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Batch 1

AI: Lab Assignment. 1

Aim: Solve 8 puzzle problem using A* algorithm.

Objective: To study and implement A* algorithm for 8 puzzle problem.

Theory:

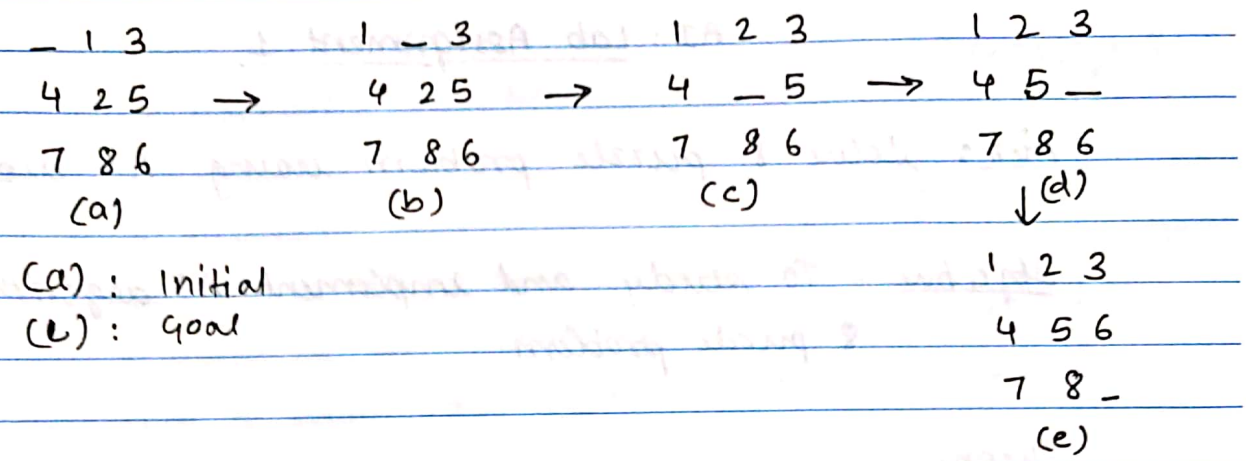
- **Best First Search Method & OR graphs**

Best First search algorithm which explores a graph by expanding the most promising node chosen according to a specified rule. It is described as estimating the promise of node n by a heuristic evaluation function f(n) which in general may depend on the description of n, the description of goal, the information gathered by the search up to that point.

The OR graph is useful for representing the solution of problems that can be solved by decomputing them into a set of smaller problems all of which must then be solved

- **8 Puzzle Problem**

The 8 puzzle problem is a puzzle invented ~~by~~ and popularized by Noyes Palmer Chapman. It is played on a 3X3 grid with 8 square blocks labeled 1 through 8 and a blank square. Your goal is the rearrangement of the blocks so that they are in order.



(a) : Initial
(b) : Goal

- Data structures and other details about A* algorithm including ~~ago~~ algorithm.

A* algorithm is one of the best and popular techniques used for path finding and graph traversals. A lot of games and web based maps used this algorithm for finding the shortest path efficiently. It is essentially a best first search algorithm.

A* algorithm works as:

1. It maintains a few of paths originating at the start node.
2. It extends these paths one edge at a time.
3. It continues until its termination criterion is satisfied.

Input: Initial State
Output: Solution state with Optimal Path
Algorithm: A*
Programming Language: C/C++/ Python

FAQs.

1) What is heuristic function? What is the advantage of using heuristic function?

→ It is a function which is used informed search and it finds the most promising path. It takes the current state of agent as its input and output produces the estimation of how close agent is from the goal.

Advantages:

a) It can provide some quick and relatively inexpensive feedback to designers.

b) you can obtain feedback early in the design process

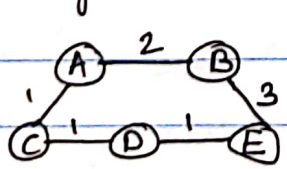
d) Assigning the correct heuristic can help suggest the best corrective measure to designers.

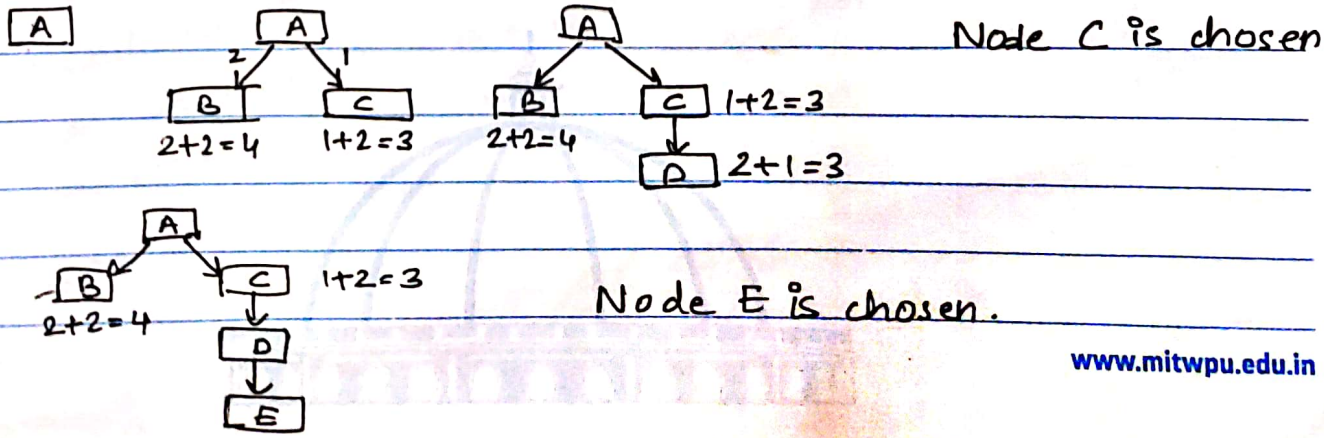
2) Explain A* algorithm with example.

→ A* algorithm is a searching algorithm that searches for the shortest path between the initial and final state. It is used in various applications such as maps.

Example: Suppose you have following graph and you apply A* algorithm on it. Initial Node A and Goal Node is E.

Graph:





3) Explain different heuristic functions that can be used for the 8-puzzle problem.

→ Nilsson's sequence score : $h(n) = P(n) + 3S(n)$

$P(n)$ is the manhattan distance of each tile from its proper position.

"The quantity $S(n)$ is a sequence score obtained by checking around the noncentral squares in turn, allotting 2 for every tile not followed by its proper successor and 0 for every other tile, except that a piece in the center scores 1."

This might be easier to understand if you know that the goal state that Nilsson uses is represented by :
(1 2 3 8 space 4 7 6 5). This heuristic is not admissible.

X-Y: decompose the problem into two one dimension problems where the "space" can swap with any tile in an adjacent row/column. Add no. of steps from the two subproblems.

- No. of tiles out of row plus no. of tiles out of column.
- n-MaxSwap : assume you can swap any tile with the "space". use the no. of steps it takes to solve this problem as the heuristic value.
- n-Swap : represent the "space" as a tile and assume you can swap any two tiles. Use the no. of steps it takes to solve this problem as the heuristic value.