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Internal Assessment Test 1 – Oct. 2022

Sub:	**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**				Sub Code:	**18CS71**	Branch:	**CSE**
Date:	20/10/2022	Duration:	90 mins	Max Marks: 50	Sem / Sec:	7/A,B,C		OBE

	Answer any FIVE FULL Questions	MARKS	CO	RBT
1	a) Describe simple hill-climbing algorithm. b) Discuss drawbacks of hill climbing algorithms and methods to overcome them. c) Explain the terms local minima and plateau in hill climbing algorithm	[4+3+3]	CO1	L1

Ans:

a)

1. Evaluate the initial state. If it is also a goal state, then return it and quit. Otherwise, continue with the initial state as the current state.

2. Loop until a solution is found or until there are no new operators left to be applied in the current state:

(a) Select an operator that has not yet been applied to the current state and apply it to produce a new state.

(b) Evaluate the new state.

(i) If it is a goal state, then return it and quit.

(ii) If it is not a goal state but it is better than the current state, then make it the current state.

(iii) If it is not better than the current state, then continue in the loop.

b) Both simple and steepest hill climbing algorithms may fail to find the best solution (global maximum) if the search enters the following states.

1. Local maximum: It is a state which is better than all its neighbouring states however there exists a state which is better than it (global maximum). At local maximum, all further moves appears to make the solution worse.

2. Plateau/flat local maximum: It is a flat region of state space where neighbouring states have the same value.

3. Ridge: It is region which is higher than its neighbours but itself has a slope. It is a special kind of local maximum.

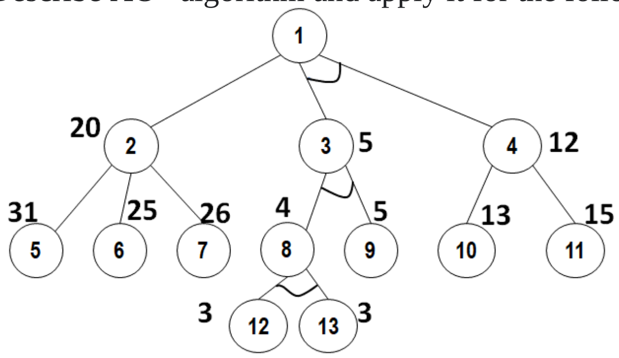
Techniques to escape from local minimum

Backtrack to some earlier node and try going in a different direction

Make a big jump in some direction

Apply two or more rules before doing the test

2	Describe AO* algorithm and apply it for the following graph and find the final path	[5+5]	CO2	L3



Ans:

Simplified AO* algorithm

1. Initialize the graph to the starting node.
2. 2. Loop until the starting node is labeled *SOLVED* or until its cost goes above *FUTILITY*:

   (a) Traverse the graph, starting at the initial node and following the current best path, and accumulate the set of nodes that are on that path and have not yet been expanded or labeled as solved.

   (b) Pick one of these unexpanded nodes and expand it. If there are no successors, assign *FUTILITY* as the value of this node. Otherwise, add its successors to the graph and for each of them compute *f′* (use only *h′* and ignore *g*). If of any node is 0, mark that node as *SOLVED.*

   (c) Change the *f′* estimate of the newly expanded node to reflect the new information provided by its successors. Propagate this change backward through the graph. If any node contains a successor arc whose descendants are all solved, label the node itself as *SOLVED.* At each node that is visited while going up the graph, decide which of its successor arcs is the most promising and mark it as part of the current best path.

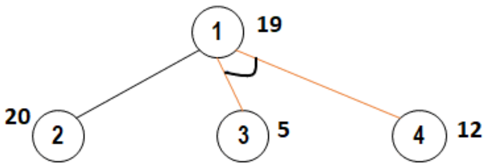
Assuming edge weight of 1.

Iteration 1: Expand node 1.

Estimated cost of path to 2: 20+1 = 21

Estimated cost of "and" arc (nodes 5 and 6): 5+12+1+1 = 19

Estimated cost of root and best path: 19, 1-> (3,4)

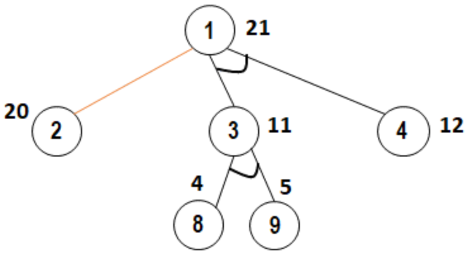


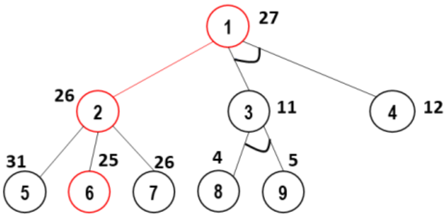
Iteration 2: Expand node 3.

Estimated cost of and arc (8,9) = : 4+5+1+1 = 11

Estimated cost of "and" arc (nodes 5 and 6): 11+12+1+1 = 25

Estimated cost of root and best path: 21, 1-> 2



	Iteration 3: Expand node 2. Estimated best cost of node 2 = : 25+1 = 26 Since node 6 is a terminal node, node 6 is SOLVED, Hence node 2 is SOLVED and hence node 1 is SOLVED Cost of root and best path: 27, 1-> 2->6  			
3	Using constraint satisfaction, solve the cryptarithmetic problem C R O S S + R O A D S ----------------- D A N G E R	10	CO2	L3
	Ans: Initial Constraints: D= {1}, R = {2, 4, 6, 8}, E=S+1 or S+2 or 0. Final Answer is: 96233 +62513 ------- 158746			
4	a) List all production rules for the water jug problem and present a solution b) List all the task domains of AI	7+3	CO2	L2
	Ans: a) 1 (x, y) if $x < 4$ → $(4, y)$ Fill the 4-gallon jug 2 (x, y) if $y < 3$ → $(x, 3)$ Fill the 3-gallon jug 3 (x, y) if $x > 0$ → $(x - d, y)$ Pour some water out of the 4-gallon jug 4 (x, y) if $y > 0$ → $(x, y - d)$ Pour some water out of the 3-gallon jug 5 $(x, y\}$ if $x > 0$ → $(0, y)$ Empty the 4-gallon jug on the ground 6 (x, y) if $y > 0$ → $(x, 0)$ Empty the 3-gallon jug on the ground 7 (x, y) if $x + y \geq 4$ and $y > 0$ → $(4, y - (4 - x))$ Pour water from the 3-gallon jug into the 4-gallon jug until the 4-gallon jug is full			

	8 (x, y) if $x + y \geq 3$ and $x > 0$ → $(x - (3 - y), 3)$ Pour water from the 4-gallon jug into the 3-gallon jug until the 3-gallon jug is full 9 (x, y) if $x + y \leq 4$ and $y > 0$ → $(x + y, 0)$ Pour all the water from the 3-gallon jug into the 4-gallon jug 10 (x, y) if $x + y \leq 3$ and $x > 0$ → $(0, x + y)$ Pour all the water from the 4-gallon jug into the 3-gallon jug 11 $(0, 2)$ → $(2, 0)$ Pour the 2 gallons from the 3-gallon jug into the 4-gallon jug 12 $(2, y)$ → $(0, y)$ Empty the 2 gallons in the 4-gallon jug on the ground Ans. B) Mundane Tasks Perception Natural language processing (NLP) Common sense reasoning Robot control Formal Tasks Games: Mathematics Expert Tasks Engineering: Scientific Analysis Medical Diagnosis Financial Analysis			
5	a) Write various knowledge representation issues. b) What are the properties of a good system for knowledge representation?	6+4	CO1	L1
	Ans a) Are there any basic attributes of objects? How to handle special attributes like "isa" and "instance" Are there any basic relationships among objects? Special attention is needed to address the properties such as inverses, "isa" hierarchy. Special care should be taken to reason about values and to handle single valued attributes At what level should knowledge be represented? Set of low level primitives vs high level representation How should sets be represented? Extensional definition vs intensional definition How should knowledge be accessed? Ans b) A good system for the representation of knowledge should possess the following properties. Representational Adequacy: Ability to represent all kinds of knowledge			

<table>
<tr><td></td><td>Inferential adequacy: Ability to manipulate the representational structures to derive new structures
Inferential efficiency: Ability to incorporate additional information
Acquisitional Efficiency: Ability to acquire new information</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>a) Explain concept learning task with an example
b) Describe Find-S algorithm and apply it on the dataset to arrive at a maximally specific hypothesis. The target attribute is “smart”.
<table>
<tr><th>hair</th><th>body</th><th>likesSimon</th><th>pose</th><th>smile</th><th>smart</th></tr>
<tr><td>blond</td><td>thin</td><td>yes</td><td>arrogant</td><td>toothy</td><td>no</td></tr>
<tr><td>brown</td><td>thin</td><td>no</td><td>natural</td><td>pleasant</td><td>yes</td></tr>
<tr><td>blond</td><td>plump</td><td>yes</td><td>goofy</td><td>pleasant</td><td>no</td></tr>
<tr><td>black</td><td>thin</td><td>no</td><td>arrogant</td><td>none</td><td>no</td></tr>
<tr><td>blond</td><td>plump</td><td>no</td><td>natural</td><td>toothy</td><td>yes</td></tr>
</table></td><td>5+5</td><td>CO2</td><td>L3</td></tr>
<tr><td></td><td>Ans a)
1. Initialize h to the most specific hypothesis in H
2. For each positive training instance x
• For each attribute constraint a_i in h
If the constraint a_i in h is satisfied by x
Then do nothing
Else replace a_i in h by the next more general constraint that is satisfied by x
3. Output hypothesis h

Ans b)
0. Initial Hypothesis: <0, 0, 0, 0, 0>

Find S considers only positive examples. There are only two positive instances in the dataset

1. Taking the first positive example,
S1: <brown, thin, no, natural, pleasant>

2. Taking the second positive example,
S2: <?, ?, no, natural, ?></td><td></td><td></td><td></td></tr>
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