

PAPER CODE NO.
COMP310

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MAY 2005 EXAMINATIONS

Bachelor of Arts : Year 3
Bachelor of Engineering : Year 3
Bachelor of Science : Year 3
Bachelor of Science : Year 4
Master of Engineering : Year 3
Master of Engineering : Year 4
Master of Science : Year 1
No qualification aimed for : Year 1

Multiagent Systems

TIME ALLOWED : 2½ hours

INSTRUCTIONS TO CANDIDATES

This paper contains **five** questions in total. Answer **any four** questions only.

If you attempt to answer more questions than the required number of questions (in any section), the marks awarded for the excess questions will be discarded (starting with your lowest mark).



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Question 1

- a) The concept of an agent is usually defined by listing the properties that agents exhibit. Identify and explain the properties that are associated with intelligent agents.

[10 marks]

- b) Consider the environment $Env_1 = \langle E, e_0, \tau \rangle$ defined as follows:

$$E = \{e_0, e_1, e_2, e_3, e_4, e_5\}$$

$$\tau(e_0 \xrightarrow{\alpha_0}) = \{e_1, e_2\}$$

$$\tau(e_0 \xrightarrow{\alpha_1}) = \{e_3, e_4, e_5\}$$

There are just two agents possible with respect to this environment, which we shall refer to as Ag_1 and Ag_2 :

$$Ag_1(e_0) = \alpha_0$$

$$Ag_2(e_0) = \alpha_1$$

Assume the probabilities of the various runs are as follows:

$$P(e_0 \xrightarrow{\alpha_0} e_1 \mid Ag_1, Env_1) = 0.15$$

$$P(e_0 \xrightarrow{\alpha_0} e_2 \mid Ag_1, Env_1) = 0.85$$

$$P(e_0 \xrightarrow{\alpha_1} e_3 \mid Ag_2, Env_1) = 0.25$$

$$P(e_0 \xrightarrow{\alpha_1} e_4 \mid Ag_2, Env_1) = 0.25$$

$$P(e_0 \xrightarrow{\alpha_1} e_5 \mid Ag_2, Env_1) = 0.5$$

Finally, assume the utility function u_1 is defined as follows:

$$u_1(e_0 \xrightarrow{\alpha_0} e_1) = 1$$

$$u_1(e_0 \xrightarrow{\alpha_0} e_2) = 75$$

$$u_1(e_0 \xrightarrow{\alpha_1} e_3) = 85$$

$$u_1(e_0 \xrightarrow{\alpha_1} e_4) = 3$$

$$u_1(e_0 \xrightarrow{\alpha_1} e_5) = 3$$

Given these definitions, determine the expected utility of the agents Ag_1 and Ag_2 with respect to Env_1 and u_1 , and explain which agent is optimal with respect to Env_1 and u_1 .

[15 marks]



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Question 2

- a) With reference to the way in which they communicate with one another, contrast the concept of an object (in the sense of object-oriented programming) with that of an agent (in the sense of multiagent systems).
[5 marks]
- b) With the aid of an example, explain how decision making is done in a procedural reasoning agent in terms of *deliberation* and *means-ends reasoning*.
[5 marks]
- c) Explain, with the aid of example where appropriate, what you understand by *coordination* and *coherence* in the context of cooperative distributed problem solving systems.
[5 marks]
- d) The CONTRACT NET protocol is one of the most widely used cooperation protocols in multiagent systems. Briefly explain how the protocol works and the main stages of it.
[10 marks]

Question 3

- a) From what you have studied, explain the meaning of the term *agent architecture*.
[5 marks]
- b) Explain the relative advantages and disadvantages of *deliberative*, *reactive*, and *hybrid* agent architectures.
[15 marks]
- c) With the aid of examples, explain the role of the Knowledge Interchange Format (KIF) in agent communication languages.
[5 marks]



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Question 4

Consider the following two payoff matrices for agents i and j :

Payoff matrix A:

		i	
		defect	coop
j	defect	3	4
	coop	0	1
		4	1

Payoff matrix B:

		i	
		dove	hawk
j	dove	3	4
	hawk	1	0
		4	0

With reference to these payoff matrices:

- a) Define the concept of strongly and weakly dominant strategies. With reference to these two payoff matrices, identify which strategies (if any) are strongly dominant and which are weakly dominant.

[10 marks]

- b) Define the concept of Nash equilibrium strategy pair. Explain why the concept of Nash equilibrium strategies is important. Identify with justification which (if any) strategy pairs in these two payoff matrices are in Nash equilibrium.

[10 marks]

- c) Define what it means for an outcome to maximise *social welfare*. Identify with justification which (if any) outcomes in these two payoff matrices maximise social welfare.

[5 marks]



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Question 5

a) A negotiation setting is described in terms of the following components:

- *a negotiation set*
- *a protocol*
- *a set of strategies*

Give a brief description of the above three components.

[15 marks]

b) The two important properties of a negotiation outcome are *individual rationality* and *Pareto optimality*. Define these two terms.

[5 marks]

c) The two main approaches to negotiation are *game-theoretic negotiation* and *logic-based argumentation*. Compare and contrast these two approaches. What are the applications to which you believe these approaches are best suited?

[5 marks]