Exploring Optimal path on ZC Campus | Project

Muhammed Khalid 201901493
Samaa Khair 201901481

University of Science and Technology at Zewail City

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Supervised by:
Dr. Doaa Shawky

I. Introduction

The main objective of this project is to model a problem that is able to detect the optimal path available for navigating between buildings and stops on ZC Campus. Through various search algorithms; whether uninformed, informed, or local we try to find the optimal algorithm in terms of accuracy, time, and completeness to solve the given problem efficiently.

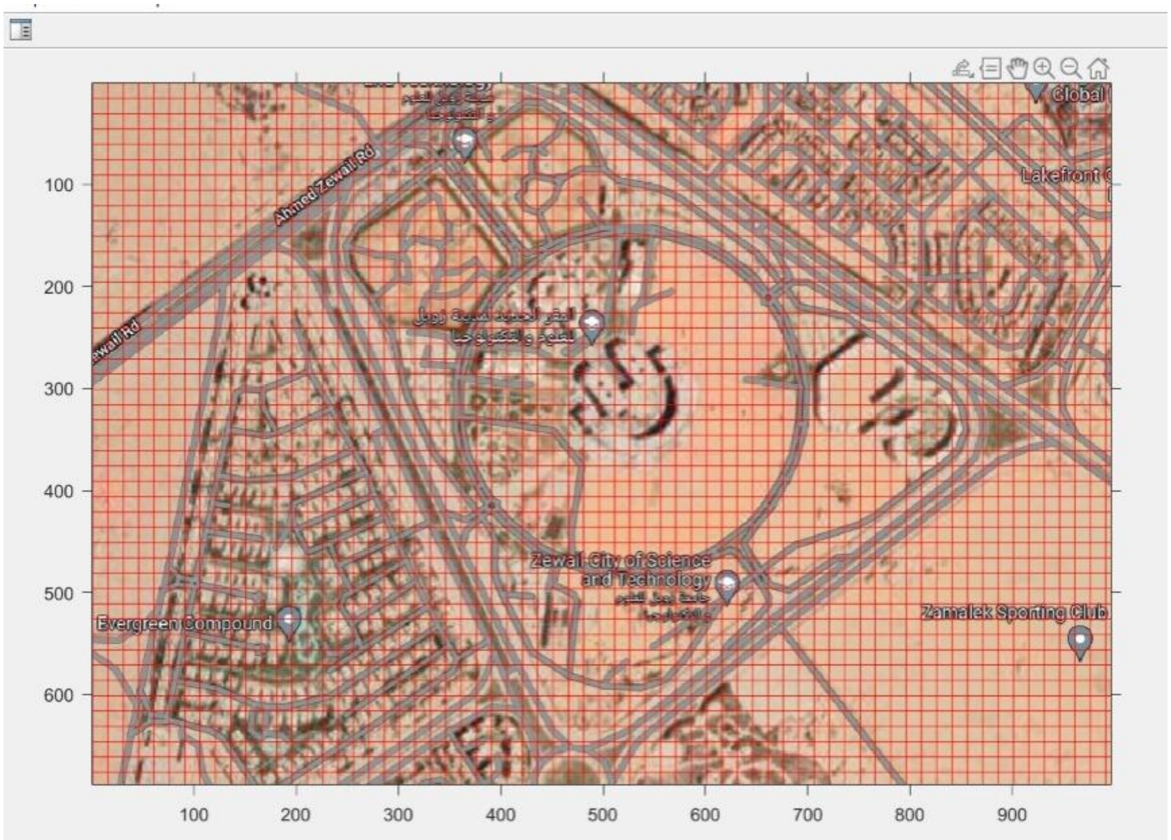
A. Problem Statement: Finding the optimal path on ZC Campus, navigating between buildings and stops.

B. Problem Abstraction:

- **Initial State:** This can be a set of states defined anywhere on campus but for starters, we can have the origin point at the main gate.
- **Goal:** Also a state to reach from all possible states.
- **States:** Cross Roads. Where each cross road lead to other cross roads
- **Actions:** 16 degree of freedom compass (Example: North, East,South,West, South north 1, south north 2 , …)
- **Solutions:** Sequence of actions (sequence of directions to move through.
- **Path Cost:** Measured distances in Kilometers.

Our map is here for your reference:

For the heuristic calculations, we used python grid to obtain the following grid:



C. Environment Type:

- Fully Observable
- Deterministic
- Sequential
- Discrete

D. Heuristic Assumption:

The heuristic function is assumed to be the **Euclidean Distance or the Manhattan distance** between two states.

E. Assumptions

The problem is divided into TWO sub problems. First problem is to reach the needed building and the second problem is to reach the needed zone or department.

First Problem is defined as follows:

For all actions, we have the first dic which is ActionMovements.

ActionMovements contains all possible actions from a given state , we have 44 states defined as the cross roads.

the second dic is ResultMovements which contains every result for every taken action. The result is a new state.

The third dic is the cost dic. It contains the cost for a chosen action given a certain state.

For actions function. It returns all possible actions given a state (key for dic)

For results function. It returns a result (state) given a state and action.
For cost function. it returns the cost given a state and action.
Heuristic function uses the excel sheet derived from the grid picture to calculate SLD and Manhattan distance
For the second problem, after you reach the building using the first problem algorithm with the map you can reach your destination given the following assumptions:

1- Entrance of NB is NANSCI
2- Entrance of AB is ZoneA
3- Entrance of HB is BMS
4- Entrance of AC is FR
4- Entrance of OB is ADM

F. Summary:

We have 44 possible states (cross roads) where each cross road is connected to other cross roads. The agent can move using a 16 degree of freedom compass to move between roads (Actions). There are some roads that lead to the buildings. These roads were added to your map. For the heuristic part, we used a grid to divide the map into grids and then get the coordinates of each point to calculate the heuristic function.

II. Work Load

Name	Work Distribution
Samaa Khair	**Problem Definition, Informed Search , Local Search , Heuristic Function in Problem**
Muhammed Khalid	**Problem Definition, Uninformed Search , Local Search**

III. Conclusions

For search problems that have no cost (or the costs are equal) we can use uninformed search techniques such as BFS and DFS techniques. We can use IDS to avoid stucking in a loop in BFS or DFS algorithms. On the other hand, if we knew the cost for each step then it's better to use informed search techniques. If you want to reach your goal at what cost as fast as possible it’s advisable to use the greedy algorithm. But if it’s to reach your goal with the most optimum cost, it’s a good idea to use A* search algorithm with a good heuristic function that doesn't overestimate the cost. The most used heuristic function is the straight line distance between the initial state and the goal.