Artificial Intelligence : DS251

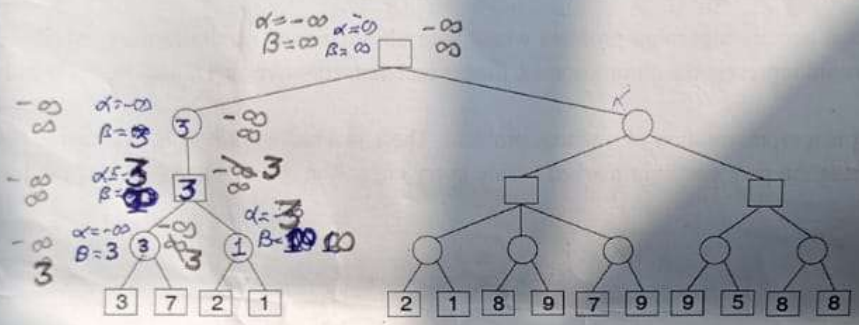
MidSem

Time - 120 Minutes

1. Three missionaries and three cannibals are on one side of a river, along with a boat that can hold one or two people. The goal is to find a way to get everyone to the other side, without ever leaving a group of missionaries outnumbered by cannibals. Remember, at least one person must be on the boat to make it cross the river. Represent the states of this problem indicating the initial state, the goal state and state transition rules. Draw the state space tree up to 2 levels below the root node i.e. for depth 0, 1 and 2.

(6)

2. Apply α-□ pruning on the following tree. Show the (α, □) value of each node and indicate which branches to prune and why. The rectangles indicate "Max" nodes and circles indicate "Min" nodes. (5)



3. Consider the game of tic-tac-toe where X is the MAX player. Given the game board below where it is X's turn to play next assuming depth cutoff of 2 (i.e. 2 ply lookahead), show the game tree.

__ | X | __
0 | __ | __
X | __ | 0

The evaluation function is given by:

Evaluation(s) = $8X_3(s) + 3X_2(s) + X_1(s) - (8O_3(s) + 3O_2(s) + O_1(s))$ Where $X_n(s)$ is the number of rows, columns, or diagonals in state s with exactly n number of X's and no O's and $O_n(s)$ is the number of rows, columns, or diagonals in states with exactly n number of O's and no X's.

Can you observe any "horizon effect" here? (8+2)

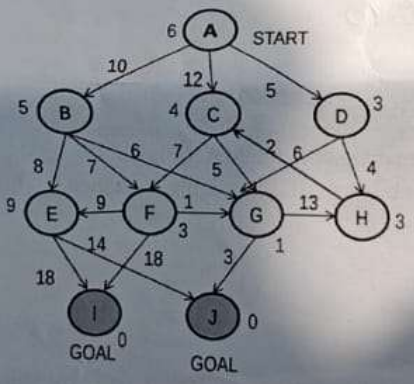
4. Let's say, you are going to spend a month in the wilderness. Only thing you are carrying is the backpack which can hold a maximum weight of 40 kg. Now you have different survival items, each having its own "Survival Points" (which are given for each item in the table). Some of the items are so essential that if you do not take them, you incur some additional penalty.

Here is the table giving details about each item.

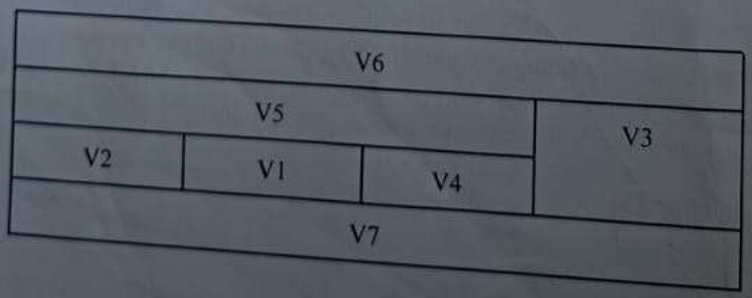
Item	Weight	Survival Value	Penalty if not taken
Sleeping Bag	30	20	0
Rope	10	10	0
Bottle	5	20	0
Torch+Battery	15	25	-20
Glucose	5	30	0
Pocket Knife	10	15	-10
Umbrella	20	10	0

Formulate this as a genetic algorithm problem where your objective is to maximize the survival points. Write how you would represent the chromosomes, fitness function, crossover and mutation. (3+2+2+1)

5. The following is a representation of a search problem. There is a heuristics h which is marked beside every node whereas the path costs are marked beside every edge. Run A* on this search space and show the steps. (8)



6. Consider the following map coloring problem where V1, V2,..V7 are different states of a country which need to be colored in a way such that no two neighboring states get the same color. Each state needs to be assigned one of the three colors - Red, Green and Blue.



Part-(a): Write down the semantic ru
tation.
Hints: (1) You can use

a. Draw the constraint graph for these states.
b. As per backtracking search algorithm, choose the first three states to color and decide which colors should be assigned to them. Mention your logic of choosing the state and corresponding color in every step. Note that if there is a tie, you can choose one of the options randomly.
c. After choosing the values for the first three states, do an Arc consistency check between the unassigned variables. Is a valid assignment possible?
d. Describe how you would have exploited the problem structure in this problem using the cutset principle.

(2+6+3+2)