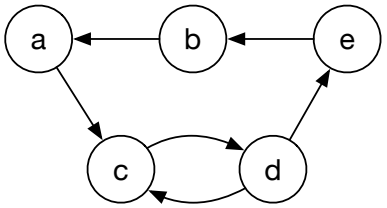
(i) What are the conditions under which O wins the game?

[2 marks]

(ii) What are the conditions under which P wins the game?

[2 marks]

(iii) Consider the Dung Argumentation Framework illustrated in the figure below. Suppose P makes the initial claim "in(c)". Specify all the subsequent moves of a proof dialogue and state whether P or O wins the game.



[8 marks]

(c) Suppose that the preferred extensions of a Dung Argumentation Framework are

$$\{\{a, c, e, f\}, \{a, e, f, h\}, \{a, c, e, i\}\}.$$

Which of these statements are true and which are false:

(i) Argument c is sceptically accepted. [1 mark]

(ii) Both arguments i and f are credulously accepted. [1 mark]

END OF PAPER