LNMIIT
The LNM Institute of Information Technology

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Computer Science and Engineering

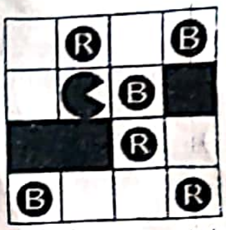
Artificial Intelligence (CSE328)

Mid Term Exam

Time: 90 Minutes **Date:** Oct 05, 2019 **Max. Marks:** 30

Instruction: *1. There are 5 questions printed on both sides of the paper.*
2. In case of any doubt, write your assumptions, write it clearly and continue.

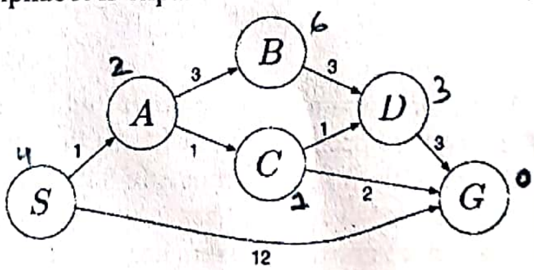
Q1. There are two kinds of food pellets, red and blue. Pacman is interested to eat all the two different kinds of food: however, the game ends when he has eaten equal number of red and blue food pellets (for example 1 red and 1 blue pellet). Pacman has four actions: up, down, left, or right, and does not have a "stay" action. There are equal number K of red pellets and blue pellets, and the dimension of the board is N by M. The figure is showing the board for K=3, N=M=4.



A) Give an efficient state space formulation of this problem. Specify the domain of each variable in your state space. Define the start state a goal test for the problem. [1]
B) Give a tight upper bound on the size of the state space. [1]
C) Suppose, the initial state is random position of pacman. Can we apply hill climbing to solve the problem? If yes, explain by generating at least one further step. [2]
D) For each of the following heuristics, indicate (yes/no) whether or not it is admissible Heuristic? [2]
1. The sum of smallest Manhattan distance to all remaining pellet from the current location
2. The minimum Manhattan distance between any two remaining pellets of opposite colors

Q2. For each of the following search strategies, give the number of nodes that will be explored and path that would be returned, if succeed. (Node for states earlier in the alphabet is expanded first in the case of ties).

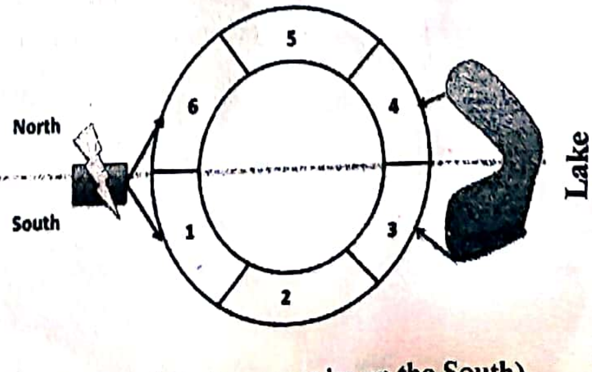
A) Depth-first graph search [1]
C) Uniform cost tree search [1]
D) Greedy graph search using $h1$ [1]
F) A* graph search using $h1$ [1]
H) Comment on the characteristics of the two heuristic functions $h1$ and $h2$ in terms of admissibility, consistency, and computational complexity. [2]



State	h_1	h_2
S	5	4
A	3	2
B	6	6
C	2	1
D	3	3
G	0	0

Q3. The new office building at LNMIIT has the following approximate circular map consisting of six office rooms labeled 1 through 6. The Electrical Grid, left side of the figure, is connected to offices 1 and 6. The Lake, right side of the figure, is visible from offices 3 and 4. There are two "halves" of the campus South (Offices 1-3) and North (Offices 4-6).

Following six departments have to allocate each of them
1. Legal (L) 2. Maps Team (M) 3. Prototyping (P)
4. Engineering (E) 5. Tim's office (T) 6.Storage (S)



The constraints are as follows:
(L) needs a view of the lake.
(T) must not be across from (M)aps.
(P) must have an electrical connection.
(S) must be next to (E).
(E) must be across from (T).
(P) and (L) cannot be next to one another.
(P) and (E) must be on opposite sides of the campus (if one is on North side, the other must be on the South).

No two departments may occupy the same office.

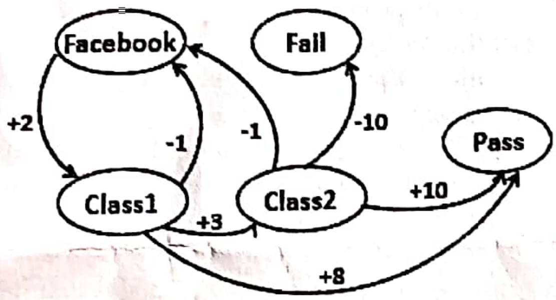
A) Draw a linearized constraint graph for this CSP? [1]

B) Show the variable domains after unary constraints have been enforced and the value 1 has been assigned to the variable P. Cross out all values that are eliminated by running Forward Checking after this assignment. [1]

C) After assigning P=1 and Unary constraints have been forced, explain the next assignment according to minimum remaining value (MRV) and least constraining value (LCV)? [1]

D) After unary constraints have been enforced, the value 1 has been assigned to the variable P, and now the value 3 has been assigned to variable T. Cross out all values that are eliminated if arc consistency is enforced after this assignment. Will there be any backtrack due to this? [2]

Q4. The below figure shows the student Markov chain, where the possible transitions from each state are shown by the directed edges. However, the student is only 80% certain that he will move to the expected next state and rest 20% divide equally to other possible transitions. For example, from Class1 if student take an action to move to Class2, next state will Class2 with 80% probability, 10% Facebook and 10% Pass. The reward for every transition is mentioned along with every edge. Calculate the optimal values using value iteration method if the number of actions allowed to the students is 3. Consider discount factor =1. (Show all the calculations for at least for one-step) [5]



Q5. Explain one iteration of steps of policy iteration for the given student MDP. Consider a random policy to start. [3]

Q6. The tree below shows the Vikram-Betal game tree where the Betal has the first chance. Betal wants to minimize the utility while Vikram wants opposite. Betal with his dark magic can take control over Vikram's action — and in doing so be 80% in charge of the Vikram's move i.e 80% a different action compared to the action according to the minimax will be performed. However, Betal has to pay a price of c every time he uses his magic.
Note: For each of Vikram's actions, ~~Pacman~~ Betal has the choice to either let Vikram act optimally (according to minimax), or to take control over Vikram's action at a cost of c

A) In case of perfect scenario (absence of magic), will there be any advantage to perform alpha-beta pruning in terms of utility and computational efficieny? [2]

B) Consider the cost of magic c = 1. Is it optimal for Pacman to use his dark magic? If so, mark in the tree below where he will use it. Either way, mark what the outcome of the game will be and the sequence of actions? [3]