CS 440 Assignment 1 Report

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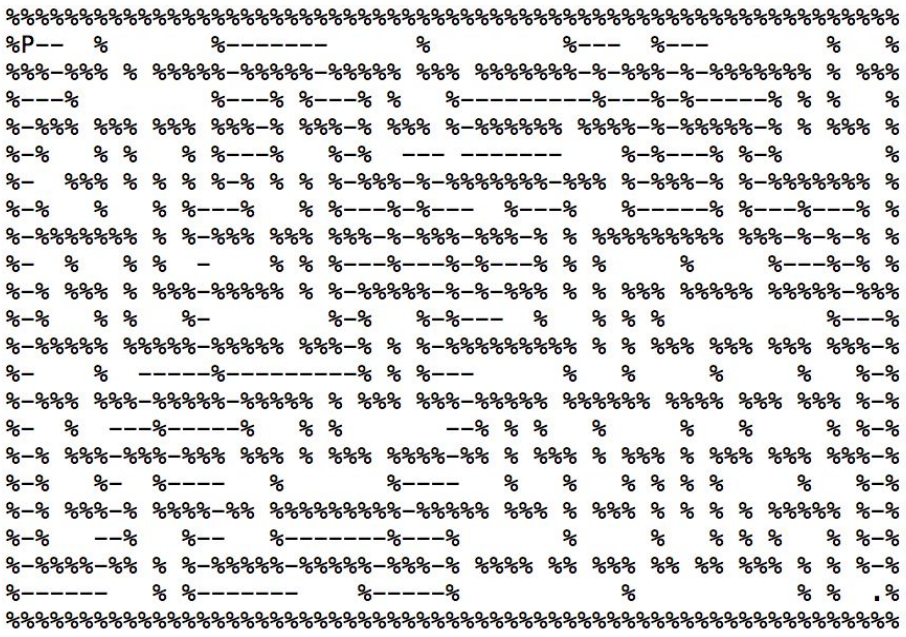
Part 1.1

We decided to keep a visited list in the algorithm, since without it the DFS search will be stuck in an infinite loop for some of the mazes.

1. DFS solutions
   Our algorithm for DFS used python list since DFS works as a stack (Last in First out). We append possible paths that pacman can take from certain location to the list and expand on the last value in the list. We print the path from the X,Y location of dot to the parent node until the root of tree.



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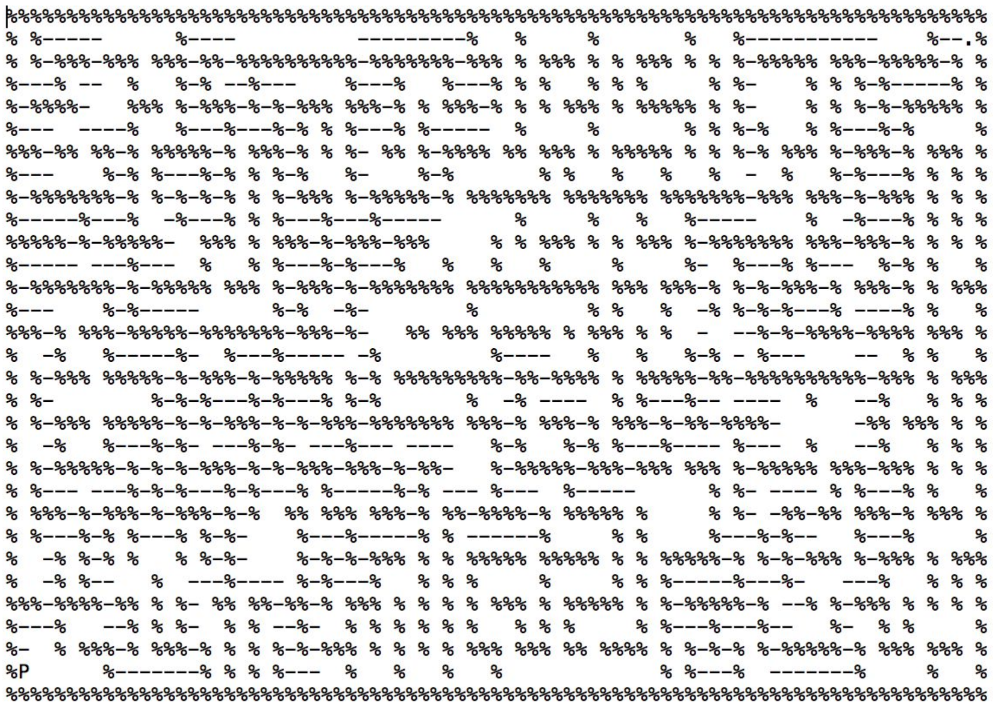
   a. mediumMaze (Solution cost = 226, Nodes expanded = 441)



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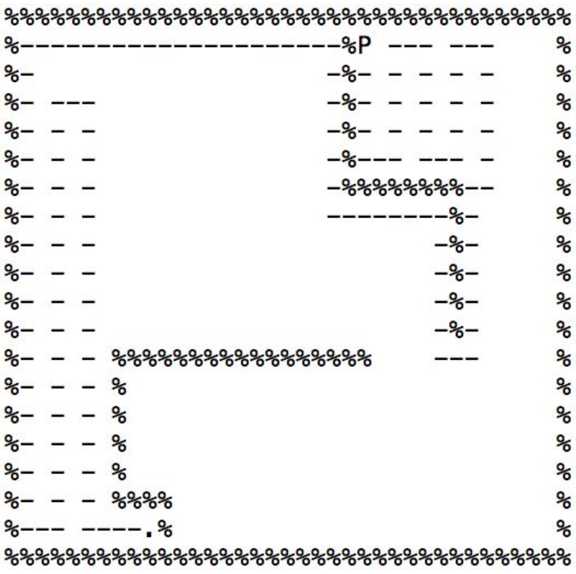
b. bigMaze (Solution cost = 562, Nodes expanded = 834)



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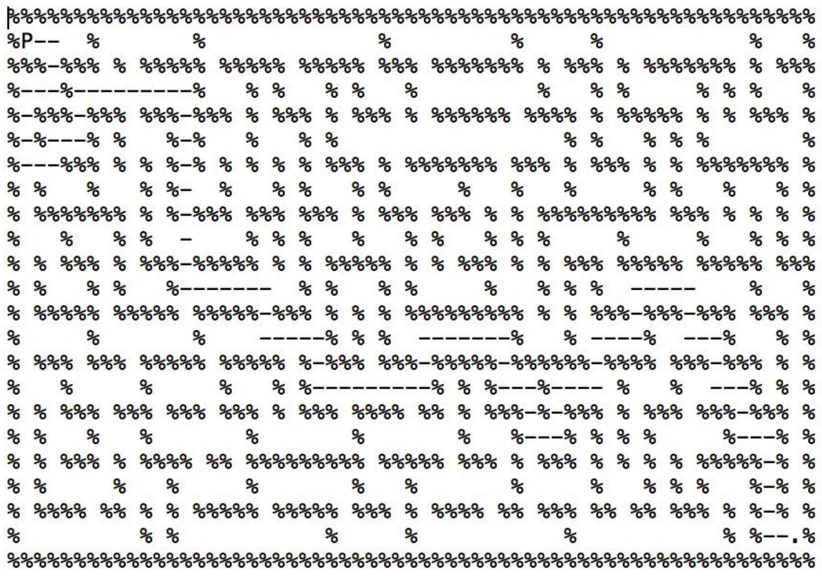
c. openMaze (Solution cost = 131, Nodes expanded = 132)

2. BFS solutions

Algorithm for BFS uses python queue as the data structure of the frontier list (First in First out). We enqueue possible states that pacman can take from certain location and recursively dequeue and expand on a state until we reach the goal. From that goal location, we tracked the parent node to print the path of the maze



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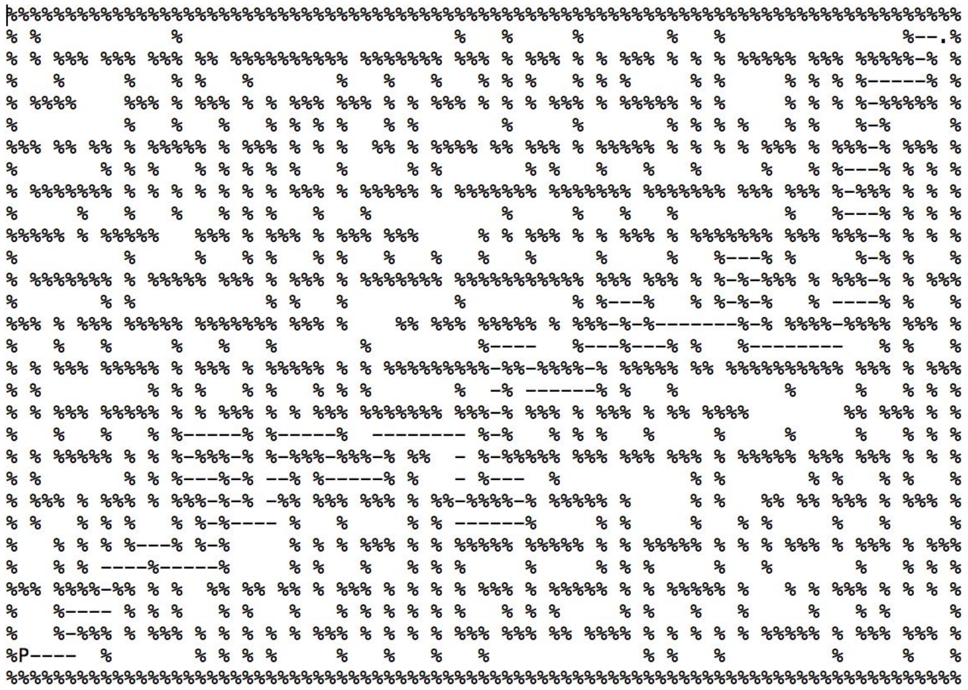
a. mediumMaze (Solution cost = 104, Nodes expanded = 632)



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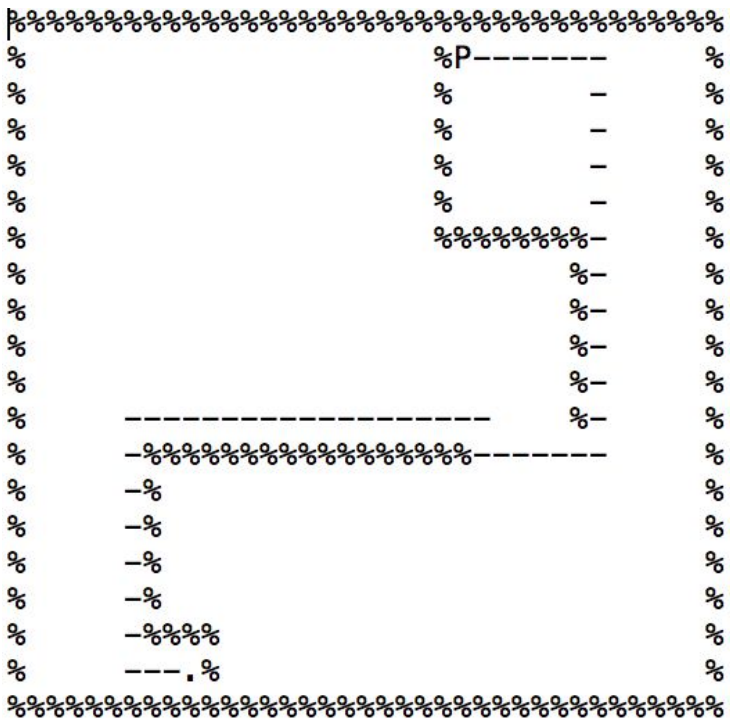
b. bigMaze (Solution cost = 156, Nodes expanded = 2655)



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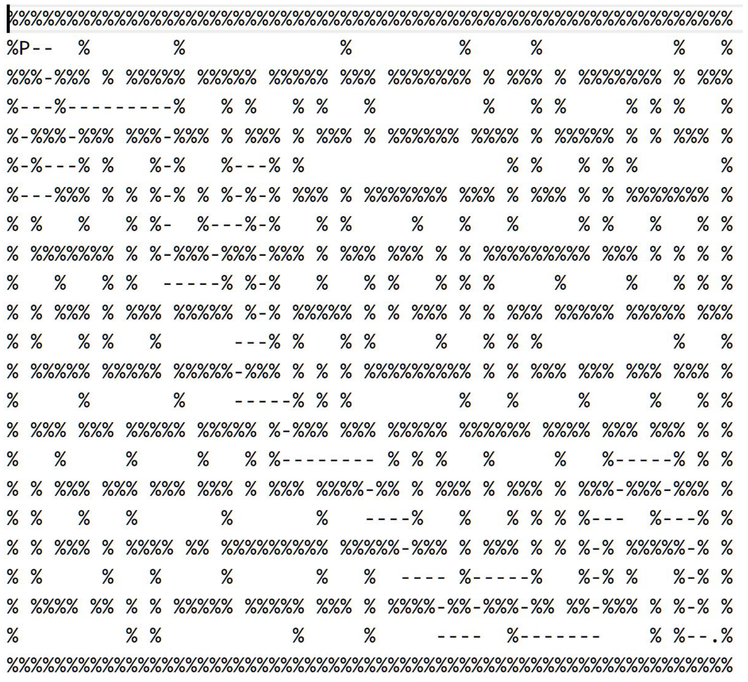
c. openMaze (Solution cost = 53, Nodes expanded = 3214)

3. Greedy Best First Search Solutions

Unlike DFS and BFS, GBFS used priority queue since GBFS seeks the distance that is the closest to the goal point. It used manhattan distance to for heuristic. If pacman can move left top right down and the downside heuristic is the lowest among four, pacman moves toward bottom since manhattan distance (priority) is the shortest. We queued, manhattan distance and X,Y position and dequeued based on priority which is manhattan distance.



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a. mediumMaze (Solution Cost = 115, Nodes Expanded = 143)

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b. bigMaze (Solution cost = 233, Nodes expanded = 293)

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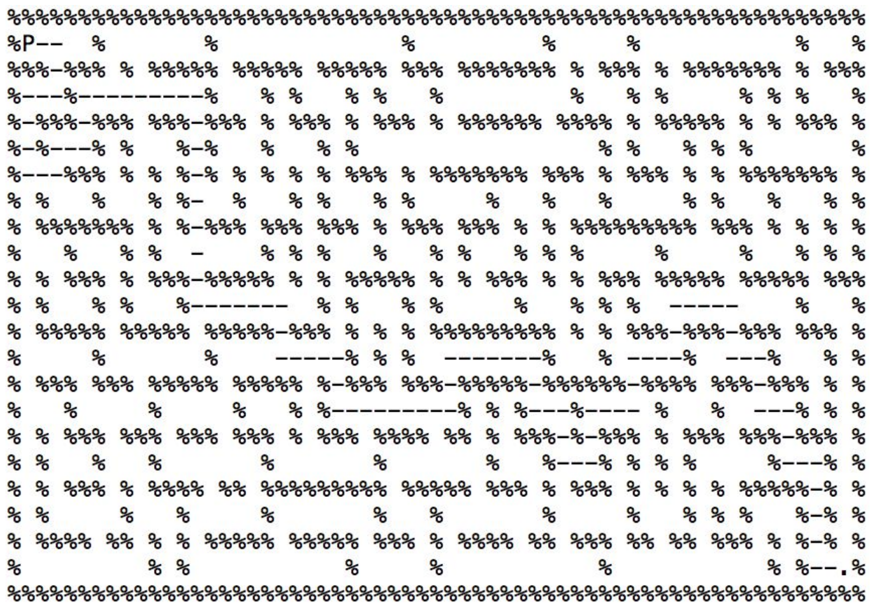
c. openMaze (Solution Cost = 52, Nodes Expanded = 198)

4. A star solution

For A star algorithm, we used priority queue like GBFS but the priority of the queue was given differently. Unlike GBFS which used manhattan distance as priority, A star algorithm used cost from beginning to current position + estimated value of current position to the goal. Manhattan distance was used to estimated value of current position to the goal and we tracked the cost from beginning to current position by incrementing a value whenever pacman made a movement.



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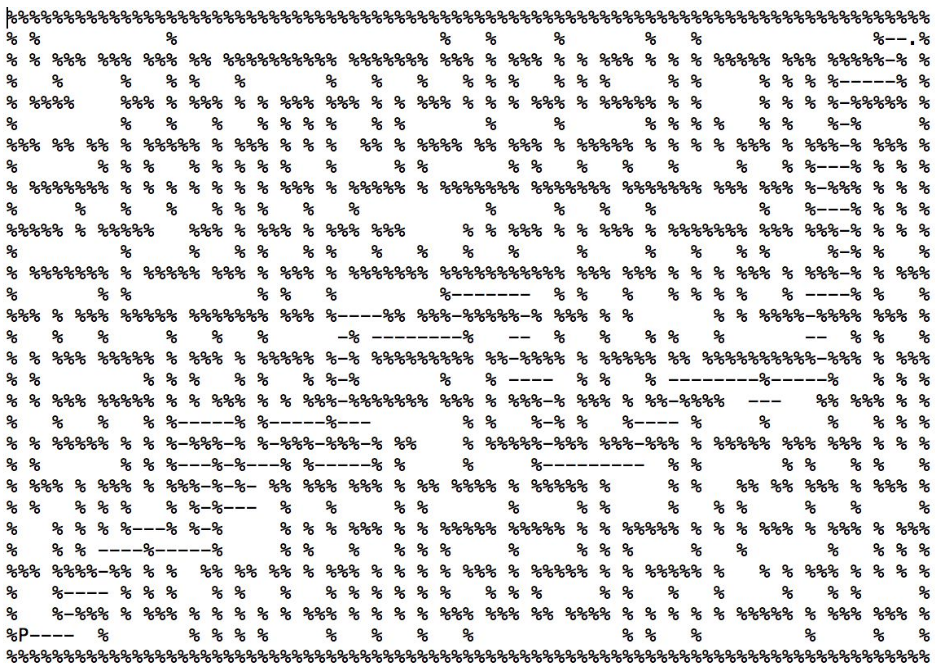
a. mediumMaze (Solution cost = 104, Nodes expanded = 519)



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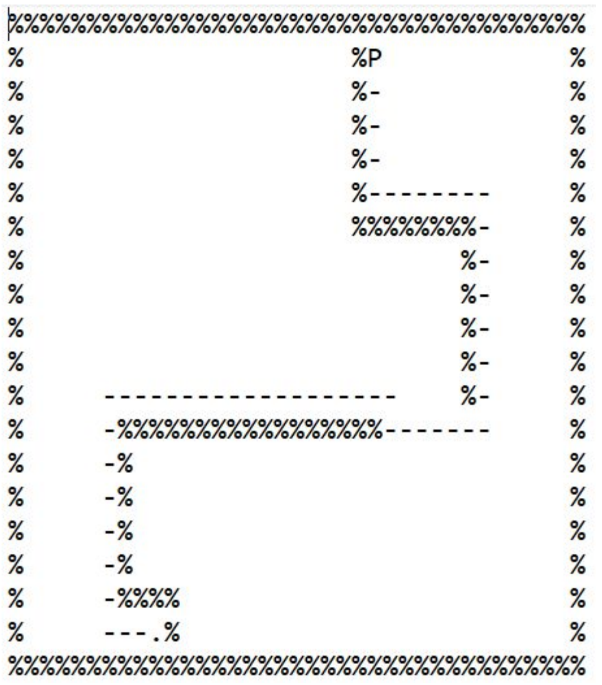
b. bigMaze (Solution cost = 156, Nodes expanded = 1136)



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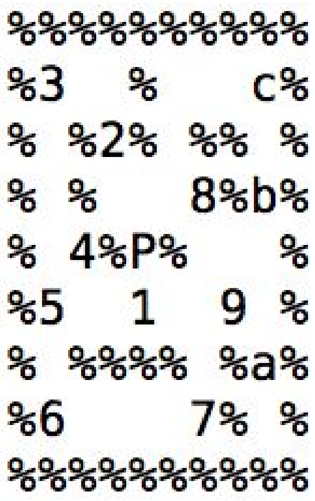
c. openMaze (Solution cost = 53, nodes expanded = 352)

1.2. Search With Multiple Dots

In this problem, we use A* search. We had to change our state representation because there are multiple goals. The state representation is (position, goals remaining). Besides, to improve the performance, we use A* to calculate the distance between points. Initially, the distances between all goals are calculated and stored in a dictionary list. For our heuristic, we use the Minimum Spanning Tree method. The library used was Python's scipy.sparse. For each node, a graph of remaining goals was created based on the calculated distances between goals. The graph was represented by an adjacency matrix. Since Scipy's MST require a CSR matrix, we had to form a CSR matrix based on the adjacency matrix. Then, we got a MST by calling the MST function. The heuristic is the total of MST. It is admissible because the sum of distances between remaining goals will not be more than the actual cost.



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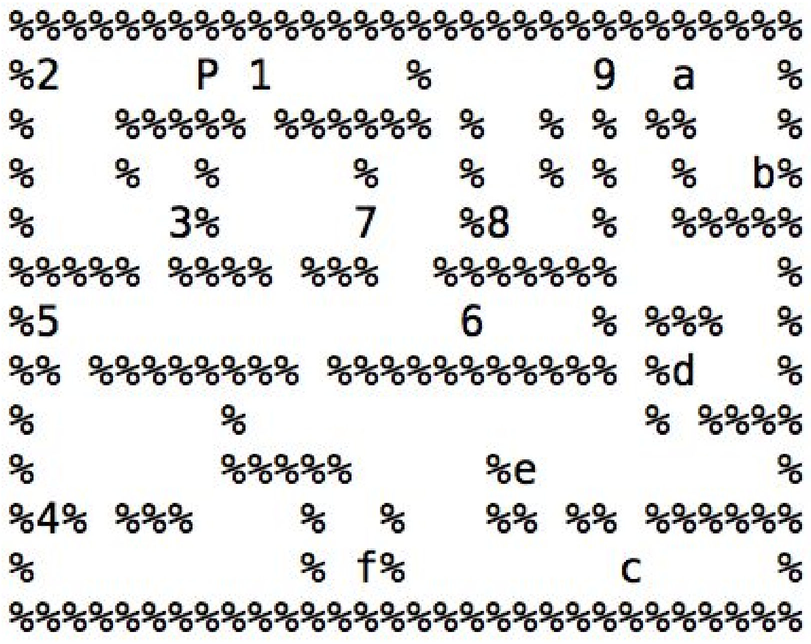
a. tinySearch (solution cost = 35, nodes expanded = 714)



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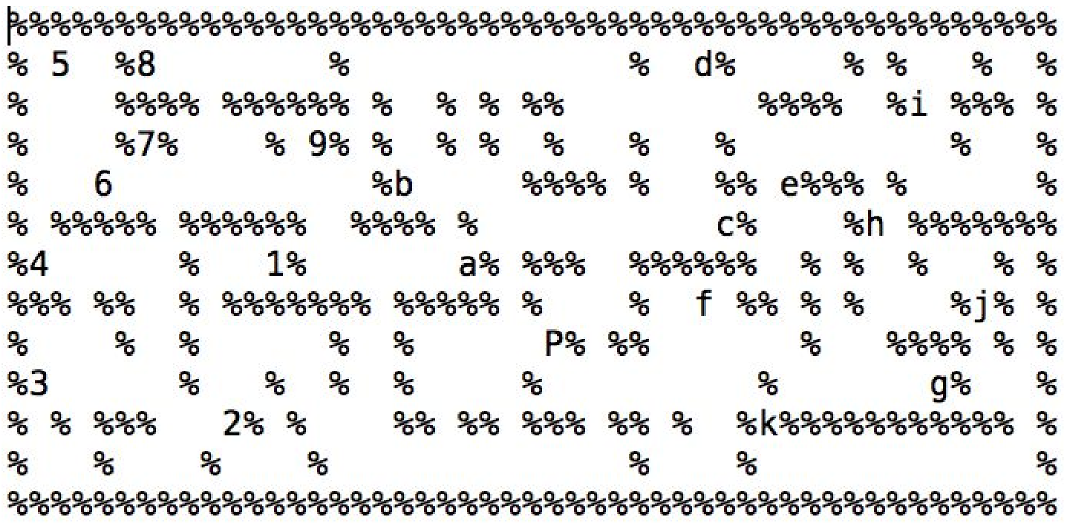
b. smallSearch (solution cost = 124, nodes expanded = 12669)



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c. mediumSearch (solution cost = 198, nodes expanded = 75071)