B. E. COMPUTER SCIENCE AND ENGINEERING 3rd YEAR 2nd SEMESTER EXAMINATION, 2024

ARTIFICIAL INTELLIGENCE

Time : 3 Hours   **Total Marks 100**

Q1: Answer either (a) or (b) [CO1]
Answer any two from Q2, Q3 and Q4 [CO2]
Answer any one from Q5 and Q6 [CO3]
Q7: Answer either (a) or (b) [CO4]
Q8 is compulsory [CO5]

Answer different parts of the same Question together.

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1. (a) Discuss on primary aim and secondary aim of Artificial Intelligence (AI).   5

   What is Eliza? What type of AI approaches were followed in Eliza? Why was it not so successful?   5

   (b) Discuss on AI systems that act rationally.   5

   What is the future of AI? Will AI replace human? Discuss.   5

2. (a) Draw the differences between utility based agent and learning agent. Indicate the points of differences.   5

   (b) Discuss elaborately on "Formulate-Search-Execute" steps of any search process.   5

   (c) Are optimality and time complexity related? Discuss.   5

   (d) "The minimum space complexity of a search algorithm is linear in nature" – Justify with reasoning.   5

   (e) "Island driven search could be viewed as an extension of Bi-directional search"- Justify this considering problem formulation, time complexity and space complexity aspects.   5

3. (a) Compare BFS, DFS and IDS with respect to computation time requirement (find out the ratio).   5

   (b) It would have been said that "Iterative Deepening" search should have a higher asymptotic time complexity than "Breadth First Search" because every time the depth bound is increased, it must start its search from scratch. However, this is not true, why?   5

(c) Consider the maze shown in Fig. 1. S is the initial state and G is the goal state. Shaded squares are blocked cells.

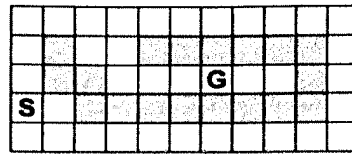

Fig. 1

(i) Consider that the same state will be visited only once. The next state is expanded in the following fixed order: North, West, South, East. Draw the search tree using BFS. Represent each node using its (x,y) coordinates. Number the nodes in the order visited by BFS.   6

(ii) In this part of the question also, you consider that the same state will be visited only once and the next state is expanded in the following fixed order: North, West, South, East. Now assume that each move has an associated cost--- North has cost 2 and all other moves have cost 1. What is the order in which nodes are visited using UCS?   4

(iii) With Manhattan distance as heuristic, write down the order of nodes to be visited by A*. 5

4. (a) Compare Alpha-beta pruning algorithm and Minimax methods. Indicate the points of similarity and points of distinction.   4

(b) What is Look Ahead Depth? How does it affect the performance of Minimax algorithm?   2

(c) Consider the game tree in which static scores are all from first player's point of view. The static scores at the leaf nodes from left to right are as follows:
5 5 2 3 4 7 1 1 8 3 2 8 6 3 2 1 4 1 6 4 6 5 1 7 3
------What is the best move of A? Which nodes will be pruned using α-β search? **(Show all intermediate values)**   3+5
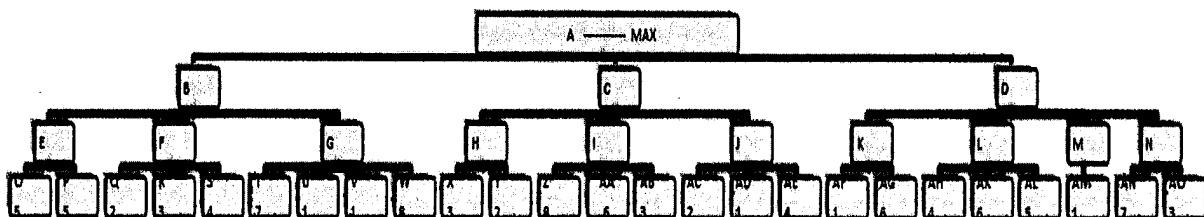
(d) Compare between hill climbing and simulated annealing algorithms.   5

(e) (i) Suppose you are using a Genetic Algorithm. Two individuals (i.e., candidate solutions) in the current generation are given by 8-digit sequences: 1 4 6 2 5 7 2 3 and 8 5 3 4 6 7 6 1. What is the result of performing one-point crossover with a cross-site between the third and fourth digits? Consider the probability of crossover is 0.9.

(ii) If there are *M* individuals in the current generation, how many crossover operations are used to produce the next generation?

(iii) A Genetic Algorithm (including crossover, mutation and natural selection) where the population size *M* = *1*, would perform most like which of the following search methods (select one) and why?

    x. Simulated annealing

    y. Hill-climbing

    z. A random walk

    w. Nothing will change (i.e., the initial individual will stay the same)   6

5.(a) In Predicate Calculus, what is a "term"?   3

(b) In theorem proving system what is the necessity of Substitution? Discuss on the rules for Substitution while performing Unification.   .   4

(c) Find the *mgu* of the following:
$$\{P(f(x), y, g(y)),\ P(f(x), z, g(x))\}$$ 4

(d) Convert the following *wff* into clause form.   8
$$\forall x[B(x) \rightarrow (\ \exists y\ [\ Q(x,y) \wedge {\sim}P(y)\ ]\ \wedge\ {\sim}\exists y\ [Q(x,y) \wedge Q(y,x)] \wedge \forall y\ [\ {\sim}B(y) \rightarrow {\sim} E(x,y)]\ )\ ]$$

(e) What is Skolemization? Eliminate Existential quantifier from the following WFF: 3+3

$$(\exists x)\ \textbf{Crown(x)} \wedge \textbf{OnHead (x, John)}$$

6. (a) Is it true that resolution refutation always terminates either by finding a contradiction or by failing to find a contradiction? Provide reasons in support of your answer.   5

(b) The custom officials searched everyone who entered this country who was not a VIP. Some drug pushers entered this country and they were only searched by drug pushers. No drug pusher was a VIP.
    Use resolution refutation to conclude: Some of the custom officials were drug pushers.   8

(c) Why the reasoning system under uncertain situation is non monotonic in nature? What information (about a "node") do we obtain by looking at the support list of TMS?   3+3

(d) What is Fuzzy set? Give an example of a fuzzy set that will be modelled using trapezoidal membership function.   3+3

7. (a) (i) Consider the following neural network which takes two binary valued inputs x1, x2 $\in$ {0,1}, threshold transfer function $h_\theta(x)$. Which logical function does it (approximately) compute? Explain your answer.   4
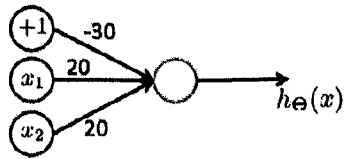
(ii) State True or False with Reason: A perceptron generates a decision boundary among two classes of patterns. 3

(iii) Why do we need to move from single layer perceptron to multilayer perceptron? 3

(b) (i) What does the machine learn through supervised learning? Discuss: 4

(ii) What are the criteria of a good clustering algorithm? 3

(iii) How do you evaluate the performance of a machine learning model? 3

8. Discuss on Ethical and Legal issues in AI. 5