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 AI-CL02

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ASSIGNMENT # 01

Scenario Given :

① 10x10 grid

	0	1	2	3	4	5	6	7	8	9
0	S	12	11	10	9	X	8	7	6	5
1	X	X	10	9	X	X	7	6	X	5
2	11	10	9	8	7	6	5	X	3	2
3	10	9	8	7	6	X	X	X	2	1
4	9	8	7	X	5	4	3	X	1	0
5	X	X	8	7	X	X	5	X	2	1
6	#	10	9	8	X	6	5	4	3	2
7	12	11	10	9	8	7	6	X	X	3
8	13	12	11	10	9	8	7	6	5	4
9	X	X	X	X	X	9	8	X	X	5

S = Start State (0,0)

G = Goal State (4,4)

X = Represent walls or obstacles.

Dot (.) = represent path

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Implement A* Search to find most cost-efficient path, considering distance & obstacles

→ The A* Search is the informed Search Algo so; heuristic function used will be Manhattan Distance;

$$MD = |x_2 - x_1| + |y_2 - y_1|$$

$$\therefore (x_2, y_2) = (4, 9)$$

e.g # Calculate all the Distances :-

$$\therefore \text{for } S(x_1, y_1) = (|(4-0)| + |9-0|) \\ = 13$$

Now; A* Search Algo states

$$f(n) = g(n) + h(n)$$

from (n) to Goal

↑
Steps from S → n

Explanation :

S(0,0) starts moving to n (0,1) to (0,2)

Here it has 2 options

$$\therefore g(n) = 2 \text{ and } h_1(n) = 10 \quad f(n) = 12$$
$$h_2(n) = 10 \quad \text{same for both!}$$

If it move to (0,3) it face wall so

It moves to (1,2) then to (2,2) → Decision making

$$\therefore g(u) = 4; \quad h_1(u) = 10 \rightarrow f(u) = 14$$
$$h_2(u) = 8 \rightarrow f(u) = 12 \text{ least}$$

moves to $f(n) = 12$ which is $(2,3)$

then keeps on moving till $(2,5)$

where again it has 2 options;

$$\therefore g(n) = 7 ; h_1(n) = 7 \rightarrow f(n) = 14$$

$$h_2(n) = 5 \rightarrow f(n) = 12$$

If it chooses $f(n) = 12$ it faces wall

so it chooses and backtracks to

$f(n) = 14$ and moves to $(0,5)$

where it again decides and chooses least distance, $(0,6)$

it keeps moving till it gets its goal

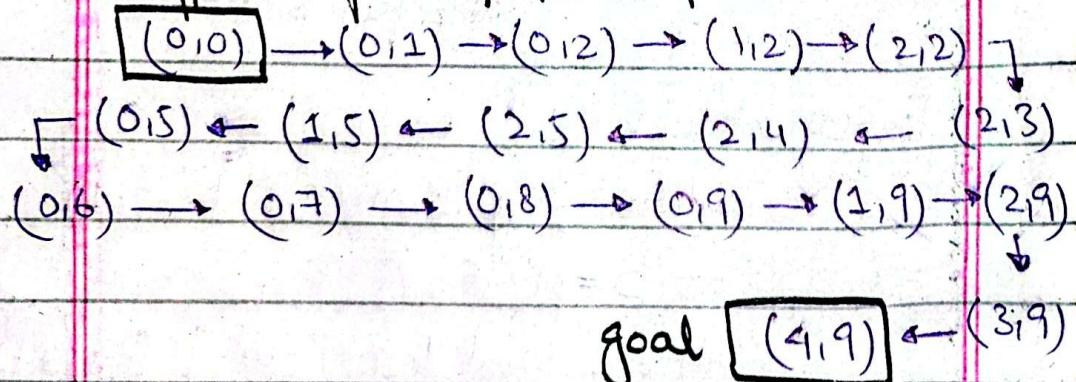
$(4,9)$

Hence;

③

Total cost (no. of steps) = 17

* efficient path / optimal path :



② Calculate $h(n)$, make sure it is admissible and consistent

- $h(n) \rightarrow$ Manhattan Distance to goal calculated.

○ Admissibility :

A heuristic is admissible if for every node n ,

$$h(n) \leq \text{true minimal cost from } n \text{ to goal}$$

- In a 4-connected grid where each move costs 1, the smallest possible # of moves from cell (x,y) to $(4,9)$ equals to Manhattan Distance $|x-4| + |y-9|$
- Therefore $h(n)$ (Manhattan) never overestimates the true cost
Hence admissible.

○ Consistency (monotonicity) \rightarrow Why h is consistent?

A heuristic is consistent if for every node (x) and every successor (y) neighbour,

$$h(x) \leq \text{cost}(x,y) + h(y)$$

Since each move in the grid costs 1, and the MD b/w 2 adjacent cells changes by at most 1, $\rightarrow |h(x) - h(y)| \leq 1 \rightarrow h(x) \leq 1 + h(y)$