'Assignment-01'

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# Ans. to the que. no - 01

| | | |
|---|---|---|
| 2 | 8 | 3 |
| 1 | 6 | 4 |
| 7 | | 5 |

Initial state

$g(n)$ = depth of node

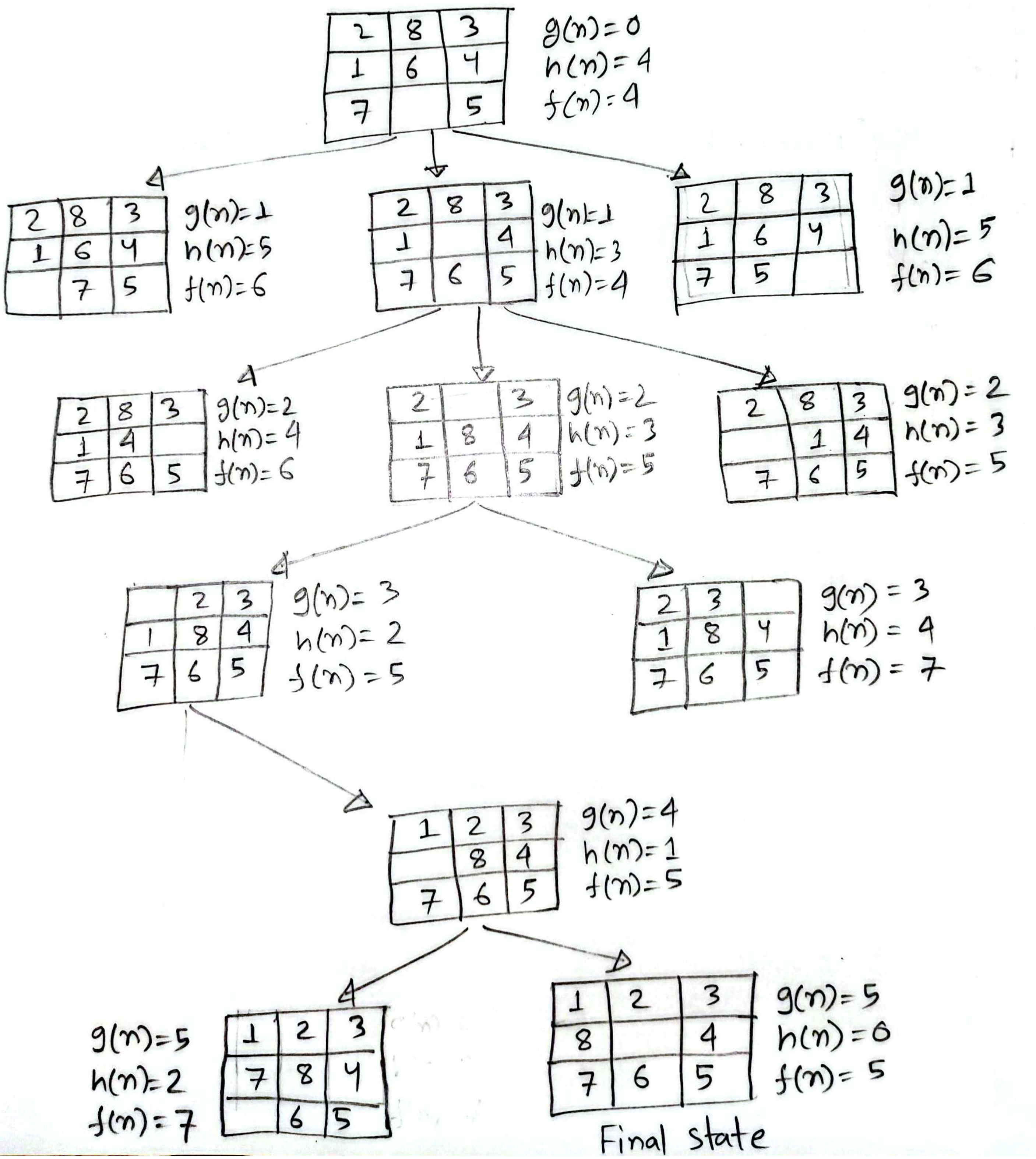
$h(n)$ = hamming distance

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

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 8 | | 4 |
| 7 | 6 | 5 |

Final state

Search tree generated using A* algorithm from initial state,



# Ans. to the question no-02

(a)

Given, a $N \times N$ maze where exit point is at $(N,N)$.

$h_1$ = Euclidean distance

$h_2$ = Manhattan distance

Here, $h_2$ is manhattan distance which we know,

$$\text{manhattan distance} = |(x_2-x_1)| + |(y_2-y_1)|$$

Now, consider starting point is at $(1,1)$. So,

$$h_2 = |(N-1)| + |(N-1)|$$

$$= 2N-2$$

$$= 2(N-1)$$

However, as diagonal moves are allowed the optimal distance from $(1,1)$ to $(N,N)$ would be $\sqrt{2}(N-1)$ as diagonal movement cost $\sqrt{2}$.

From the definition of admissible heuristic,

$$h(n) \leq h^*(n)$$

but,

$$2(N-1) > \sqrt{2}(N-1)$$

So, $h_2$ here overestimates the path cost. So, it is not an admissible heuristic.

(b)

$h_1$ is euclidean distance which is,

$$\text{euclidean distance} = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Now, from (1,1) to (N,N).

$$h_1 = \sqrt{(N-1)^2 + (N-1)^2}$$
$$= \sqrt{2(N-1)^2}$$
$$= \sqrt{2}(N-1)$$

as diagonal movements are allowed and costs $\sqrt{2}$, the optimal distance is,

$$h^*(n) = \sqrt{2}(N-1)$$

So, $h_1 \leq h^*(n)$ as $\sqrt{2}(N-1) \leq \sqrt{2}(N-1)$. It means $h_1$ is admissible heuristic.

However, if we multiply $h_1$ by 1.2,

$$\sqrt{2}(N-1) * 1.2 > \sqrt{2}(N-1)$$

the heuristic overestimates the path cost and will no longer be an admissible heuristic.

# Ans. to the question no-3

The objective function,

$$E(\theta) = |\theta * \sin(\theta) * \cos(\theta^2)|$$

given intial value, $\theta = 0.7$.

$$\therefore E(\theta) = E(0.7) = |0.7 * \sin(0.7) * \cos(0.7^2)|$$
$$= 0.3979$$

Neighbouring value of 0.7 are 0.6 and 0.8.

For $\theta = 0.6$,

$$E(\theta) = E(0.6) = |0.6 * \sin(0.6) * \cos(0.6^2)|$$
$$= 0.3171$$

for $\theta = 0.8$,

$$E(\theta) = E(0.8) = |0.8 * \sin(0.8) * \cos(0.8^2)|$$
$$= 0.4603$$

So, as $E(0.6) < E(0.8)$ and $E(0.8) > E(0.7)$, we take $\theta = 0.8$ as the next value.

Again, neighbour for 0.8 are 0.7 and 0.9.

For $\theta = 0.7$,

$$E(\theta) = 0.3979$$

for $\theta = 0.9$,

$$E(\theta) = E(0.9) = |0.9 * \sin(0.9) * \cos(0.9^2)|$$

$$= 0.4861$$

similarly, as $E(0.7) < E(0.9)$ and $E(0.9) > E(0.8)$, we choose $\theta = 0.9$ as next value.

Again, neighbour for 0.9 are 0.8 and 1.0.

For $\theta = 0.8$,

$$E(0.8) = 0.4603$$

For $\theta = 1.0$,

$$E(\theta) = E(1.0) = |1 * \sin(1) * \cos(1^2)|$$

$$= 0.4546$$

As, $E(0.8) > E(1.0)$ we choose 0.8 as best neighbour.

However, $E(0.9) > E(0.8)$. So, our algorithm halts and returns $E(0.9) = 0.4861$ as the maximum value.

Therefore, our hill climbing algorithm finds $E(0.9) = 0.4861$ as the maximum value.

(Ans.)