

## Project 1 report

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## 1 Implementation

### Q 1 to Q4 :

A generic algorithm which returns the list of actions to reach the goal has been implemented for all the search strategies. Parentnode State is stored in the dictionary of explored nodes. This information of parent node states is used to trace the path from the start state to the goal state. Each search strategy differs in data structure that is used to maintain the fringe or the frontier. Depth first search uses stack, Breadth first search uses queue, Uniform cost search uses priority queue, A star uses Priority Queue with function as their respective data structures.

### Q5:

State has been chosen to be tuple of (coordinates, unvisitedcorners). When the number of unvisited corners is zero, the goal state has been reached.

### Q6:

### Q7:

## 2 Statistics

### Q 1 :

#### TinyMaze :

[SearchAgent] using function depthFirstSearch

[SearchAgent] using problem type PositionSearchProblem

Path found with total cost of 10 in 0.0 seconds

Search nodes expanded: 16

Pacman emerges victorious! Score: 500

Average Score: 500.0

Scores: 500

Win Rate: 1/1 (1.00)

Record: Win

**MediumMaze :**

[SearchAgent] using function depthFirstSearch

[SearchAgent] using problem type PositionSearchProblem

Path found with total cost of 130 in 0.0 seconds

Search nodes expanded: 146

Pacman emerges victorious! Score: 380

Average Score: 380.0

Scores: 380

Win Rate: 1/1 (1.00)

Record: Win

**BigMaze :**

[SearchAgent] using function depthFirstSearch

[SearchAgent] using problem type PositionSearchProblem

Path found with total cost of 210 in 0.0 seconds

Search nodes expanded: 391

Pacman emerges victorious! Score: 300

Average Score: 300.0

Scores: 300

Win Rate: 1/1 (1.00)

Record: Win

**Q 2 :**

**MediumMaze :**

[SearchAgent] using function bfs

[SearchAgent] using problem type PositionSearchProblem

Path found with total cost of 68 in 0.0 seconds

Search nodes expanded: 270

Pacman emerges victorious! Score: 442

Average Score: 442.0

Scores: 442

Win Rate: 1/1 (1.00)

Record: Win

**BigMaze :**

[SearchAgent] using function bfs

[SearchAgent] using problem type PositionSearchProblem

Path found with total cost of 210 in 0.1 seconds

Search nodes expanded: 621

Pacman emerges victorious! Score: 300

Average Score: 300.0

Scores: 300

Win Rate: 1/1 (1.00)

Record: Win

**Q 3 :**

**MediumMaze :**

[SearchAgent] using function ucs

[SearchAgent] using problem type PositionSearchProblem

Path found with total cost of 68 in 0.0 seconds

Search nodes expanded: 269

Pacman emerges victorious! Score: 442

Average Score: 442.0

Scores: 442

Win Rate: 1/1 (1.00)

Record: Win

**MediumDottedMaze :**

Path found with total cost of 1 in 0.0 seconds

Search nodes expanded: 187

Pacman emerges victorious! Score: 646

Average Score: 646.0

Scores: 646

Win Rate: 1/1 (1.00)

Record: Win

**MediumScaryMaze :**

Path found with total cost of 68719479864 in 0.0 seconds

Search nodes expanded: 108

Pacman emerges victorious! Score: 418

Average Score: 418.0

Scores: 418

Win Rate: 1/1 (1.00)

Record: Win

**Q4 :**

**Manhattan Heuristic :**

[SearchAgent] using function astar and heuristic manhattanHeuristic

[SearchAgent] using problem type PositionSearchProblem

Path found with total cost of 210 in 0.0 seconds

Search nodes expanded: 539

Pacman emerges victorious! Score: 300

Average Score: 300.0

Scores: 300

Win Rate: 1/1 (1.00)

Record: Win

**Null Heuristic :**

[SearchAgent] using function astar and heuristic nullHeuristic

[SearchAgent] using problem type PositionSearchProblem

Path found with total cost of 210 in 0.1 seconds

Search nodes expanded: 620

Pacman emerges victorious! Score: 300

Average Score: 300.0

Scores: 300

Win Rate: 1/1 (1.00)

Record: Win

**Q5 :**

**tinyCorners :**

[SearchAgent] using function bfs

[SearchAgent] using problem type CornersProblem

Path found with total cost of 28 in 0.0 seconds

Search nodes expanded: 253

Pacman emerges victorious! Score: 512

Average Score: 512.0

Scores: 512

Win Rate: 1/1 (1.00)

Record: Win

**mediumCorners :**

[SearchAgent] using function bfs

[SearchAgent] using problem type CornersProblem

Path found with total cost of 106 in 0.4 seconds

Search nodes expanded: 1967

Pacman emerges victorious! Score: 434

Average Score: 434.0

Scores: 434

Win Rate: 1/1 (1.00)

Record: Win

### 3 Critical Analysis

The following observations and inferences can be made from the statistics.

1. BFS has expanded a lot of nodes before reaching the goal state compared to DFS as DFS searches deeper nodes faster.

2. A-star search finds the goal state by expanding lesser number of nodes if there is a good approximation of heuristic. As observed, in Q4, Manhattan heuristic expands very less number of nodes(539) compared to null heuristic(620) . Hence choosing a admissible and consistent heuristic that better approximates the actual distance to goal state is crucial.