CS440 MP1 Report

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# Part 1．Basic pathfinding

## 1.1．BFS

### 1.1.1．Medium maze

Solution cost (# of steps): **104** # of expanded nodes: **634**

### 1.1.2．Big maze

Solution cost (# of steps): **156** # of expanded nodes: **1261**

### 1.1.3．Open maze

Solution cost (# of steps): **53** # of expanded nodes: **573**

## 1.2． DFS

### 1.2.1． Medium maze

Solution cost (# of steps): 466 # of expanded nodes: 124

### 1.2.2． Big maze

Solution cost (# of steps): 899 # of expanded nodes: 524

### 1.2.3． Open maze

Solution cost (# of steps): 628 # of expanded nodes: 181

## 1.3． Greedy

### 1.3.1． Medium maze

Solution cost (# of steps): **116** # of expanded nodes: **143**

### 1.3.2． Big maze

Solution cost (# of steps): **234** # of expanded nodes: **293**

### 1.3.3． Open maze

Solution cost (# of steps): **53** # of expanded nodes: **198**

## 1.4． A\*

### 1.4.1． Medium maze

Solution cost (# of steps): 104 # of expanded nodes: 513

### 1.4.2． Big maze

Solution cost (# of steps): 178 # of expanded nodes: 1116

### 1.4.3． Open maze

Solution cost (# of steps): 53 # of expanded nodes: 474

# 2． Search with multiple dots

We used a combination of BFS and A\* algorithm to guide the search.

For this condition, it is obvious that the shortest distance between each pair of points will never change, and out goal is always to find a sequence of path starting from the starting point and iterate through all the other points.

At first, we wanted to list all combination of the nodes and find the shortest one. However, it will take O(n\*n!) memory and will use O(n!) time. Even the tiny search will use up my 16 GB memory. Then we notice that we can break it through by using A\* search, since we know the shortest distance between each pair of nodes and we just want a shortest path to iterate through all the dots. In our A\* search, the g (cost) is just the total distance traveled, and the h(heuristic) is the total distance of the minimum spanning tree of all the remaining dots which is admissible since the minimum spanning tree is the minimum way of connecting all the remaining dots but the actual cost is the shortest path to iterate the remaining dots, which is also one of the spanning trees. So the heuristic is guaranteed to be less than or equal to the actual cost.

The graph will be really messed up if I show all the path, so I’ll use the alphabet order to show the sequence I go through.

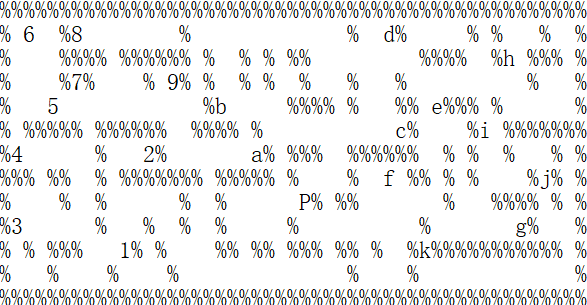
## 2.1． Tiny search

Solution cost (# of steps): 35 # of expanded nodes: 1129

## 2.2． Small search

Solution cost (# of steps): 124 # of expanded nodes: 16576

## 2.3． Medium search



Solution cost (# of steps): 198 # of expanded nodes: 828

# Part1 Extra Credit

We used a combination of greedy algorithm and A\* algorithm to guide our search. The algorithm will first find the nearest dot and mark it the current goal. Then, a\* algorithm used in 1.1 will find the optimal route to that nearest dot. The process is repeated until no dots are left in the maze. According to our output, the solution cost is **353 steps** and **883 nodes** are expanded. While choosing the nearest dot as the goal does not guarantee optimality, we compensate the algorithm by incorporating a\* search, which makes sure the optimality to each “current goal”.

# Part 2. Sokoban

For this part of the MP1, we only implemented BFS method to finish the Sokoban problem.

Here is the solution cost and the number of expanded nodes and the running time (For BFS method):

Soko1: 0.23620009422302246; Expanded: 981; Solution cost: 33

Soko2: 0.35021018981933594; Expanded: 1752; Solution cost: 51

Soko3: 400.6101870536804; Expanded: 1752; Solution cost: 51

Soko4: 1990.596181869507; Expanded: 117405; Solution cost: 144