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Report

1- I defined state as cleaner's location (as a tuple (x,y)) and map itself (as a list) in a tuple. Of course, only change in map is number of dirts but it is easier to track it when it is represented as map.

2- If the dimensions of map is NxM, there are NxM positions cleaner can take. There are also dirts. Therefore, one location in the map can be undirted or dirted 1 to 9. This makes 10^m states where m is the number of dirted locations in the map. In total:

$$Total\ number\ of\ states = NM10^m$$

3- My heuristic function is almost same with Manhattan distance except multiplying 2 with movement in the vertical direction. I did this because of the moving in the vertical direction is double of horizontal direction.

$$|x - x\_goal| + 2 \times |y - y\_goal|$$

I think, better heuristic function would take into account the walls between current node and goal position but I could not find such solution.