Indian Institute of Engineering Science & Technology, Shibpur
Department of Computer Science & Technology
8th Semester Artificial Intelligence Laboratory 2025
CS 4271
ASSIGNMENT – 2

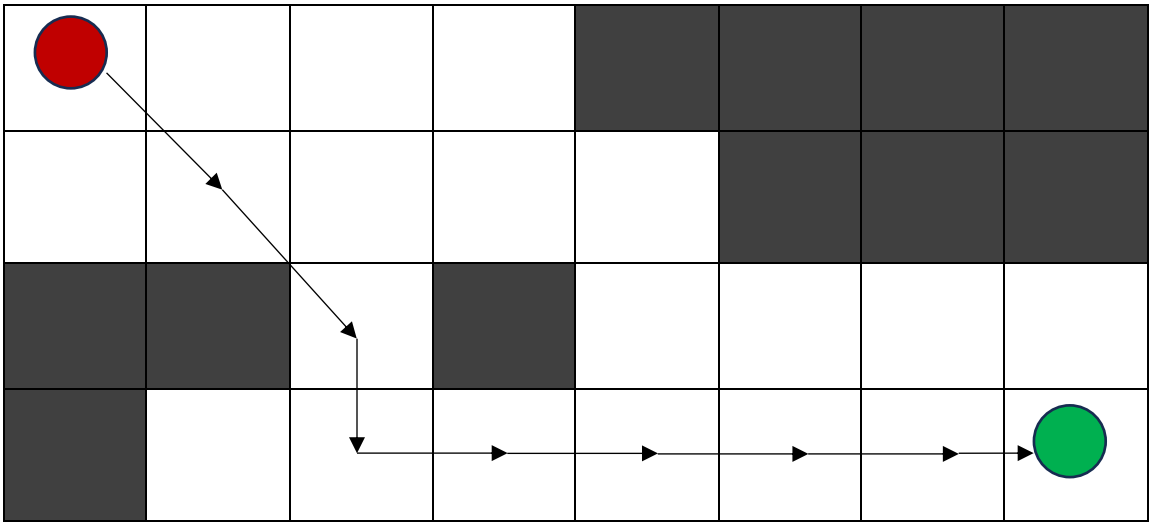
1. In a spatial context defined by a square grid featuring numerous obstacles, a task is presented wherein a starting cell, and a target cell are specified. The objective is to efficiently traverse from the starting cell to the target cell, optimizing for expeditious navigation. In this scenario, the A* Search algorithm proves instrumental.

   The A* Search algorithm operates by meticulously selecting nodes within the grid, employing a parameter denoted as 'f.' This parameter, critical to the decision-making process, is the summation of two distinct parameters – 'g' and 'h.' At each iterative step, the algorithm strategically identifies the node with the lowest 'f' value and progresses the exploration accordingly. The allowed actions are: ***left, right, top, bottom, and diagonal.***

   The parameters 'g' and 'h' are delineated as follows:
   - 'g': Represents the cumulative movement cost incurred in traversing the path from the designated starting point to the current square on the grid.

   - 'h': Constitutes the estimated movement cost anticipated for the traversal from the current square on the grid to the specified destination, by using either Manhattan or Euclidean distance. This element, often denoted as the heuristic, embodies an intelligent estimation.

   The A* Search algorithm, distinguished by its ability to efficiently find optimal or near-optimal paths amidst obstacles, holds significant applicability in diverse domains such as robotics, gaming, and route planning.



2. In a spatial context defined by a square matrix of order N * N, a rat is situated at the starting point (0,0), aiming to reach the destination at (N-1, N-1). The task at hand is to enumerate all feasible paths that the rat can undertake to traverse from the source to the destination. The permissible directions for the rat's movement are denoted as 'U' (up), 'D' (down), 'L' (left), and 'R' (right). Within this matrix, a cell assigned the value 0 signifies an obstruction, rendering it impassable for the rat, while a value of 1 indicates a traversable cell. The objective is to furnish a list of paths in lexicographically increasing order, with the constraint that no cell can be revisited along the path. Moreover, if the source cell is assigned a value of 0, the rat is precluded from moving to any other cell.

   To accomplish this, the AO* Search algorithm is employed to systematically explore the AND-OR graph and evaluate all conceivable paths from source to destination (with path cost = 1, and heuristic values given in the diagram). The algorithm dynamically adapts its heuristic function during the search, optimizing the exploration process. The resultant list of paths reflects a meticulous exploration of the matrix, ensuring lexicographical order and adherence to the specified constraints.

Source (A)	B = 4	C
D = 10	E = 3	F
G	H = 2	I = 8
J	K = 3	**Destination (L = 5)**

AND-OR Graph Representation: