DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
MAJOR - Artificial Intelligence

Max. Time: 2 hrs. **Max. Marks: 80** **Date: 7 / May / 07**

Q.1 (7, 4, 3, 2, 2)

a. The **Tower of Hanoi** puzzle consists of three pegs, and a number of disks of different sizes which can slide onto any peg. The puzzle starts with the disks neatly stacked in order of size on one peg, smallest at the top, thus making a conical shape. The objective of the game is to move the entire stack to another peg, obeying the following rules:
   - Only one disk may be moved at a time.
   - Each move consists of taking the upper disk from one of the pegs and sliding it onto another peg, on top of the other disks that may already be present on that peg.
   - No disk may be placed on top of a smaller disk.

Consider three discs Tower of Hanoi puzzle. Let the operators that describe actions be given by move(D, P, Q) (move disk D from peg P to peg Q), where D can be any of three discs D1, D2 or D3 and P & Q can be any pair of distinct pegs A, B or C. Here size(D1) > size(d2) > size(D3). (2+4+1)

   i. Define state descriptions for this puzzle. Identify the start and goal state.
   ii. Draw complete search space containing all possible states of the puzzle. Label the arcs by appropriate operators.
   iii. Propose an admissible h function for this problem that is better than h=0

a. Consider a state space where start state is numbered as 1 and the successor function for state numbered as 'n' returns two states numbered as 3n and 3n-1. Suppose the goal state is 24. List the order in which nodes will be visited using following searches. Draw search trees in each case. (2+2)
   i. Depth First search
   ii. Iterative deepening search.

b. Suppose that you are using alpha-beta pruning to determine the value of a move in a game tree and that you have decided that a particular node, n and its children can be pruned. If the game tree is in fact a graph and there is another path to the node n, are you still justified in pruning this node? Either you prove that you are or construct an example that shows that you can not. (3)

c. When do we call a heuristic function to be monotone? Can we guarantee an optimal solution, if A* search algorithm uses monotonic heuristic function? (2)

d. Differentiate two situations in A* algorithm for graph/tree, one when SUCC $\in$ open list and other when SUCC $\in$ closed list. (2)

Q.2 (3, 2, 3, 4, 4, 4)

a. Find an interpretation over D={1,2} which does not satisfy the following FOPL formula: (3)
   $[\forall x \forall y P(x, x) \rightarrow P(x, y)] \rightarrow \exists y \ \forall x P(y, x)$

b. Give an example where interaction between subgoals may find optimal path using AO* algorithm. (2)

c. Take the following statement as true from the definition of God: (3)
   'God saves those who can't save themselves'
   Write this as a prolog rule whose left and right side both refer to "**saves**" predicate of two arguments. Suppose the person saved is God. Show the bindings in the rule and explain what the rule becomes in this case. Does this prove that God doesn't exist? Why?

d. Express the following English sentences in predicate logic. Convert these statements to clauses. (4)
   1. All those who honor both their parents are blessed
   2. If anyone dislikes any of his siblings, one does not honor ones parents.
   3. John likes his sister Mary
   Conclude that John is blessed using resolution refutation.

e. Write Prolog program to implement 'login' module. It should interactively ask user its user name and password. If information is correct then display "successful login" otherwise give fixed number of chances.

f. The enterprise is a ship that was at 15N2E at 12 noon on feb.16,07 and its color is grey and its captain is Jack.
   i. Represent above information using 5 predicates namely location, time, date, color and captain each having two arguments.
   ii. Draw semantic net to represent above information.

Q3. (4, 2, 2, 4, 4, 4)

a. Consider the following way of computing cumulative probability in an expert systems. Cumulative probability is defined as the fraction of contributing probabilities that are greater than 0.5. (e.g. Cumulative probability for contributing probabilities 0.3, 0.9, 0.66, 0.2 and 0.8 would be 0.6). Define prolog program "cumulative(PL, C) that computes the cumulative probability C of probabilities given in a list PL. (4)

b. What are incomplete data structures in Prolog? How are they useful in list operations? (2)

c. Can negation as failure generate solutions? Support your answer through example. (2)

d. Two car engines are being compared in terms of various features (which have been listed). It is required to find out if the features are identical. Write a Prolog program to do this. (4)

e. Consider the following rules with probabilities as arguments. (4)

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rule(P) :- fact1(P1), P = P1 * 0.6.
rule(P) :- fact2(P).
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Suppose fact1 is known to be absolutely certain and fact2 is 80% certain. What is the cumulative probability of 'rule' using the independence assumption?

f. Suppose a doctor knows that the disease meningitis causes the patient to have stiff neck, say 50% of the time. The doctor also knows: the prior probability that a patient has meningitis is 1/50,000 and that any patient has a stiff neck is 1/20. What is the probability of a patient having a stiff neck to have meningitis?(4)

Q4. (4, 3, 2, 2, 2)

a. While solving the following block world problem, system learns the plan and stores it as micro operator. (4)

C D	A D
B A	B C
Start state	Goal state

Apply this plan (micro operator) to solve the following problem.

F E D	F A D
A C B	E C B
Start state	Goal state

b. Let S and T be two fuzzy sets of YOUNG and TALL people respectively. Define membership functions for both. If member grade of JOHN being Young is 0.85 and being tall is 0.9, then what is the member grade of JOHN being young and tall? (1+1+1)

c. If it is given that in the future it will not be the case that P was not true in the past, then can we infer that P is true now? Justify your example. (2)

d. Give an example of non monotonic reasoning you have experienced at some time. How is it implemented? (2)

e. Explain Inductive learning and why we still use it even though it is not a 'valid' form of learning. (2)

Q5. (3, 2, 2, 2)

a. Suggest how can you implement learning module using CBR for bidding agent in auction process. Take some real life example and show all the processes involved in such learning. (3)

b. Compare Dynamic Memory and Category & Exemplar models in the context of CBR (2)

c. What are the key challenges of reactive agents? (2)

d. Identify which logical operator can be generated using the following FFNN. Construct truth table for this network. (2)