MIIS - AUTONOMOUS SYSTEMS

LAB 01
SEARCH ALGORITHMS

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Question 5 - Finding All The Corners AND Question 6 - Corners Problem: Heuristic

For the Corners Problem the state representation is the following:

- S_0 Initial State: Initial localization of Pacman in the maze
- S_G Goal States: 4 corners
- $|S|$ State Space: $((n \times m) - w) \times ((n \times m) - w)^C$
    - $n \times m$: Maze grid
    - w: Walls Location
    - c: Corners
- $A(s)$ Actions: up, down, left, right

The heuristic chosen is consistent, meaning that it will always choose the same corners for a given situation. Provides a solution for the simpler problem of finding the amount of moves when not taking into account existence of walls. The heuristic will return 0 at a goal state since the minimum distance to a corner when in a corner is 0, and will never return a negative since *manhattanDistance()* can never be negative.

With respect to admissibility, the estimates made for the path used in A* when using the heuristic, are optimistic so then A* can ignore those nodes because they can not possibly lead to a cheaper solution than the one found.

When using A* without heuristics the number of nodes expanded is substantially greater (2448) than the ones expanded when including the heuristic (901), despite both of them path total cost is the same (106).

```
[SearchAgent] using function astar and heuristic nullHeuristic
[SearchAgent] using problem type CornersProblem
Path found with total cost of 106 in 0.5 seconds
Search nodes expanded: 2448
Pacman emerges victorious! Score: 434
Average Score: 434.0
Scores:        434.0
Win Rate:      1/1 (1.00)
Record:        Win
```

Figure 1. A* without heuristic function

```
[SearchAgent] using function astar and heuristic cornersHeuristic
[SearchAgent] using problem type CornersProblem
Path found with total cost of 106 in 0.1 seconds
Search nodes expanded: 901
Pacman emerges victorious! Score: 434
Average Score: 434.0
Scores:        434.0
Win Rate:      1/1 (1.00)
Record:        Win
```

Figure 2. A* with heuristic function

Question 7 - Eating All The Dots

The most important part about this problem is that the agent has to eat all the food in as few steps as possible. There are not ghosts or power pellets, so the only thing that really matters is the location of the walls, of the food and the Pacman itself. The heuristic will return 0 at every goal state and so we want to begin by initializing the current state of the Pacman. Then, the code will iterate over the next path segments and will try to find the closest path to the dots. For every action in the other path segments the code will get the legal actions, only if the actions are illegal an exception will be raised. With this in mind, the path found by the Pacman had a total cost of 60 in 21.1 seconds and the search nodes expanded were 376, which can be a bit slower than usual but the number of search nodes is very low and that was one of the main goals of the problem.

```
Path found with total cost of 60 in 21.1 seconds
Search nodes expanded: 376
Pacman emerges victorious! Score: 570
Average Score: 570.0
Scores:        570.0
Win Rate:      1/1 (1.00)
Record:        Win
```

Figure 3. Eating All the Dots