Written Assignment [Bonus]

Instructions:

Write to-the-point answers, use mathematical expression, in place to explanation wherever needed.

Long unclear/ambiguous explanation won't count towards credit.

Attempt, those Questions which you have not attempted in Mid Sem Examination. Q4, Q5, Q6 is compulsory.

Q1. Snakes and Ladders is a classic, played on a 10x10 grid having some snakes and ladders. Let assume the same game is played on a 6x6 grid with some snakes and ladders where the grid is numbered from 1 to 36. Furthermore, a custom dice is used for the modified game, consisting of 4 faces numbered 1,2,3,4. Randomly add 2 snakes and 2 ladders to the grid. Give a grid-based heuristic (Goodness value for each grid element) for the Modified Snake and Ladders game. Also, give reasons for the heuristic provided (State all "valid" assumptions taken).

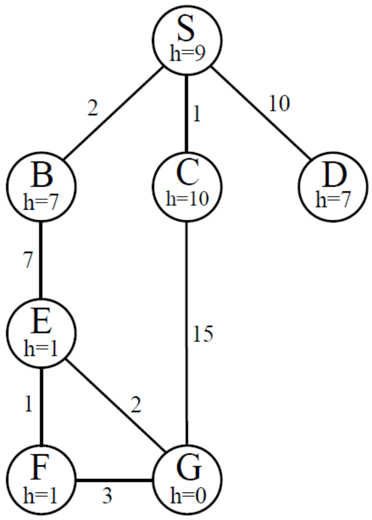
Q2. A robot has to deliver identical packages to locations A, B, and C, in an office environment. Assume it starts off holding all three packages. The environment is represented as a grid of squares, some of which are free (so the robot can move into them) and some of which are occupied (by walls, doors, etc.). The robot can move into neighboring squares and can pick up and drop packages if they are in the same square as the robot.

(a) Formulate this problem as a search problem, specifying the state space, action space, goal test, and cost function.

(b) Give a non-trivial, polynomial-time, admissible heuristic for this domain, or argue that there isn't one.

(c) Package A has to be delivered to the boss at A, and it's important that it be done quickly. But we should deliver the other packages promptly as well. How could we encode this in the problem?

Q3. Consider the search graph shown below. S is the start state and G is the goal state. All edges are bidirectional. For each of the following search strategies, give the path that would be returned, or write none if no path will be returned. If there are any ties, assume alphabetical tiebreaking (i.e., nodes for states earlier in the alphabet are expanded first in the case of ties).
(i) BFS
(ii) DFS
(iii) A*
(iv) IDA*
(v) Uniform cost graph



Q4. **A** and **B** are two computers playing Tic-Tac-Toe on a 3x3 grid where positions are numbered in a row-major order[1-9]. Both A and B are using Min-Max to decide upon their actions. The first move is performed by A which is randomly chosen from the following

1. Move at [1] (Top Left)
2. Move at [5] (Centre)
3. Move at [8]

Calculate the probability of the game ending in **B**'s win, defeat or draw.

Q5. Aircraft Landing Scheduling problem is a well-explored problem, where given a number of Aircrafts $\mathbf{A}_i$, and Runways at Airport $\mathbf{R}_j$. The aim is to minimize the penalty incurred due to the either early or delayed the arrival of the aircraft. Each aircraft has a landing window $\mathbf{[E_i, L_i]}$, where $\mathbf{E}_i$ is the earliest landing time and $\mathbf{L}_i$ is the last and $\mathbf{T}_i$ is the target landing time. The aircraft needs to compulsorily land in the interval $[E_i, L_i]$. **PE** and **PL** is the penalty incurred per unit time on the aircraft upon landing before and after T_i respectively. The penalty incurred depends upon the deviation of landing time from T_i. Maintain a separation of **S** units between aircraft when landing on the same runway and **SR** units when landing on different. (for this S/SR unit time, there is no penalty).

1<=i<=N
1<=j<=M

Formulate the problem in terms of a search problem solvable by Genetic Learning or Memetic Learning. Explain the approach followed.

Q6. Run Min-Max and Alpha Beta Pruning in the given graph. Also mention the utility value each node for both the algorithms and mention the nodes that are pruned in Alpha-Beta Pruning.