Date: 23rd March 2009   **Time: 14.00 – 17.00 hrs**

Answer **ONLY FIVE** *questions:*
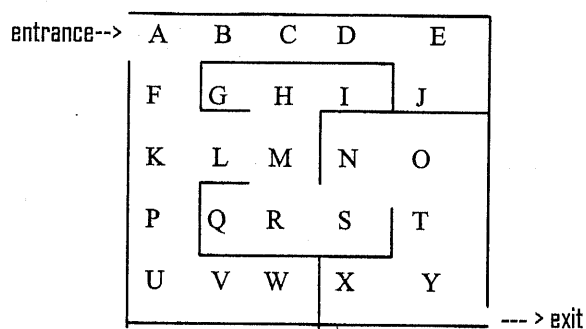
1. (a) What are the tasks of a knowledge engineer?   (4 marks)

    (b) What are the problems of using expert systems?   (3 marks)

    (c) What are the main methods of inference in expert systems? Briefly describe with examples.
                                                                                    (6 marks)

    (d) Describe the various techniques used in knowledge acquisition, and describe why knowledge
        acquisition is difficult and expensive in expert systems.   (7 marks)

2. (a) Translate the following English sentences into Prolog.
                Rice, mango, banana, carrot, bean are food.
                Mango and banana are fruits.
                Colour of rice is white
                Colour of bean and mango are green.
                Dineth likes all kinds of green foods.
                Resandu likes all foods that Dineth likes.
                All humans eat foods.
                Dineth and Resandu are humans.   (8 marks)

    (b) Write goals to extract the following information
                What colour is mango?
                What foods are green?
                What food has the same colour as bean?
                Find two food items that have the same colour.   (8 marks)

    (c) Write a Prolog program to find the summation of elements in an integer list.
            (e.g. sum([3,5,7,8,10],S   should give S = 33)   (4 marks)

3. (a) Semantic networks, Frame based representation and rule based representation are different
        knowledge representation techniques used in expert systems. Identify the appropriate
        representation technique for each of the following real world problem. Justify your answer.
            i.   Student advisory system on course selection at OUSL
            ii. Fault diagnosis in an electrical circuit
            iii. Expert system for a small vegetable shop   (12 marks)

    (b) Briefly explain what a fuzzy inference system is. List the two main types of fuzzy inference
        systems.   (6 marks)

    (c) What are the advantages of using fuzzy systems for business applications?   (2 marks)

4. Consider the Maze drawn below. The problem is to find the route from A to Y.

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entrance-->  A    B    C    D      E
             F   [G    H    I  ]   J
             K    L    M  [ N      O
             P   [Q    R    S  |   T
             U    V    W  [ X      Y
                                      ] --- > exit
```

(a) Define this problem by state space representation. Write the *Initial state, goal state,* and *rules*
                                                                                    (10 marks)

(b) To find the answer which search technique is most effective? Justify your answer.   (04 marks)

(c) Compare and contrast two search techniques used for game playing programs.   (06 marks)

5. Express the following English sentences as first order logic (predicate calculus) statements, using the given notation:

(a) For every problem, there is a solution. **(P(x):** x is a problem; **S(x,y):** x is a solution to y)   (4 marks)

(b) A good actor learns something from every director. **(A(x):** x is an actor; **L(x,y):** x learns from y; **D(x):** x is a director)
                                                                                    (4 marks)

(c) You can fool some of the people all of the time, and all of the people some of the time, but you can't fool all of the people all of the time. (Devise your own notation. Hint: You may consider a "fool" predicate that includes the concept of time)   (8 marks)

(d) Let the following predicates be defined as;
        Favourite_singer(x,y): x is y's favourite singer
        Song(x,y): x is a song sung by y

Assuming above predicates, write the following expression in simple English.   (4 marks)
        = (∀x) (∃y) (Favourite_singer(x, y) ∧ (∀z) Song(z, x): -> song_like(y,z)

Hint: Prolog clause *P(X) :- Q (X,Y)* is equivalent to the logical expression *∀x : ∃y : Q (x,y) -> P(x)*
∀x – for all, ∃y - there exists, ∨ - or, ∧ - and, → - material implication

6. Consider the following information:
   - (i) All animals can outrun any animal they eat.
   - (ii) All Carnivores eat other animals.
   - (iii) Outrunning is transitive: If x can outrun y and y can outrun z, then x can outrun z.
   - (iv) Tigers eat zebras.
   - (v) Zebras can outrun dogs.
   - (vi) Dogs are carnivores.

   (a) Write each sentence given above in first-order logic (FOL). · (6 marks)

   (b) Convert each FOL sentence into one or more sentences in normal form (clausal form).
   (6 marks)

   (c) Use resolution refutation to show that there is at least one animal that tigers can outrun.
   (8 marks)

7. (a). What is the difference between an agent function and an agent program with respect to AI?
   (2 marks)

   (b). (i) Identify an application (which is relevant to Sri Lanka) where agent technology can be used.
   (3 marks)
   (ii) Explain the following terms in the context of agents with examples taken from the above application.

autonomy	learning
collaboration	intelligence

   (12 marks)

   (c) Briefly describe 3 ways that communication is done among agents. (3 marks)

8. (a) Compare and contrast expert systems and neural networks in terms of knowledge representation, knowledge acquisition and explanation ability.
   (6 marks)

   (b) Delta rule and Hebb's rule represent 2 different methods of learning. List the features that distinguish these 2 rules from each other.
   (6 marks)

   (c) Explain why diversity is important when using genetic algorithms to solve problems. (2 marks)

   (d) Assume that after training an Artificial Neural Network, you find that it does not do data classification (or give output) as expected. List 3 reasons why it should happen so. (6 marks)