

THIS PAPER IS NOT TO BE REMOVED FROM THE EXAMINATION HALLS

UNIVERSITY OF LONDON

291 0310 ZB

**BSc Examination**  
for External Students

**COMPUTING AND INFORMATION SYSTEMS AND  
CREATIVE COMPUTING**

**Artificial Intelligence**

**Dateline:** Friday 8 May 2009 : 10.00 – 12 15 pm

**Duration:** 2 hours 15 minutes

There are five questions on this paper. Candidates should answer no more than **FOUR** questions. All questions carry equal marks and full marks can be obtained for complete answers to **FOUR** questions.

Questions involving a description or explanation should, wherever possible, be accompanied by an appropriate example.

Calculators are not allowed.

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Page 1 of 5

- Q1 Throughout this question you are to use the problem of game playing where appropriate as an example to illustrate your answers.
- a) Explain the idea and main concepts involved in search, making sure that you define terms such as *search space*, *goal branching factor*, *informed search*, *space complexity* and *completeness*. [10]
  - b) Explain how the problem of game playing can be expressed as a search problem. [5]
  - c) What are the essential technical requirements for a search algorithm to be useful in solving the game playing problem? [3]
  - d) Using game playing as an example, describe a general algorithm for search. [5]
  - e) What modifications (if any) need to be made to the general search algorithm to make it suitable for game playing in real time? [2]

Q2

- a) In the context of logic, explain the meaning of the terms: *sentence*, *theorem*, *valid*, *soundness*. [4]
- b) Explain how truth tables can be used to prove theorems, illustrating your answer by proving that  $A \Rightarrow \sim B$  is equivalent to  $\sim(A \wedge B)$ . [5]
- c) Explain how semantic tableau can be used to prove theorems. [5]
- d) What criteria would you use to decide whether using a truth table or a semantic tableau is the more appropriate method for a given example? [4]
- e) Using a semantic tableau, show that 'It is evening' follows from 'It is either 19:00 or 20:00 hrs' and '19:00 is in the evening' and '20:00 is in the evening'. [5]
- f) State any assumptions that you made in your answer to e) above. [2]

Q3

- a) Distinguish between progression planners and regression planners. [4]
- b) Sketch an algorithm for progression planning. [6]
- c) Comment on the relative advantages and disadvantages of progression over regression. [4]
- d) Distinguish between linear and non linear plans. [4]
- e) Explain how the STRIPS system would search for a plan that transforms the diagram on the left into that on the right. [7]



Q4 Consider the following grammar:

sentence	→	np vp
np	→	det noun
vp	→	verb
vp	→	verb-trans np
det	→	'a'
det	→	'every'
noun	→	'ship'
noun	→	'captain'
noun	→	'steward'
noun	→	'bow'
noun	→	'wheel'
verb-trans	→	'has'
verb	→	'flies'
verb	→	'sails'

- a) How would one estimate the number of sentences that are defined by the grammar above? [2]
- b) List the types of ambiguity that occur in natural language. [2]
- c) Give one example of each of the following types of sentence defined by the grammar above:
- i) a sentence that is likely to be true
  - ii) a sentence that is almost certainly false
  - iii) an ambiguous sentence, together with two meanings. [3]
- d) Give a parse tree for each of the sentences in i) and ii) above. [2]
- e) Explain the meaning of 'attribute-value' as used when describing grammars. [4]
- f) Show what might be added to the grammar above to make it an attribute-value grammar. [4]
- g) Add semantic annotations to the grammar above to show how semantic annotations can be used to give meaning to sentences. [4]
- h) Give a sentence, its parse tree(s) and semantic analysis to illustrate the occurrence of quantifier scope ambiguity. [4]

Q5 In this question you are required to use the knowledge of AI applications and developments gained whilst completing this course.

- (a) Describe the application or development that you feel is most likely to have the largest impact in the future. Give reasons for your choice. [10]
- (b) Evaluate the development using arguments similar to those of Turing, Searle and their followers. [10]
- (c) Giving reasons and examples from your experience, answer the question: 'Is AI alive and well after almost a decade of the 21<sup>st</sup> century'? [5]

**END OF EXAMINATION**