UNIVERSITY OF SOUTHAMPTON COMP6207W1

SEMESTER 2 EXAMINATION 2017 - 2018

ADVANCED INTELLIGENT AGENTS

DURATION 120 MINS (2 Hours)

This paper contains 9 questions

Answer **All questions** in section A and **THREE of the FIVE questions** from section B. You are advised to spent no longer than 40 minutes on Section A.

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.

10 page examination paper.

Section A

Question A1.

主导策略，纳什均衡，消除策略

Consider the 2-player game in Table 1:

	L	C	R
U	-2, 3	-1, 2	2, 1
M	1, -1	3, 0	4, -2
D	4, 2	0, -1	3, -2

TABLE 1: 2-player game.

(a) Does either player have a dominant strategy? Why or why not? [2 marks]

(b) Does either player have dominated strategies? If so, eliminate them. [2 marks]

(c) After elimination of dominated strategies, is there any pure Nash equilibrium of the game? If yes, identify all pure Nash equilibria. [3 marks]

(d) Compute the mixed Nash equilibrium in this game. [3 marks]

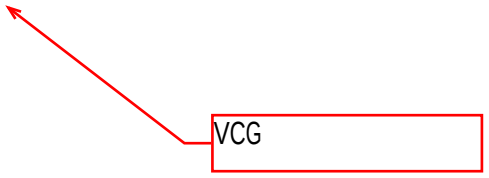
Question A2.

There are three bidders and five items. Find the VCG solution for the following combinatorial auction:

Bidder A wants bundle $\{3, 4, 5\}$ for $\pounds 2$, or $\{1, 3\}$ for $\pounds 5$, or $\{1, 5\}$ for $\pounds 4$, or $\{3, 4\}$ for $\pounds 1$.
Bidder B wants bundle $\{1, 2, 3\}$ for $\pounds 5$, or $\{1, 2\}$ for $\pounds 1$, or $\{2, 3\}$ for $\pounds 2$.
Bidder C wants bundle $\{1, 3, 5\}$ for $\pounds 6$, or $\{1, 3\}$ for $\pounds 1$, or $\{2, 5\}$ for $\pounds 2$, or $\{3, 5\}$ for $\pounds 3$.

(a) Find the optimal allocation in the VCG solution. [3 marks]

(b) Calculate the payment of each bidder. [7 marks]



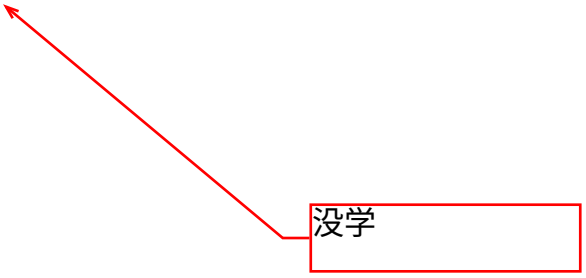
TURN OVER

Question A3.

(a) Explain the exploration vs. exploitation dilemma. [3 marks]

(b) Give the definition of the stochastic multi-armed bandit model. [4 marks]

(c) Why it is good to have a Hannan consistent bandit algorithm? [3 marks]

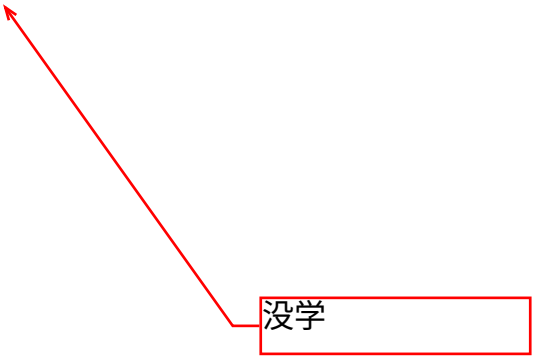


Question A4.

What are the main differences between

(a) multi-armed bandit and duelling bandits models? [5 marks]

(b) epsilon-first and epsilon-greedy? [5 marks]



TURN OVER

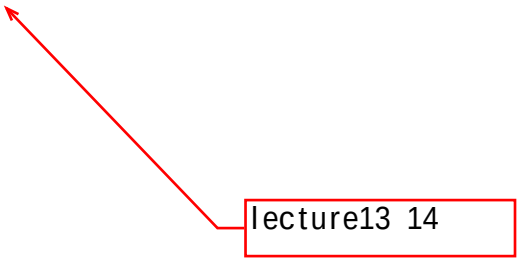
Section B

Question B1.

There are four medical school graduate students and three hospitals. Each of them has a strict preference ordering over the other side.
$g_1 : h_2 > h_1 > h_3$, $g_2 : h_2 > h_3$, $g_3 : h_3 > h_2$, $g_4 : h_1 > h_3 > h_2$;
$h_1 : g_1 > g_3$, $h_2 : g_2 > g_4 > g_1$, $h_3 : g_3 > g_1 > g_4$.
Suppose the hospitals h_1, h_2 and h_3 have quota $q_1 = 1, q_2 = 1$ and $q_3 = 2$, respectively. Answer the following questions and show intermediate steps.

(a) Find the stable matching when graduates propose. [10 marks]

(b) Find the stable matching when hospitals propose. [10 marks]



Question B2.

There are five advertisers who are interested in bidding for the same keyword on a search engine. Their values of the keyword are 8, 7, 5, 3, and 2, respectively. The search engine offers three advertising slots for the keyword; each slot is associated with 40, 30, and 20 clicks, respectively.

(a) Will these advertisers bid truthfully under the GSP mechanism? If yes, prove it; if no, identify one advertiser and show how it can manipulate.

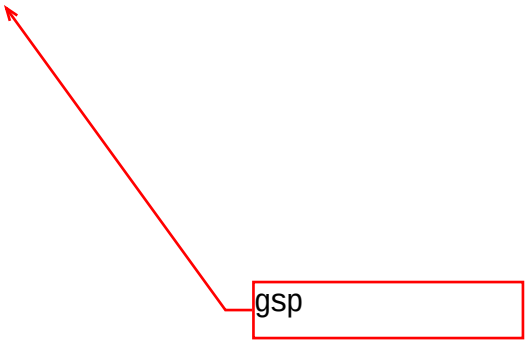
[2 marks]

(b) If the search engine is using the VCG mechanism, what are the allocation and payments?

[8 marks]

(c) If the search engine is using the GSP mechanism and assuming all advertisers truthfully bid in the auction, what are the allocation and payments? [8 marks]

(d) Does the search engine get more revenue in case (b) or case (c)? What if they bid strategically in GSP? Would one mechanism always generate more revenue than the other? [2 marks]

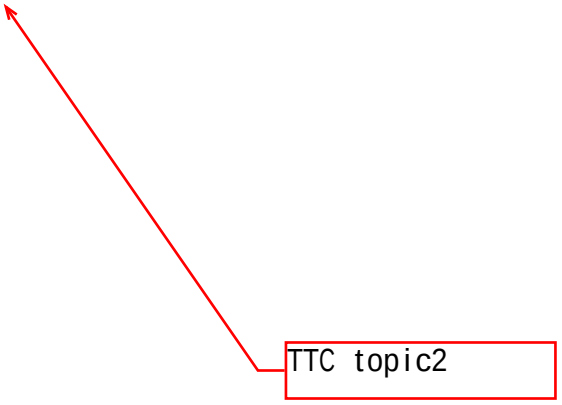


TURN OVER

Question B3.

You need to rent a flat. You have arranged n viewings. After each viewing, you have to either sign the lease agreement or continue to view the next flat. If you do not sign an agreement with the flat you just viewed, the flat will be taken off the market immediately as there is someone who wants to rent it. What is the best strategy that would maximize the probability of renting your favorite flat? Show the calculation steps.

[20 marks]



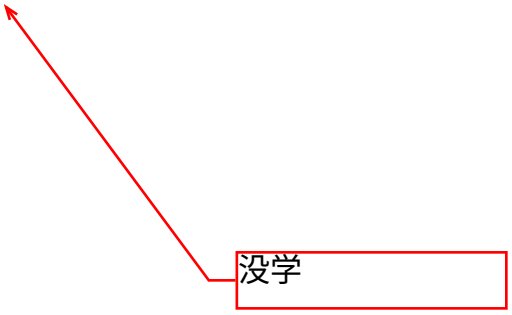
Question B4.

In a prediction market, suppose the market maker is using the Logarithmic market scoring rule with $b = 100$, and there are two possible outcomes Y and N for prediction.

(a) How much is the market maker's loss in the worst case? [5 marks]

(b) Suppose the market is newly open, i.e., 0 share on Y and N. How much does it cost if you want to buy 20 shares on outcome Y? [10 marks]

(c) Suppose there are 100 shares of Y and 50 shares of N in the market, what is the instantaneous price of Y? [5 marks]



TURN OVER

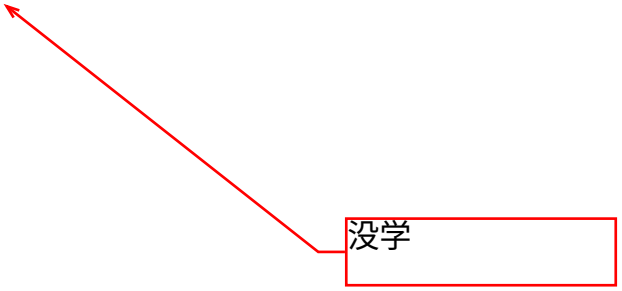
Question B5.

(a) Consider a stochastic multi-armed bandit problem, for which we use an algorithm A to pull the arms. We know that by pulling any arm, we will get a (random) reward from the interval $[0, 1]$ (i.e., the maximal reward value is 1 for any arm at any time). Note that by using A, we can achieve an expected regret of at most $\sqrt{KT}$ where K is the number of arms, and T is the time horizon. If the best arm has an expected reward of 0.8, prove that the probability of the event where the total reward of A is 0 after T rounds is at most $\sqrt{\frac{5K}{4T}}$.

[10 marks]

(b) Consider a 2-armed bandit. When Arm 1 is pulled, it provides a fixed reward of 0, whereas Arm 2 provides a (uniformly randomly distributed) reward between 0.3 and 1. Note that these details are not known for the agent who would like to pull the arms to maximise their total expected rewards. Prove that if the agent uses UCB to pull the arms, then after 120 pulls, it will never pull Arm 1 anymore.

[10 marks]



END OF PAPER