**Assignment No: 4**

**Problem Statement:**

Implement the A\* Algorithm for an application.

**Theory:**

The A\* Algorithm is a widely used pathfinding and graph traversal technique known for its optimality and completeness. It guarantees the discovery of the shortest path between a starting node and a goal node, provided an admissible heuristic is utilized.

* *A Algorithm*\*: This algorithm integrates Dijkstra's Algorithm (which finds the shortest path) with a Greedy Best-First Search (which employs heuristics to direct the search).
* The function f(n)=g(n)+h(n) represents the total estimated cost:
  + g(n): the cost from the start node to node nnn.
  + h(n): the estimated cost from node nnn to the goal (the heuristic function).
  + f(n): the total estimated cost of the cheapest solution through node nnn.

**Methodology:**

1. Problem Representation:
   * Model the problem as a graph where nodes symbolize states and edges represent transitions between these states. For instance, a grid-based map can illustrate locations where A\* identifies the shortest route from a starting point to a destination.
2. Algorithm Steps:
   * Initialize the open list (which contains nodes to be explored) and the closed list (which includes nodes that have already been explored).
   * Begin from the initial node and compute f(n) for all neighbouring nodes.
   * Expand the node with the lowest f(n) value to move closer to the goal.
   * Continue expanding nodes and updating their costs until the goal is reached.
3. Heuristics:
   * In a grid-based system, common heuristics include Manhattan distance or Euclidean distance for estimating h(n).
4. Application Examples:
   * Game AI: Determining the shortest path for a character in a game.
   * Robot Navigation: Facilitating pathfinding for robots in grid-like environments.
   * GPS Systems: Finding the shortest routes in maps for navigation purposes.

**Conclusion:**

We successfully implemented the A\* algorithm for a pathfinding application, showcasing its efficiency in determining the shortest path by leveraging a combination of cost functions and heuristics.