

Assignment 1

Using Informed and Uninformed Search Algorithms to Solve 8-Puzzle

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Problem statement:

Solving 8_puzzle game using algorithms like BFS , DFS and A*

the data structure used (if any) and algorithms:

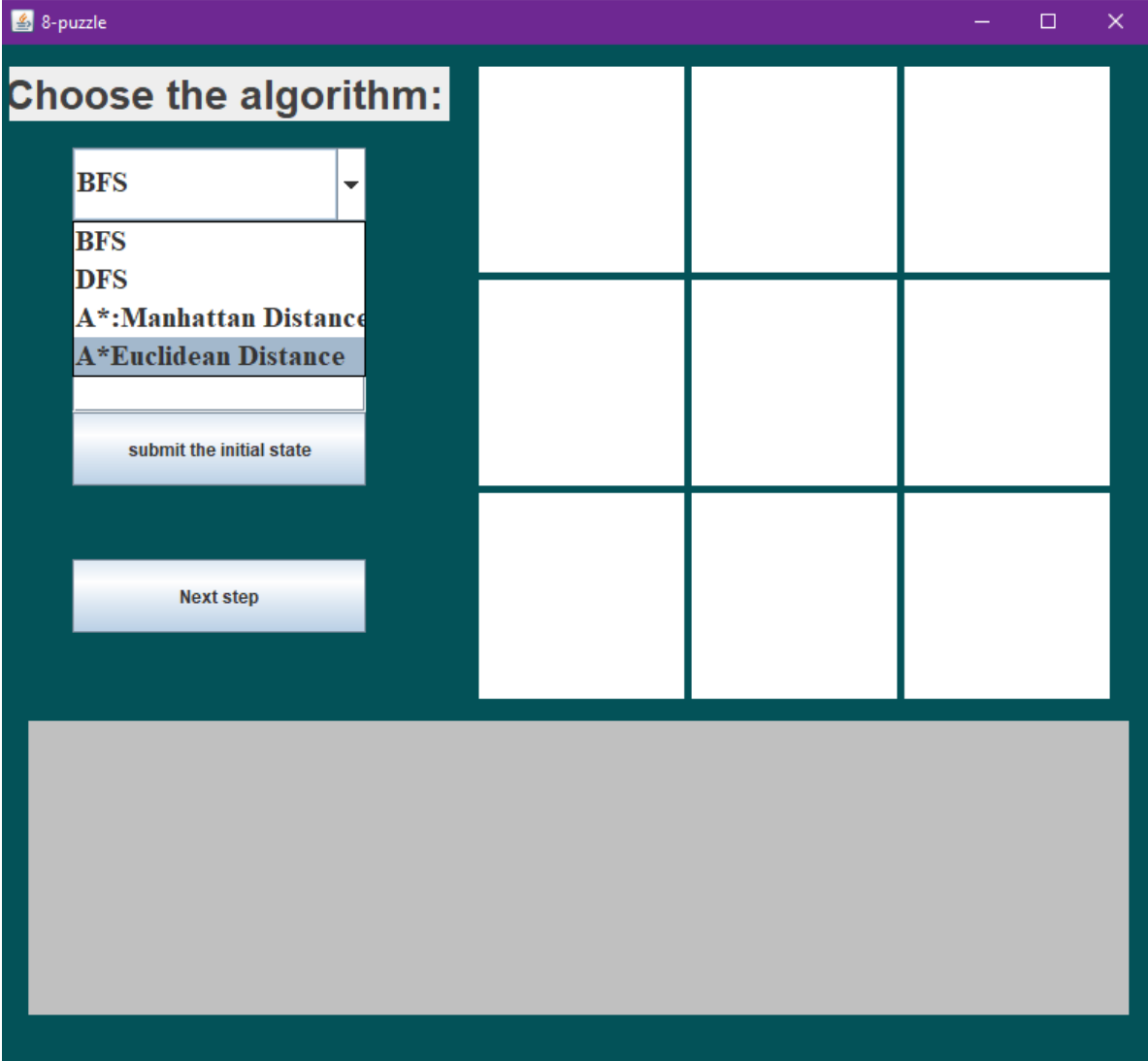
1. Queue: in BFS technique as frontier.
2. Stack: in DFS technique as frontier.
3. Priority Queue: in A* as frontier.
4. Hash set: as explored list, as frontier set in BFS and DFS, as the running time of queue and stack is $O(n)$.
5. Hash map: in A star Manhattan and A star Euclidean to store the lowest cost for the states that are currently in the frontier only, as the complexity of the priority queue is $O(n)$.
6. Linked list: to store children(neighbours) and the path.

Assumptions:

- The code can detect any unsolvable and invalid states and does not solve them.
- Simulation to show the path to the goal (by pressing button next step)
- We assumed that the algorithm moves up the down then right then left

How to use:

- To run the program user should first choose the search algorithm that he wants from the drop-down menu (BFS, DFS, A* Manhattan, A* Euclidean) used to solve the puzzle.



The screenshot shows a web application window titled "8-puzzle". The interface is divided into several sections:

- Choose the algorithm:** A label above a dropdown menu.
- Dropdown menu:** Contains the following options: "BFS", "DFS", "A*:Manhattan Distance", and "A*Euclidean Distance". The "A*Euclidean Distance" option is currently selected and highlighted.
- submit the initial state:** A button located below the dropdown menu.
- Next step:** A button located below the "submit the initial state" button.
- Puzzle Grid:** A 3x3 grid of empty squares, intended for displaying the puzzle state.
- Results Area:** A large, empty gray rectangular box at the bottom of the interface, intended for displaying search results.

- Then enter the initial state in this form (012345678) and press on submit button, numbers will appear on the square, the results (the path to goal, cost of path, nodes expanded, search depth and the running time) also will appear under it.

8-puzzle

Choose the algorithm:

DFS

125340678

submit the initial state

Next step

1	2	5
3	4	
6	7	8

-->Cost of path :3
-->Search depth :66056
-->Running time :726
-->Nodes expanded :181438

- Pressing the next step button to show all the steps of solving the puzzle.

8-puzzle

Choose the algorithm:

DFS

125340678

submit the initial state

Next step

1	2	
3	4	5
6	7	8

-->Cost of path :3
-->Search depth :66056
-->Running time :726
-->Nodes expanded :181438

- There will be some states with unsolvable or not valid conditions.

Sample runs:

- Starting with an already solved puzzle (goal state):

The screenshot shows a window titled "8-puzzle" with a purple title bar. On the left, there is a control panel with a label "Choose the search algorithm:" and a dropdown menu showing "A*:Manhattan Dis...". Below this is a text input field containing "012345678" and a button labeled "submit the initial state". At the bottom of the control panel is a button labeled "Next step". To the right of the control panel is a 3x3 grid representing the puzzle state. The top row contains an empty cell, the number 1, and the number 2. The middle row contains the numbers 3, 4, and 5. The bottom row contains the numbers 6, 7, and 8. Below the grid, a grey box displays the following statistics: "-->Cost of path :0", "-->Search depth :0", "-->Running time :0", and "-->Nodes expanded :0".

	1	2
3	4	5
6	7	8

-->Cost of path :0
-->Search depth :0
-->Running time :0
-->Nodes expanded :0

- BFS example(with simulation):

8-puzzle

Choose the search algorithm:

BFS

125340678

submit the initial state

Next step

1	2	5
3	4	
6	7	8

-->Cost of path :3
-->Search depth :3
-->Running time :0
-->Nodes expanded :11

8-puzzle

Choose the search algorithm:

BFS

125340678

submit the initial state

Next step

1	2	
3	4	5
6	7	8

-->Cost of path :3
-->Search depth :3
-->Running time :0
-->Nodes expanded :11

8-puzzle

Choose the search algorithm:

BFS

125340678

submit the initial state

Next step

1		2
3	4	5
6	7	8

-->Cost of path :3
-->Search depth :3
-->Running time :0
-->Nodes expanded :11

8-puzzle

Choose the search algorithm:

BFS

125340678

submit the initial state

Next step

	1	2
3	4	5
6	7	8

-->Cost of path :3
-->Search depth :3
-->Running time :0
-->Nodes expanded :11

- DFS example (Base example up-up):

8-puzzle

Choose the algorithm:

DFS

312645078

submit the initial state

Next step

3	1	2
6	4	5
	7	8

Cost of path :2

Search depth :2

Running time :0

Nodes expanded :3

8-puzzle

Choose the algorithm:

DFS

123457860

submit the initial state

Next step

1	2	3
4	5	7
8	6	

Cost of path :62842

Search depth :62846

Running time :352

Nodes expanded :80411

- A* example :

The screenshot shows a window titled "8-puzzle" with a purple header bar. On the left, there is a control panel with a label "Choose the algorithm:" and a dropdown menu showing "A*:Manhattan Dis...". Below this is a text input field containing the sequence "768243105" and a button labeled "submit the initial state". At the bottom of the control panel is a button labeled "Next step". To the right of the control panel is a 3x3 grid representing the puzzle state. The grid contains the numbers 7, 6, 8 in the top row; 2, 4, 3 in the middle row; and 1, an empty space, 5 in the bottom row. Below the grid, a grey rectangular box displays the following results: "-->Cost of path :27", "-->Search depth :27", "-->Running time :68", and "-->Nodes expanded :4919".

Choose the algorithm:		
A*:Manhattan Dis... ▼		
768243105		
submit the initial state		
Next step		

7	6	8
2	4	3
1		5

-->Cost of path :27
-->Search depth :27
-->Running time :68
-->Nodes expanded :4919

- Unsolvable example:

The image shows a web application window titled "8-puzzle". On the left side, there is a control panel with a label "Choose the algorithm:" above a dropdown menu currently set to "DFS". Below this is a text input field containing the sequence "432650781", followed by a button labeled "submit the initial state". At the bottom of the control panel is a button labeled "Next step". To the right of the control panel is a 3x3 grid representing the puzzle state. The tiles in the grid are numbered as follows: the top row contains 4, 3, and 2; the middle row contains 6, 5, and an empty space; the bottom row contains 7, 8, and 1. Below the grid, a large grey rectangular area displays the word "unsolvable" in a bold, black, sans-serif font.

Choose the algorithm:			
DFS	4	3	2
432650781	6	5	
submit the initial state	7	8	1
Next step	unsolvable		

- Not valid situation :

The screenshot shows a window titled "8-puzzle" with a purple title bar. The main interface has a dark teal background. On the left side, there is a control panel with the following elements:

- A label "Choose the algorithm:" in a light gray box.
- A dropdown menu showing "A*Euclidean Dista..." with a downward arrow.
- A text input field containing the number "123456788".
- A button labeled "submit the initial state".
- A button labeled "Next step".

To the right of the control panel is a 3x3 grid representing the puzzle state. The grid is currently empty, with all cells being white. Below the grid is a large gray rectangular area containing the text "NOT VALID" in bold, black, uppercase letters.