Assignment - AI 41403

- Title: 8 puzzle using A^* Algorithm
- problem definition: Solve 8-puzzle problem using A^* Algorithm. Assume any initial configuration & define goal configuration clearly.

- Learning objectives: - learn informed search algorithms
  - learn A^* algorithm & its app^n
  - Learn about 8 puzzle problem
  - To define perception, cognition, Action & Goal clearly.

- Outcomes: I will be able to design A^* algorithm to solve the 8 puzzle problem.

- S/w & H/w : OS 64 bit, python 3, jupyter environment

- mathematical model:

$S = \{s; e; X; Y; fme; Ff; DD; NDD\}$

s = start state

- $\{\{1,2,3\}, \{0,4,6\}, \{7,5,8\}\}$

e = end state

- $\{\{1,2,3\}, \{4,5,6\}, \{7,8,0\}\}$

$X = \{X1\}$

- $X1 = s$

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$Y = \{Y1\}$

* $Y1 = e$

$Fme = \{fo\}$

* fo = function to perform A* searching

$f_f = \{f_1, f_2, f_3, f_4, f_5\}$

where

* f_1 - fun to find cost
* f_2 - fun to find states
* f_3 - fun to display grid
* f_4 - fun to generate next possible set of moves
* f_5 - fun to validate moves

DD - 3x3 grid of puzzle

NDD - No non deterministic data.

- Concept related theory.

8 - puzzle problem.

- 8 puzzle is a popular puzzle that consists of 8 tiles & one empty space
- The puzzle is divided into 3 rows & 3 columns
- The other 8 tiles have numbers 1 through 8 on it.
- The puzzle can be solved by moving the tiles one by one in the single empty space & thus achieving the goal state.

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Start state.

$S = \{\{1,2,3\}, \{0,4,6\}, \{7,5,8\}\}$

1	2	3
	4	6
7	5	8

- perception
  - we visualize swapping the empty space with its neighbours
  - The empty tile can have 3 possible locations
  - $\exists x . (move(x) \wedge valid\ location(x))$
  - The empty space can only move in four directions.
  - The empty space cannot move diagonally and can take only one step at a time
  - $\exists x\ (move(x) \rightarrow \sim diagonal(x))$

- cognition:

cost of A* algorithm: $f(n) = g(n) + h(n)$

- $g(n)$ is the cost of the path traversed from the initial state to node n.
- $h(n)$ is the estimated path-cost or the heuristic function cost from node n to goal node.

$g(n)$ = path cost.

- each step costs 1, so the path is no. of steps in the path.

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For any 8-puzzle's tile

- misplaced(i) = $\{((x_{1i} = x_{2i}) \wedge (y_{1i} = y_{2i}))$ $\forall$ $x_1, y_1, x_2, y_2 \in \{0,1,2\}$

where,

(x_1, y_1) is the coordinate of the tile with no. of i in current state

(x_2, y_2) is the coordinate of the tile with i in goal state

- $x_i, y_i, x_{2i} y_{2i} \in \{0,1,2\}$
- $i \in \{0,1,2,3,4,5,6,7,8\}$
- $h(n)$ = misplaced(i) for $0 \le i \le 8$
- Action - {U, L, D, R}
  - action can represented as set of 4
  - each action represents the interchanging of blank tile with the neighbour tile one of the 4 direction
  - constraints
    - the neighbour should not be diagonally adjacent
    - the edge positions can interchange in only three direction
    - the corner in 2 positions

$f_{min} = min(f_1, f_2 \ldots f_n)$

- Goal state

1	2	3
4	5	6
7	8	

- conclusion: I have successfully designed A* search algorithm for 8 puzzle & defined perception cognition, Action & Goal for the same.