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

B. E. COMPUTER SCIENCE AND ENGINEERING 3rd YEAR 2nd SEMESTER EXAMINATION, 2021

ARTIFICIAL INTELLIGENCE

Time : 3 Hours **Total Marks 70**

Q1 is compulsory [CO1]
Answer any ONE from Q2, Q3 and Q4 [CO2]
Q5 is compulsory [CO3]
Q6 is compulsory [CO4]
Q7 is compulsory [CO5]

Different parts of the same Question should be answered together.

[In some questions you may need to use your Roll number as input. For this, use the last two digits of your Class Roll number. For the student whose Roll number starts with L (Lateral Entry), add 80 with the last two digits of your Class Roll Number]

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1. **Answer either (a) or (b)**
(a) How many different approaches are followed in Artificial Intelligence (AI) for solving problems? What are they? Discuss any one. 5

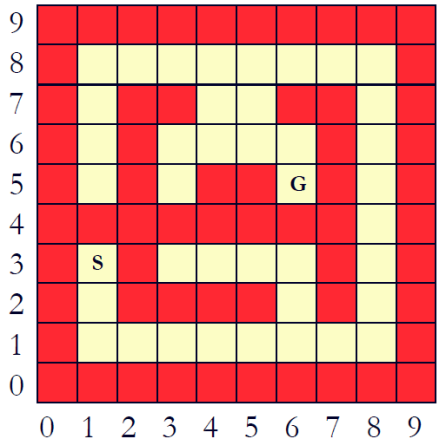
(b) Write down the differences between rational agent and learning agent. Indicate the point of differences also. 5

2. (a) Can you devise a search algorithm where the time complexity will be lesser than $O(b^d)$? Provide reasons in support of your answer. 5

(b) Write down the differences between uninformed search algorithms and Game Playing search techniques. 5

(c) *You need to measure x [where, x = (your Roll Number mod 9) + 1] liters of water from jugs of 12, 8 and 5 liters.*
Solve this problem using formal search procedure (mention start state, goal state, operators).
Draw the search tree. Find out the shortest path to the goal state. What is the cost of optimal solution? 10

3.(a) Consider the problem of Maze search with the following figure. 15



In this problem, an agent is trying to traverse a maze from the starting point **S** to the goal point **G**. In each step, the agent can move in one of the four compass directions; each move costs 1 unit. The agent always considers alternative moves in the following order:

1. Move North
2. Move East
3. Move South
4. Move West

Apply **A*** search algorithm to solve this problem. Number the squares in the order the agents visits the squares, starting with 0 at the starting point. You do not need to re-expand nodes already visited; this means that you can "jump" from the current node to the next node in the queue.

Calculate the path cost on the basis of one cost unit per move. The heuristics to use is the function of the difference between the horizontal position of the current node and the goal node, plus the difference in the vertical position of the current node [xn,yn] and the goal node [xg,yg] and it is: h([x,y]) = (|xg - xn|) + w(|yg - yn|) (where, w is a real number and is equal to your Roll number /100 [the symbol "/" represents division])

For this problem,

- Mark the sequence in which the nodes are visited in the maze.
- Draw the corresponding search tree.
- Fill in the table with the information about the search trace. (initial one is S, and you may need to insert the rows into the table)

Current Node	Path Cost	Heuristic	f-cost	Queue
S				

(b) Suppose we are devising a new search algorithm, named *XYZ*, modfying the working principle of Iterative Deepening Search strategy. In *XYZ* we are performing Breadth First search strategy in each iteration. Discuss on the advantages and disadvantages of *XYZ*. 5

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+7

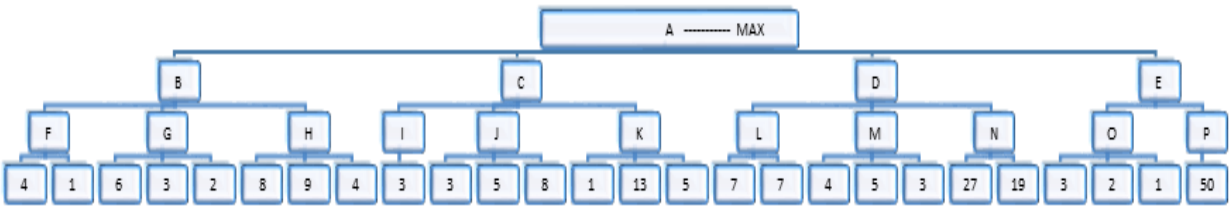
(Show all intermediate values)

(Ignore the static scores written at the leaf nodes; Rather, consider the scores in the following manner (from right to left):

Rightmost node (node 1): Your last two digit roll number mod 10
2nd Rightmost mode (node 2): Your last two digit roll number mod 9
3rd Rightmost mode (node 3): Your last two digit roll number mod 8
... … … …
9th Rightmost mode (node 9): Your last two digit roll number mod 2

Again, the 10th Rightmost mode (node 10): Your last two digit roll number mod 10
11th Rightmost mode (node 11): Your last two digit roll number mod 9
and so on….

i.e., the same process for all the remaining nodes. (where, mod represents remainder)



(b) Consider Alpha-Beta pruning algorithm using a tree with depth *d* and branching factor *b*. Estimate the amount of static evaluations you may require if you want maximum pruning. 4

(c) Discuss on Horizon effect. 3

(d) Write down the differences between "AND" tree and "OR" tree. 3

5. (a) Justify with explanation: While converting Clauses from Well Formed Formula, order of Quantifiers is irrelevant. 4

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

$$\forall x \ [\exists y \ \ Animal(y) \wedge \neg Loves(x, y)] \vee [\exists z \ \ Loves(z, x)]$$

(c) Find out the resolvents for the following pair of clauses: {P(z,b), Q(z)} and {~P(a,z), R(z} 3

(d) What type of information (about a 'node') you can obtain by looking at the SL-justification part? Discuss. 3

(e) Model 'old' man using suitable membership function. From this, graphically represent "not very old". 4

6. (a) Discuss on the cooling schedule of simulated annealing algorithm. 2

(b) Consider 4 chromosomes into a population in genetic algorithm (GA). The decimal values of the chromosomes are: x, x+1, x+2, x+3 (where, x = the last two digits of your Roll number). Use binary coded GA. Now hand execute GA for the first two generations. Show each steps. 8

(c) Consider the following set of Data. X and Y are numerical features and Z is the class label (True or False)

X	Y	Z
1	2	T
2	1	F
3	2	T
1	1	F

(i) Let P be a perceptron with weight values: wX = 2, wY = 1, and Threshold T=4.5. What will be the Total error for this perceptron?

(ii) Find out a set of weights and threshold values which will provide 100% classification accuracy for it. 10

7. Discuss on Ethical issues in AI. 5

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