Code -

G. S. Mandal's

Maharashtra Institute of Technology, Aurangabad

(An Autonomous Institute)

END SEMESTER EXAMINATION

Second Year B.Tech (AI &DS) – Feb/Mar-2023

Course Code : AID202 **Course Name : Introduction to Artificial Intelligence**
Duration : 2 Hrs Max. Marks : 50 **Date :**

Q.1	**Answer any five (Marks:10)**	**Marks**
a)	What is AI? Explain how an AI system is different from a conventional computing system **AI Definition**: Artificial intelligence is the branch of computer science that deals with the automation of intelligent behavior. AI gives basis for developing human-like programs which can be useful to solve real life problems and thereby become useful to mankind. **how an AI system is different from a conventional computing system:** write minimum two points	2 1 1
b)	What is Inductive learning? **Definition of Inductive learning:** (write minimum two points)	2
c)	Differentiate between branch and bound technique and backtracking **Differentiate between branch and bound and backtracking: Write minimum four points**	2
d)	Explain formulation of problem in game playing **A game can be defined as a type of search in AI which can be formalized of the following elements:** • **Initial state:** It specifies how the game is set up at the start. • **Player(s):** It specifies which player has moved in the state space. • **Action(s):** It returns the set of legal moves in state space. • **Result(s, a):** It is the transition model, which specifies the result of moves in the state space. • **Terminal-Test(s):** Terminal test is true if the game is over, else it is false at any case. The state where the game ends is called terminal states. • **Utility(s, p):** A utility function gives the final numeric value for a game that ends in terminal states s for player p. It is also called payoff function. For Chess, the outcomes are a win, loss, or draw and its payoff values are +1, 0, ½. And for tic-tac-toe, utility values are +1, -1, and 0.	1 1
e)	Define local consistency and its type. **Define local consistency:** **Types**	1 1
f)	How will you measure the problem-solving performance? Problem solving performance is measured with 4 factors. 1) Completeness - Does the algorithm (solving procedure) surely finds solution if really the solution exists.	2

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	2) Optimality – If multiple solutions exits then the algorithm returns optimal amongst them. 3) Time requirement. 4) Space requirement	
g)	Differentiate between supervised and unsupervised learning Differentiate between **supervised and unsupervised learning: Write minimum four points**	2
h)	What is Reinforcement learning? Explain in brief. Reinforcement learning Explanation.	1 1
Q.2	**Solve any one following questions**	8
a)	What are agent and environment? Explain properties of agent Define agent and environment Properties of Environment 1. Fully observable vs Partially Observable 2. Static vs Dynamic 3. Discrete vs Continuous 4. Deterministic vs Stochastic 5. Single-agent vs Multi-agent 6. Episodic vs sequential 7. Known vs Unknown 8. Accessible vs Inaccessible	1 1 1 1 1 1 1 1
b)	Draw and explain architecture of utility-based agent and illustrate this with real life example GPS. Architecture and explanation Real life example of utility-based agent	6 2
Q3	**Solve any one following questions**	8
a)	Explain A* admissible & consistency. Consider the following directed graph, having A as the starting node and G as the goal node, with edge costs as	

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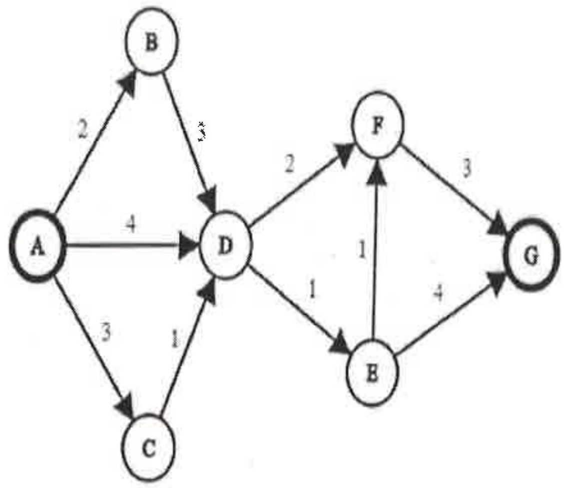
mentioned, and the heuristic values for the nodes are given as - {h(A)=7, h(B)=6, h(C)=5, h(D)=4, h(E)=3, h(F)=3, h(G)=0}. Determine h(n) will satisfy admissibility and consistency property.



Explain A* admissible & consistency

4

Steps

to check consistency:

h(n) - h(n+1) ≤ actual path i.e h(n) → h(n+1)

A → B 7-6 ≤ 2, 1 ≤ 2	A → C 2 ≤ 3	A → D 3 ≤ 4	B → D 2 ≤ 5
C → D 1 ≤ 1	D → E 1 ≤ 1	D → F 1 ≤ 2	F → G 3 ≤ 4
E → F 3 ≤ 4	E → G 3 ≤ 3		

Since, all nodes satisfy both the conditions of consistency as well as admissibility the give heuristic funⁿ is admissible and consistent for all nodes

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i) To check whether admissible and consistent or not

→ Admissibility: $h(n) \le h(n+1) + g(n+1)$

To check for all nodes

For A:

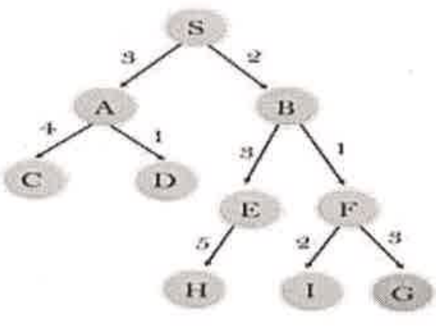
A→B $7 \le 6+2$, $7 \le 8$, yes | A→D $7 \le 4+4$, $7 \le 8$, yes | A→C $7 \le 8$, yes

For B: B→D $6 \le 9$, yes | For C: C→D $5 \le 8$, yes

For D: D→E $4 \le 9$, $4 \le 8$, $4 \le 8$, yes | D→F $4 \le 10$, $4 \le 9$, $4 \le 9$, yes

For E: E→G $3 \le 10$, $3 \le 9$, $3 \le 9$, yes | For F: F: $3 \le 10$, $3 \le 9$, $3 \le 9$, yes

b) Explain Best first Search algorithm. Consider the following graph to find optimal path using best first search algorithm from start node S to goal node G. Draw stepwise tree search space for every visited node and write path and time complexity. — 8



node	H (n)
A	12
B	4
C	7
D	3
E	8
F	2
H	4
I	9
S	13
G	0

- **Step 1:** Place the starting node into the OPEN list.
- **Step 2:** If the OPEN list is empty, Stop and return failure.
- **Step 3:** Remove the node n, from the OPEN list which has the lowest value of h(n), and places it in the CLOSED list.
- **Step 4:** Expand the node n, and generate the successors of node n.
- **Step 5:** Check each successor of node n, and find whether any node is a goal node or not. If any successor node is goal node, then return success and terminate the search, else proceed to Step 6.

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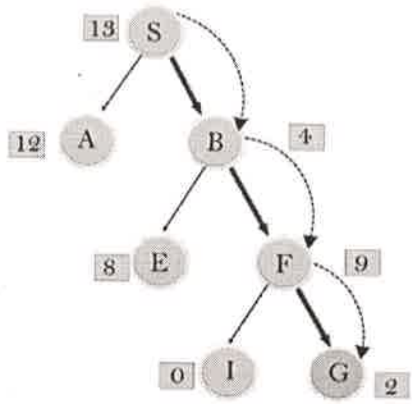
- **Step 6:** For each successor node, algorithm checks for evaluation function f(n), and then check if the node has been in either OPEN or CLOSED list. If the node has not been in both list, then add it to the OPEN list.
- **Step 7:** Return to Step 2.

n this search example, we are using two lists which are **OPEN** and **CLOSED** Lists. Following are the iteration for traversing the above example.



Expand the nodes of S and put in the CLOSED list

Initialization: Open [A, B], Closed [S]

Iteration 1: Open [A], Closed [S, B]

Iteration 2: Open [E, F, A], Closed [S, B]
: Open [E, A], Closed [S, B, F]

Iteration 3: Open [I, G, E, A], Closed [S, B, F]
: Open [I, E, A], Closed [S, B, F, G]

Hence the final solution path will be: **S----> B----->F----> G**

Time Complexity: The worst case time complexity of Greedy best first search is $O(b^m)$.

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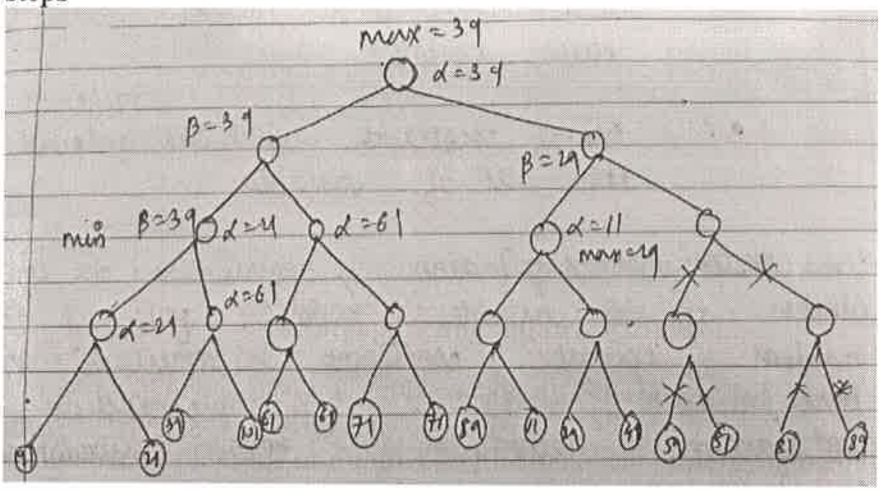
Q.4	**Solve any one following questions**	8
a)	Explain alpha beta pruning. Apply alpha -beta pruning with mini-max search tree on following data 91 21 39 101 61 69 71 71 89 11 29 49 59 51 81 and 79. Also compare complexities of minimax with alpha beta pruning algorithms. Explanation of alpha beta pruning: steps 	 4 4
b)	Consider the game of 3 X 3 Tic-Tac-Toe where Max plays (cross) X and Min plays (naught) O. If the Max player wins then the final score is +1. If the Min player wins then the final score is -1 and 0 for a draw. Assume that the game has reached the position shown below where max and min player plays thrice. Show the optimal path in a game tree search space using backing-up values.	8

0	0	x
x		0
		x

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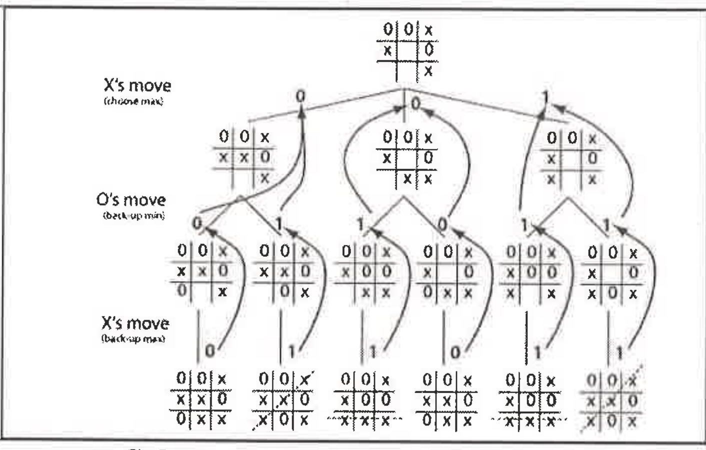

Q.5	**Solve any two following questions**	8
a)	Write backtracking search algorithm for CSPs. Explain the failure stages of this algorithm with map coloring. Write backtracking search algorithm for CSPs.	2
	Explain the failure stages of this algorithm with map coloring.	2
b)	What is cryptarithmetic problem? Illustrate use of CSP with following example with complete solution SEND +MORE MONEY **Define** cryptarithmetic problem	2
	• **Steps:** **Follow the below steps to understand the given problem by breaking it into its subparts:** • Starting from the left hand side (L.H.S) , the terms are **S** and **M.** Assign a digit which could give a satisfactory result. Let's assign **S->9** and **M->1.** S → 9 +M → +1 MO → 10	2

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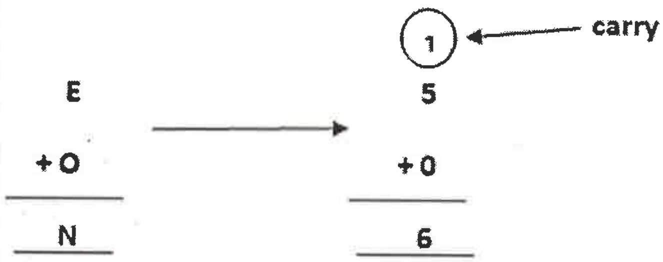
Hence, we get a satisfactory result by adding up the terms and got an assignment for **O** as **O->0** as well.

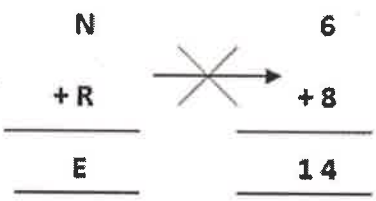
- Now, move ahead to the next terms **E** and **O** to get **N** as its output.

Adding E and O, which means 5+0=0, which is not possible because according to cryptarithmetic constraints, we cannot assign the same digit to two letters. So, we need to think more and assign some other value.



Note: When we will solve further, we will get one carry, so after applying it, the answer will be satisfied.

- Further, adding the next two terms **N** and **R** we get,



But, we have already assigned **E->5**. Thus, the above result does not satisfy the values because we are getting a different value for **E.** So, we need to think more. **Again, after solving the whole problem, we will get a carryover on this term, so our answer will be satisfied.**

```
                 (1)  <---- carry
  N               6
 +R   ------->   +8
 ---             ---
  E              15
                 ↑
```

where 1 will be carry forward to the above term
Let's move ahead.

- Again, on adding the last two terms, i.e., the rightmost terms **D** and **E**, we get **Y** as its result.

```
  D          7
 +E         +5
 ---        ---
  Y         12
            ↑
```

where 1 will be carry forward to the above term

- Keeping all the constraints in mind, the final resultant is as follows:

```
  SEND
 +MORE
 -----
 MONEY
```

- Below is the representation of the assignment of the digits to the alphabets.

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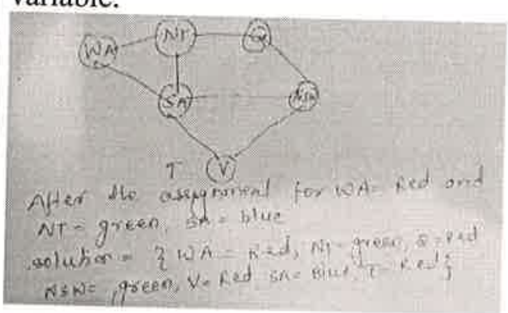
S	9
E	5
N	6
D	7
M	1
O	0
R	8
y	2

c) Explain how the minimum remaining value and least constraining value are used to paint proper color of the following map

The idea behind choosing the variable with the fewest legal value A-K-A most constraint variable or fail first heuristic. If picks a variable that is most likely because a failure so there by turning the search tree if some variable x has no legal value first. The Minimum-Remaining-Values (MRV) heuristic will select x and failure will be detected immediately evaluating pointers searches through other variable. 2



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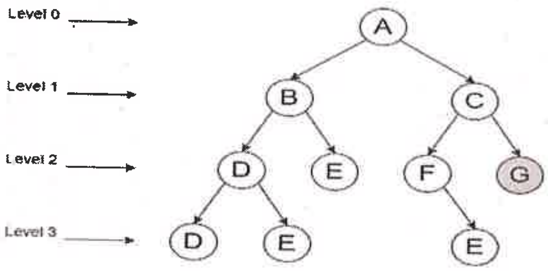
Q.6	**Solve any two**	8
a)	How artificial intelligence will change the future (any application Retail, Healthcare) Explain The future of AI in healthcare/Retail	4
b)	Apply the depth-first iteratively deepening search on the following tree. For the same, determine the space and worst-case time complexity.  Write point on Iterative deepening depth-first Search 1'st Iteration-----> A 2'nd Iteration----> A, B, C 3'rd Iteration------>A, B, D, E, C, F, G 4'th Iteration------>A, B, D, H, I, E, C, F, K, G In the fourth iteration, the algorithm will find the goal node. **Completeness:** This algorithm is complete is ifthe branching factor is finite. **Time Complexity:** Let's suppose b is the branching factor and depth is d then the worst-case time complexity is **$O(b^d)$**. **Space Complexity:** The space complexity of IDDFS will be **$O(bd)$**. **Optimal:**	1

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	IDDFS algorithm is optimal if path cost is a non- decreasing function of the depth of the node.	
c)	Explain Steepest-Ascent hill-climbing algorithm. What are various problem in hill climbing algorithm, Steepest-Ascent hill-climbing algorithm steps various problem in hill climbing algorithm, Local maximum Plateau Ridge	 2 2