

**NANYANG TECHNOLOGICAL UNIVERSITY**  
**SEMESTER 2 EXAMINATION 2017-2018**  
**CE4046/CZ4046 – INTELLIGENT AGENTS**

Apr/May 2018

Time Allowed: 2 hours

**INSTRUCTIONS**

1. This paper contains 4 questions and comprises 4 pages.
2. Answer **ALL** questions.
3. This is a closed-book examination.
4. All questions carry equal marks.

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1.
    - (a) The statement ‘aren’t agents just expert systems by another name?’ refers to the relationship between agents and expert systems. What is an expert system? And, list TWO main differences between agents and expert systems.  
(7 marks)
    - (b) The five trends in the history of computing have led the emergence of the field of multiagent systems. One of the trends is *intelligence*. Explain with an example what *intelligence* means.  
(4 marks)
    - (c) Utility functions can be used as a method for telling agents what to do without telling them how to do it. Give two types of utility functions and discuss the challenges faced when designing such functions.  
(10 marks)
    - (d) Two most common types of tasks are *achievement tasks* and *maintenance tasks*. Explain what these two types of tasks are.  
(4 marks)

2. You are preparing to go for a bike ride and are trying to decide whether to use your thin road tires or your thicker, knobbier tires. The advantage of the thin road tires is that you can ride much faster. But, you know from previous experience that your thin road tires are more likely to go flat during a ride. There is a 40% chance your thin road tires will go flat but only a 10% chance that the thicker tires will go flat. Because of the risk of a flat tire, you also have to decide whether or not to bring your tools along on the ride (a pump, tire levers and a puncture kit). These tools will weigh you down.

The utilities of different cases are given in Table Q2 below. Using the above, answer the following questions.

**Table Q2**

<b>Which tire to use</b>	<b>Whether tire goes flat</b>	<b>Whether to bring tools</b>	<b>Utility</b>
Thin road tire	Yes	Yes	50
Thicker tire	Yes	Yes	40
Thin road tire	No	Yes	75
Thicker tire	No	Yes	65
Thin road tire	Yes	No	0
Thicker tire	Yes	No	0
Thin road tire	No	No	100
Thicker tire	No	No	75

- (a) What are the three types of nodes in a decision network for this problem? Draw the decision network. (10 marks)
- (b) What is the optimal decision? What is the expected utility of the optimal decision? Show clearly the detailed steps of deriving your answers. (15 marks)
3. (a) USA's Defense Advanced Research Projects Agency recently launched the OFFSET program, which envisions future small-unit infantry forces using swarms comprising upwards of hundreds of small Unmanned Aircraft Systems (UASs) and/or small Unmanned Ground Systems (UGSs) to accomplish diverse military missions in complex urban environments. List and briefly explain a few key ideas in multi-agent systems which can use used to build such a system. (6 marks)

Note: Question No. 3 continues on Page 3

- (b) Assume that you are the leader of a student organization and you need to organize an annual celebration which involving many tasks. Briefly describe how you can use CONTRACT NET to allocate tasks to the members of the organization.  
(6 marks)
- (c) Explain why bidding one's private value (truthful bidding) is a dominant strategy in the second price sealed auction.  
(6 marks)
- (d) We say that Player  $i$  is a dummy in a coalitional game if  $v(\{i\} \cup S) = v(S)$  for every coalition  $S$ . In particular,  $v(\{i\}) = 0$ . Thus, a dummy cannot help (or harm) any coalition. Show that if Player 1 is a dummy and  $(x_1, x_2, \dots, x_n)$  is in the core, then Player 1's payoff  $x_1 = 0$ .  
(7 marks)
4. Consider the two payoff matrices 1 and 2 in Table Q4a and Table Q4b respectively. The first number in each entry is the payoff received by the row player **A**; while the second number is the payoff received by the column player **B**.

Payoff matrix 1:

**Table Q4a**

	<b>B: left</b>	<b>B: right</b>
<b>A: up</b>	(6, 0)	(1, 2)
<b>A: down</b>	(4, 4)	(2, 3)

Payoff matrix 2:

**Table Q4b**

	<b>B: left</b>	<b>B: right</b>
<b>A: up</b>	(2, -2)	(-2, 3)
<b>A: middle</b>	(0, -1)	(2, -1)
<b>A: down</b>	(-1, 2)	(1, -1)

Note: Question No. 4 continues on Page 4

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- (a) Identify the dominant strategies (if any) of each player in these two payoff matrices. Briefly explain your answer.  
(5 marks)
- (b) Identify which strategy pairs (if any) in these two payoff matrices are in Nash equilibrium. Briefly explain your answer.  
(8 marks)
- (c) Identify which outcomes in these two payoff matrices are Pareto optimal. Briefly explain your answer.  
(7 marks)
- (d) Identify which outcomes in these two payoff matrices maximize social welfare. Briefly explain your answer.  
(5 marks)

END OF PAPER







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Please read the following instructions carefully:

- 1. Please do not turn over the question paper until you are told to do so. Disciplinary action may be taken against you if you do so.**
2. You are not allowed to leave the examination hall unless accompanied by an invigilator. You may raise your hand if you need to communicate with the invigilator.
3. Please write your Matriculation Number on the front of the answer book.
4. Please indicate clearly in the answer book (at the appropriate place) if you are continuing the answer to a question elsewhere in the book.