

PAPER CODE NO.
COMP210

EXAMINER : Dr Simon Parsons
DEPARTMENT : Computer Science Tel. No. 46760



THE UNIVERSITY
of LIVERPOOL

SEPTEMBER 2001 EXAMINATIONS

Bachelor of Arts : Year 2
Bachelor of Science : Year 1
Bachelor of Science : Year 2

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

TIME ALLOWED : Two Hours

INSTRUCTIONS TO CANDIDATES

Section A: Answer all 10 questions.
Section B: Credit will be given for the best 3 answers

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

Section A.

Each question is worth 4 marks.

1. What does it mean for a knowledge representation scheme to have a well-defined syntax and semantics?
2. In the context of propositional logic, what does it mean for a formula to be consistent?
3. What is the role of a knowledge engineer?
4. What is the relationship between an agent and an environment?
5. What is an accessible environment?
6. What is an ontology?
7. What is the difference between directed and undirected search?
8. How does first order logic differ from propositional logic?
9. What is the role of the depth-limit in depth-limited search?
10. What is a frame?

Section B

Answer 3 of the questions below. Each question is worth 20 marks.

1. Here is a simple puzzle: A farmer is trying to cross a river with a dog, a chicken, and a bag of grain. He cannot leave the dog alone with the chicken (because the dog will eat the chicken) and he cannot leave the chicken alone with the grain (because the chicken will eat the grain). He has a rowboat that will carry him and one other item across the river.
 - (a) Writing (d, c, g, b) to denote that there are d dogs, c chickens, g bags of grain, and b boats on the original side of the river, give the initial state of the problem and the goal state of the problem. (4 marks)
 - (b) Give the operations that may be performed during the solution of the problem. (8 marks)
 - (c) Describe how a breadth-first search of the state space would be performed, and draw the state space searched by this search to a depth of 2. (8 marks)

2. (a) What is a rule-based system? (4 marks)
- (b) Describe the architecture of a typical rule-based system (6 marks)
- (c) Explain how forward chaining and backward chaining work in a rule-based system (6 marks)
- (a) Give one advantage and one disadvantage of rules as a method of knowledge representation (4 marks)
3. (a) With reference to propositional logic, formally define the notion of “logical consequence” (6 marks)
- (b) Using a truth table, show that in propositional logic:

$$p \wedge q \vdash p \vee q \quad (6 \text{ marks})$$

- (b) Describe how it is possible to show, in propositional logic, that:

$$p \wedge q \vdash p \vee q$$

by application of the proof rules:

$$\wedge -E \frac{| -f \wedge j}{| -f; | -j}$$

and

$$\vee -I \frac{| -f}{| -f \vee j}$$

(8 marks)

- 4 (a) A robotic agent is to be implemented for a simple “blocks world”. This world contains three blocks and a table-top. The robot will be given various tasks to perform in this world, such as stacking the blocks in certain orders. Suggest a representation for the various actions that such a robot might be able to perform, and show how the actions available to our robot might be represented within this scheme. (10 marks)
- (b) Using these actions write down a plan to create a stack of three blocks, where block A is on block B, block B is on block C, and block C is on the table, from an initial situation in which block C is on block B, block B is on block A and block A is on the table (10 marks)