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Artificial Intelligence

8- Block Puzzle

Aim:

The aim of this experiment is to explore and compare the performance of various search algorithms - specifically Best-First Search with 2 different heuristics. The goal is to determine which algo is most efficient in terms of the number of moves required to reach solution, given a randomly generated initial state.

Algorithm Overview:

1. Best-First Search:
   - Heuristic h1:
     Counts number of misplaced tiles in the current state compared to goal state.
   - Heuristic h2:
     Calculates Manhattan dist for all tiles, which is sum of verticle & horizontal dist. between each tile's current posn and its goal posn.
2. Breadth-First Search:
   Explore all possible states level by level, ensuring that shortest path to the solution is found. Guaranteed optimal solution.
3. Depth-First Search
   Explore as far down a branch as possible before backtracking.

Methodology:

1. Problem setup:
   - A random start state is given
   - 'Eight puzzle' class is implemented to manage puzzle's state, generate possible moves, and apply search algorithms.
2. Search Implementation:
   - Best-First Search
   - Breadth-first Search
   - Depth-First Search
3. Performance Comparison:
   - Each algo is executed, & number of moves required to solve the puzzle is recorded.
   - The results are then graphically represented using a bar chart to compare that performance of each algorithm.

2	6	7
8	8	4
1	5	3

Random Initial State

1	2	3
8		4
7	6	5

Goal state

8-Block Puzzle

Architecture:

1. Data Structure:
   - 2D Array: for Start & goal state
   - Priority queue: used in BFS
   - Queue: used in BFS to maintain order of nodes
   - Stack: used in DFS to enable backtracking along different branches.

2. Class structure:
   - Eight Puzzle class:
     Encapsulates puzzle's state, move generation, and implementation of search algos
   - Heuristic Functions:
     'h1' & 'h2' are implemented as methods within the 'EightPuzzle' class to calculate the number of misplaced tiles & the Manhattan distance, respectively.

3. Visualization:
   - Matplotlib.pyplot
   - Matplotlib.Animation.

Conclusion:

This provides us the best algo to complete the puzzle.