ARTIFICIAL INTELLIGENCE

**Path Planning using A\* Final Report**

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**ABSTRACT**

1. INTRODUCTION
2. PROBLEM FORMULATION
3. A\* SEARCH
   1. HEURISTICS
   2. ADMISSIBILITY
4. IMPLEMENTATION
   1. (the different classes)
   2. Making it more efficient
5. CONCLUSION
   1. outputs

# Problem Formulation

1. **Initial state:** Robot’s starting position given by an (x,y) coordinate.
2. **Actions:** Robot moves left, right, up, down.
3. **Transition Model:** Depending on action, robot coordinate will change.
4. **Goal Test:** Check if robot is at the rendezvous point.
5. **Path Cost:** f(n)=h(n)+g(n).

# Input Example

Input is taken through a text file with the following information:

8 10                 // the room has dimensions 8 by 10

2                 // there are N = 2 robots

2 1                 // 1st robot initial position: point (2,1)

8 2                 // 2nd robot initial position: point (8,2)

4 7                 // the rendezvous point R has coordinates (4,7)

1000000001            // room points (0,7), (1,7), ... (9,7)

1100000011

0000000000

1000110001

1001111001

0001111000

0000110000             // room points (0,1), (1,1), ... (9,1)

1100000011             // room points (0,0), (1,0), ... (9,0)

# A\* Algorithm

The A\* algorithm is a popular algorithm for pathfinding and graph traversal. It avoids expanding all possible paths which can be expensive. It uses the total estimated solution cost to determine each move towards the end node. The estimated solution cost is defined as:

f(n)=g(n)+h(n)

Where g(n) is the cost to reach the current node from the start node, h(n) is the estimated cost to get from the current node to the end node and f(n) is the estimated total cost of the cheapest solution.

# Path Finding Robot

For our artificial intelligence final project, we decided to implement a program to help a robot find a path to get to its desired destination. We have decided to use the A\* algorithm and the language we will use to implement the project is Java. Currently we have 4 different classes:

**Node class:** The node class contains all the deliverables for each coordinate on the puzzle. For each node object instance the object will have, a straight line distance for how far the said node is from the starting point point (g-value), an actual distance for how far the said node is to the rendezvous point (h-value), the position of the node (row,col), a boolean value for if the node is a object or not, and lastly a parent node so if there is a solution it can easily be traced back to return a full path.

/\*===============================================================  
Node Class  
----------  
  
This class create a instance for each node (position on the maze) which includes  
the specific nodes function values (g,h and f) its row and column position (x,y),  
if the node is a object, and each parent node it has.  
  
================================================================\*/  
  
public class Node{  
 private double g=0;  
 private double h;  
 private double f;  
 private int row;  
 private int col;  
 private boolean isObject;  
 private Node parent;  
  
 public Node(int row, int col, boolean isObject){  
 this.row=row;  
 this.col=col;  
 this.isObject=isObject;  
 }

**Robot class:** This class defines the robot and its current position. It also contains an array list of nodes that lead the

/\*===============================================================  
Robot Class  
----------  
This class create a instance for each robot which includes the position  
of the robot.  
================================================================\*/  
  
public class Robot{  
 int row;  
 int col;  
 private ArrayList<Node> path= new ArrayList<Node>();  
 public Robot(int row, int col){  
 this.row=row;  
 this.col=col;  
 }  
  
 public void addToPath(Node newPathNode){  
 this.path.add(newPathNode);  
 }  
  
 public ArrayList<Node> getRobotPath(){  
 return this.path;  
 }  
  
 /\*===============================================================  
 getRow: gets the row value of the robot  
 ================================================================\*/  
 public int getRow(){  
 return this.row;  
 }  
   
 /\*===============================================================  
 getCol: gets the col value of the robot  
 ================================================================\*/  
 public int getCol(){  
 return this.col;  
 }

1. **Maze class:** Defines the maze that the robot will traverse
2. **PathFinding class:** Uses the Node, Robot and Maze class to see if the given maze has a solution for all the robots specified or not.

# Running the Program