PAPER CODE NO.	EXAMINER : **Dr. Simon Parsons**
COMP304	DEPARTMENT : Computer Science Tel. No. **46760**

SUMMER 2001 EXAMINATIONS

Bachelor of Arts : Year 3
Bachelor of Engineering : Year 3
Bachelor of Science : Year 3
Master of Science : Year 1

KNOWLEDGE BASED SYSTEMS

TIME ALLOWED : Two Hours and a half

INSTRUCTIONS TO CANDIDATES

Answer 4 out of the 5 questions listed.

Credit will be given for the best 4 answers.

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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 depth-limited search of the state space, with a depth limit of 2, would be performed, and draw the state space searched by this depth limited search. (8 marks)

   (d) How would the search differ if an iterative-deepening search was used? (5 marks)

2. (a) What is an expert system? (6 marks)

   (b) Describe the architecture of a typical expert system. (9 marks)

   (c) What is the control strategy used by the expert system MYCIN? (7 marks)

   (d) Give one general problem with the development and use of expert systems. (3 marks)

3. (a) Give three desirable features of a knowledge representation scheme. (6 marks).

   (b) Draw a semantic network that represents the following statements:

   Chevette is a courier.
   Rydell is a policeman.
   Couriers are a kind of person.
   Policemen are a kind of person.
   Chevette is a friend of Rydell.
   Chevette picked up the sunglasses at the party. (10 marks)

   (c) Using your answer to (b), explain how inference is performed in a semantic network. (4 marks)

   (d) Give an example of a statement that it is hard to represent using a semantic network, and explain why it is hard to represent it. (5 marks).

4. (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:

   $$p \wedge (p \Rightarrow q) \nvdash q$$ (9 marks)

(c) What does it mean for a proof system to be sound with respect to some semantics? (5 marks)

(d) Describe how a proof problem can be formulated as a search problem. (5 marks)

5. (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 pseudo-code, give an algorithm that will take as input a representation of the current state of the blocks world from part (a) of this question, a representation of the actions available to the agent, and a goal state, and gives as output a plan to achieve the goal using the actions, if such a plan exists. (15 marks)