

Subject Code: EX/CSE/PC/B/T/326 /2025

**B. E. COMPUTER SCIENCE AND ENGINEERING 3rd YEAR 2nd SEMESTER
EXAMINATION, 2025**

ARTIFICIAL INTELLIGENCE

Time : 3 Hours

Total Marks 100

Q1: Compulsory [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: Compulsory [CO5]

Answer different parts of the same Question together

1. (a) What is Artificial Intelligence (AI)? Discuss on the objectives of Artificial Intelligence (AI). 2+3

(b) Discuss on “Laws of thought approach” of AI. 2

(c) What is Turing Test in connection to intelligence of a machine? 3

2. (a) What is an Agent? How do you view an Agent as a Search process? 2+4

(b) Draw the differences between “Reflex Agent with State” and “Goal based Agent”. Indicate the points of difference. 4

(c) Write down the criteria for evaluating any search algorithm. According to you which one is crucial and why is it so? 6

(d) Can you devise a search algorithm where the time complexity will be lesser than $O(b^d)$? (b: branching factor of the tree and d: depth of the goal node). Provide reasons in support of your answer. 3

(e) Define “order” and “solution path” in connection to a search algorithm. For a problem having multiple goal solutions, can a search algorithm visit all the paths from root node to goal node(s)? If yes, provide a situation; If no, state why. 2+4

3. (a) Consider a puzzle where $2N$ blocks are aligned in a ruler with $2N+1$ positions. There are N Blue (B) and N White (W) blocks and an empty position. Suppose that the goal is to have all the white blocks positioned to the left of the blue one AND one blue block on the rightmost position. The empty position is not specified.
Blocks can hop to the empty position when the empty position is at most N cells away. This means that a block can only move half the length of the ruler, not the whole length. Hence, there are at most $2N$ legal moves. The cost of $Hop(i)$, $i=1,2,...,N$ is i . There are no circular hops (i.e., hops wrapping from one end of the ruler to the other).

[Turn over

Consider $N = 2$ and the following initial configuration:

W	B	B	W	---
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Use the following rules while answering the questions below.

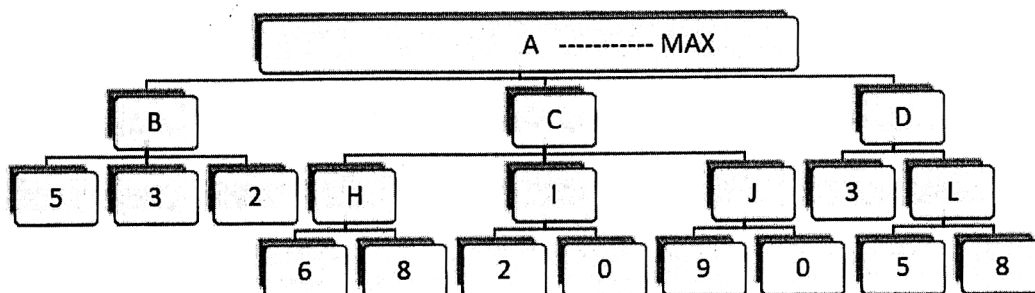
- Repeated states are detected, and therefore, are not represented in the search tree.
- Successors states are expanded in a fixed order: hops of empty position to the left are done before hops to the right; hops in each direction are done in increasing order of their cost values.

- Complete the search tree.
- Consider Breadth First Search (BFS) is carried out. If you are told that the queue contains five nodes, what are the five nodes in it? Use the labels on the node.
- Consider Uniform Cost Search. If you are told that the priority queue contains three nodes, what is a possibility of what those nodes are?
- Show all the contents of the queue for all the steps of Iterative Deepening using the same tree. 6+4+4+4

(b) Justify the following statements with suitable reasoning and/or example. 3
IDA* may take more time as compared to A*.

(c) If $h_1()$ and $h_2()$ are both admissible heuristic functions, is $h_3()$ admissible? (where, $h_3 = |h_1 - h_2|$) ---Discuss. 4

4. (a) Consider the following game tree in which static scores are all from first player's point of view.
- Which path will be chosen if Minimax algorithm is used?
 - Which branches will be pruned if α - β pruning algorithm is used? (3+6)
- (Show all intermediate values)



(b) What is static evaluation function? Where and how is it computed? 4

(c) Draw the similarities and differences between Hill Climbing method and Simulated Annealing Algorithm? 4

(d) Discuss on the replacement technique and termination condition of Genetic Algorithm. 4

(e) Discuss on the effectiveness of Genetic Algorithm over single solution based search techniques. 4

5.(a) State the differences between propositional logic and first order predicate logic. 3

(b) Convert the following in Predicate Calculus *WFFs*. 6

- (i) No student can fool all other students.
- (ii) There is a student who is loved by every other student.
- (iii) If two persons fight over a third one's property then the third one gains.

(c) What is Skolem constant? Give an example. 2

(d) Convert the following *wff* into *clause* form:

$$\sim (\forall x) \{P(x) \rightarrow [(\forall y) [P(y) \rightarrow P(f(x,y))]] \wedge \sim (\forall y) [Q(x,y) \rightarrow P(y)]\} \quad 4$$

(e) Consider the following sentences.

- i. For every mall there is some Santa who is at the mall.
- ii. Every child who visits anywhere talks with every Santa who is at the place visited.
(do not make a predicate for "place visited"; it should be just a variable)
- iii. Every child who is a city child visits some mall.
- iv. Every child who is good or who talks with some Santa gets some toy.

Prove using Resolution ---If every child who is not a city child is good, then every child gets some toy. 10

6. (a) For each of the following sentences, decide if the logic sentence given is a correct translation of the English sentence or not. If not explain briefly why not and correct it. There can be more than one mistake in each expression. 3+3

(i) Any red mushroom costs less than any purple mushroom.
 $\forall x [\text{mushroom}(x) \wedge \text{red}(x)] \implies [\exists y \text{ mushroom}(y) \wedge \text{purple}(y) \wedge \text{cost}(x) < \text{cost}(y)]$

(ii) There is a mushroom that is tastier than any other mushroom.
 $\forall x \exists y [\text{mushroom}(x) \wedge \text{mushroom}(y)] \implies \text{tastier}(y, x)$

(b) Use Resolution to prove $\forall x.((p(x) \Rightarrow q(x)) \Rightarrow p(x)) \Rightarrow p(x)$. 4

(c) Why do we say that reasoning under uncertainty is non monotonic in nature? Give suitable example in support of your answer. 2+3

(d) Define fuzzy set. Is there any difference between probability and membership value? – Discuss. 2+3

(e) Model Young man using fuzzy set. Considering this curve, model “very young” and “not young”. 5

7. (a) What is Learning? Draw the differences between Classification and Clustering. Write down the points of distinction. How does K-Nearest Neighbor classifier work? Discuss. 2+3+5

OR

- (b) (i) What is a Feature (Attribute)? What is Regression? 2+3

(i) Describe the role of a "Critic" in a Learning Agent. Name the other components of a Learning Agent. 3+2

8. Discuss on Ethical issues in AI. 5

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