Assignment 1 Report

Q1. N Puzzle - (i) Input matrix :- [[5,1,8], [3,0,6], [7,2,4]]

a) **BFS** :
   i) No. of nodes explored = 224113
   ii) Avg time = (26.44 + 26.00 + 26.50) / 3 = 26.31 sec

b) **DFS:**
   i) No. of nodes explored = 83466
   ii) Avg time = (9.13 + 8.99 + 9.16) / 3 = 9.09 sec

c) **A* :**
   i) No. of nodes explored = 5742
   ii) Avg time = (0.89 + 0.98 + 0.92) / 3 = 0.93 sec

d) **IDA* (Initial Limiting Value = 8 ; increased in steps of 2) :**
   i) No. of nodes explored = 2517
   ii) Avg time = (0.42 + 0.43 + 0.41) / 3 = 0.42 sec

(ii) Input Matrix : - [[7,2,3],[6,0,5],[4,1,8]]

a) **BFS :**
   i) No. of nodes explored = 62257
   ii) Time = 11.4711

b) **DFS**
   i) No. of nodes explored = 17132
   ii) Time = 2.386

c) **A* :**
   i) No. of nodes explored = 1287
   ii) Time = 0.192

d) **IDA* :**
   i) No. of nodes explored = 1135
   ii) Time = 0.178

(iii) Input Matrix : [[6,1,2] ,[3,0,5], [8,4,7]]

a) **BFS :**
   i) No. of nodes explored = 65592
   ii) Time = 9.2405

b) **DFS**
   i) No. of nodes explored = 50951
   ii) Time = 6.7927

c) **A* :**
   i) No. of nodes explored = 3882
   ii) Time = 1.0056

d) **IDA* :**
   i) No. of nodes explored = 3598
   ii) Time = 0.6796

I. For IDA* and A* , f(n) = no. of steps from start state + manhattan distance to the goal state. Since the manhattan distance is the closest distance of a cell from its goal state, the heuristic never overestimates the cost of reaching the goal state, i.e., h(n)<=h*(n). Hence, f(n) is admissible.

II. A* and IDA* explore very less nodes as compared to BFS and DFS. The total number nodes explored by IDA* depends on the limiting value. If the initial limiting value is large enough, then the number of nodes explored by IDA* will be equal to the number of nodes explored by A*.

Q2. 4-Color - (i) input grid = [[3,3,3,1], [2,2,3,1], [3,3,3,4], [4,1,2,1]]

a) **BFS :**
   i) No. of nodes explored = 28
   ii) No. of steps = 3
   iii) Time = 0.0692

b) **A* :**
   i) No. of nodes explored = 3
   ii) No. of steps = 3
   iii) Time = 0.0105

(ii) input grid = [[3, 4, 3], [2, 3, 1], [1, 3, 1]]

a) **BFS :**
   i) No. of nodes explored = 7
   ii) No. of steps = 2
   iii) Time = 0.0034

b) **A* :**
   i) No. of nodes explored = 2
   ii) No. of steps = 2
   iii) Time = 0.0013

(iii) input grid = [[1, 1, 3, 1, 1], [4, 3, 3, 1, 3], [1, 3, 2, 2, 3], [3, 1, 4, 3, 4], [4, 3, 1, 2, 2]]

a) **BFS :**
   i) No. of nodes explored = 489
   ii) No. of steps = 4
   iii) Time = 3.0318

b) **A* :**
   i) No. of nodes explored = 7
   ii) No. of steps = 6
   iii) Time = 0.0224

(iv) input grid = [[2, 4, 4, 1], [2, 1, 4, 1], [3, 3, 1, 4], [4, 1, 4, 2]]

a) **BFS :**
   i) No. of nodes explored = 4
   ii) No. of steps = 2
   iii) Time = 0.0099

b) **A* :**
   i) No. of nodes explored = 2
   ii) No. of steps = 2
   iii) Time = 0.0050

I. For IDA* and A* , f(n) = no. of steps from start state +(n*n - number of connected components). The connected components have been defined as follows : If two adjacent cells have the same color, they are linked to each other.
Since the number of connected components in a properly colored matrix is equal to n!, where n is the number of rows in the matrix, less the number of (n*n - number of connected components) in a matrix, closer is the solution, Hence, the heuristic never overestimates the cost of reaching the goal state, i.e., h(n)<=h*(n).
Hence, f(n) is admissible.