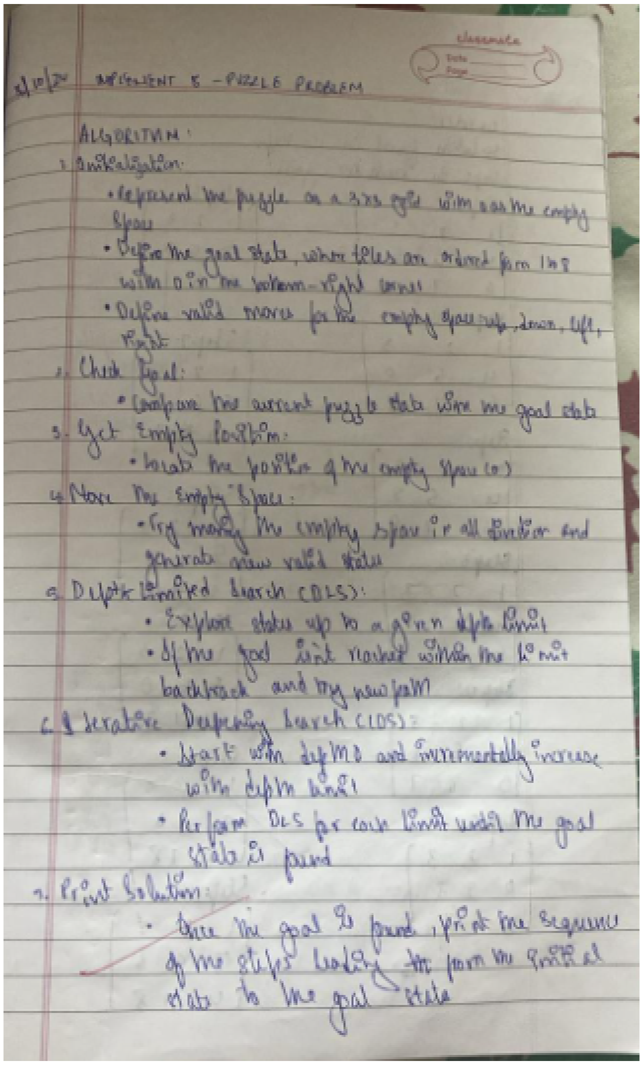
Date:8/1024

Program Title:Implement 8 Puzzle Problem

Algorithm:



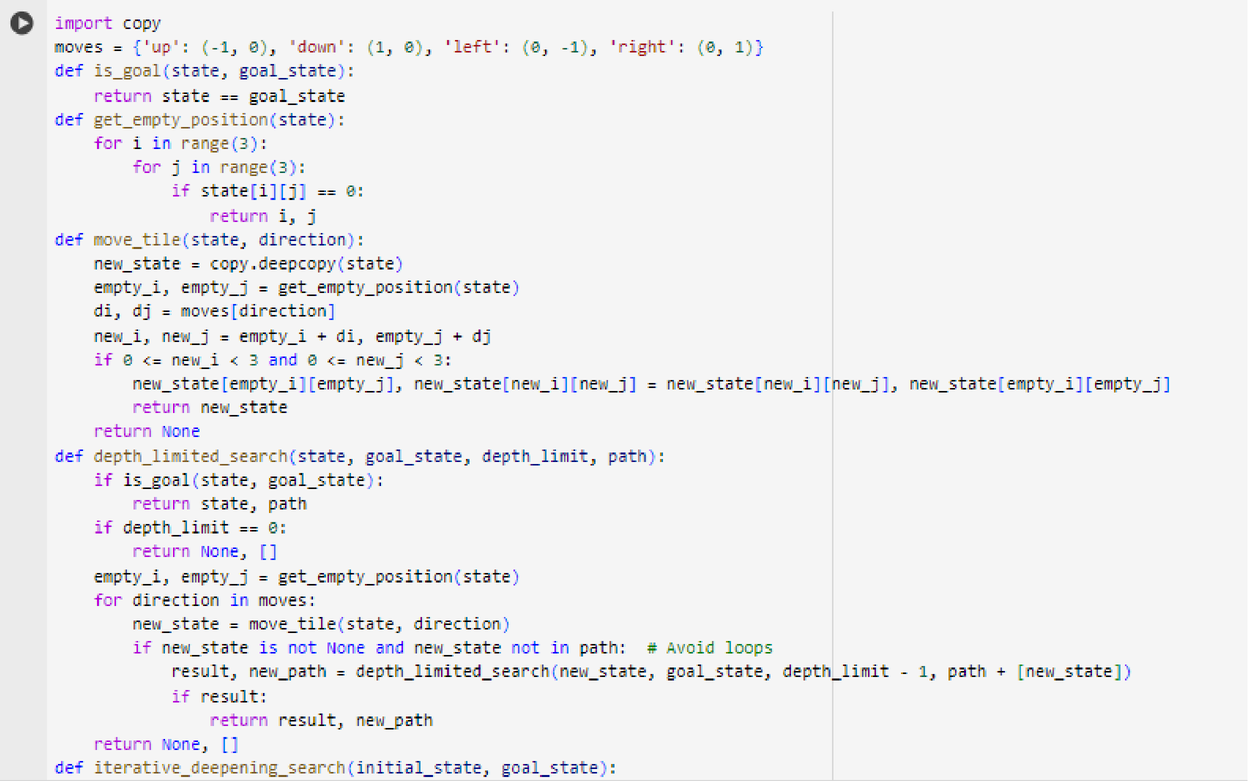
Date
Page

8/10/24 IMPLEMENT 8 - PUZZLE PROBLEM

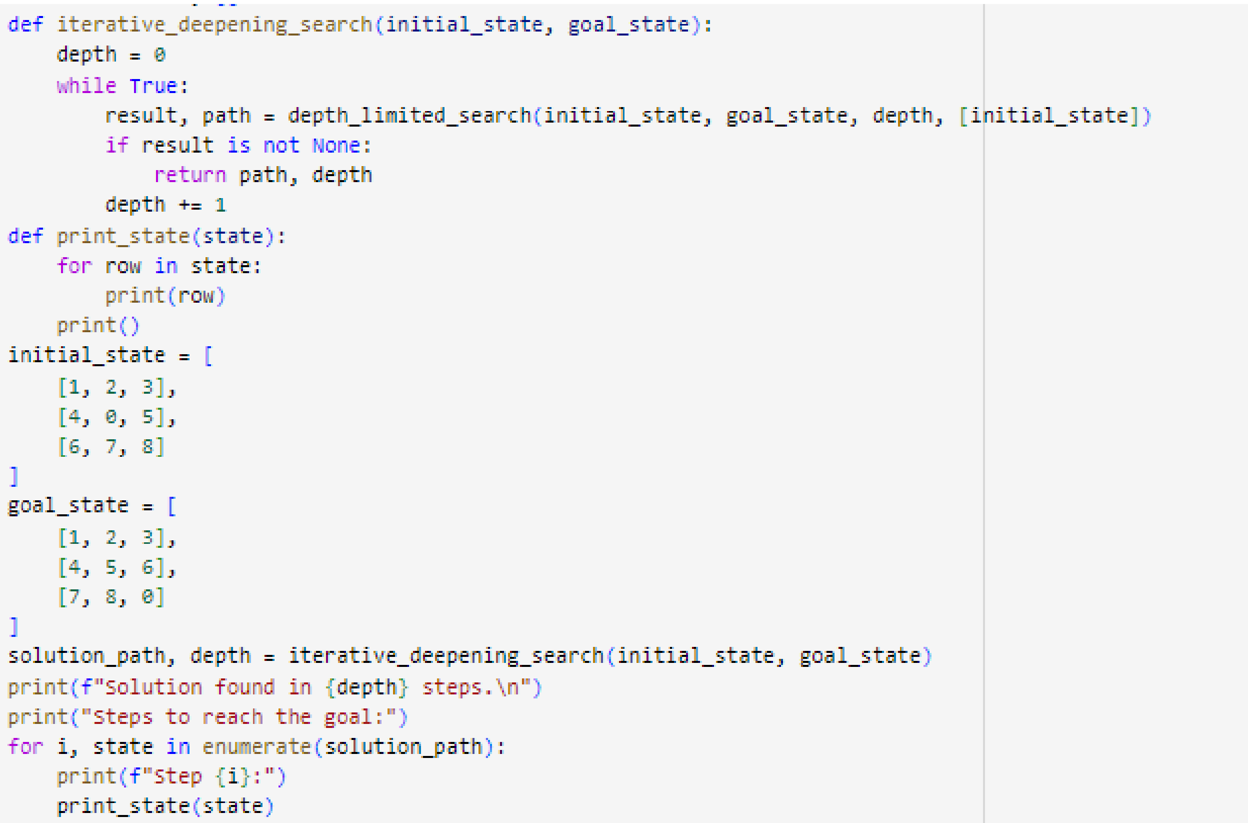
ALGORITHM:

1. Initialization:
    - Represent the puzzle as a 3x3 grid with 0 as the empty space
    - Define the goal state, where tiles are ordered from 1 to 8 with 0 in the bottom-right corner
    - Define valid moves for the empty space up, down, left, right
2. Check Goal:
    - Compare the current puzzle state with the goal state
3. Get Empty Position:
    - Locate the position of the empty space (0)
4. Move the Empty Space:
    - Try moving the empty space in all direction and generate new valid states
5. Depth Limited Search (DLS):
    - Explore states up to a given depth limit
    - If the goal isn't reached within the limit backtrack and try new path
6. Iterative Deepening Search (IDS):
    - Start with depth 0 and incrementally increase with depth limit
    - Perform DLS for each limit until the goal state is found
7. Print Solution:
    - Once the goal is found, print the sequence of the steps leading to from the initial state to the goal state

Code:



```python
import copy
moves = {'up': (-1, 0), 'down': (1, 0), 'left': (0, -1), 'right': (0, 1)}
def is_goal(state, goal_state):
    return state == goal_state
def get_empty_position(state):
    for i in range(3):
        for j in range(3):
            if state[i][j] == 0:
                return i, j
def move_tile(state, direction):
    new_state = copy.deepcopy(state)
    empty_i, empty_j = get_empty_position(state)
    di, dj = moves[direction]
    new_i, new_j = empty_i + di, empty_j + dj
    if 0 <= new_i < 3 and 0 <= new_j < 3:
        new_state[empty_i][empty_j], new_state[new_i][new_j] = new_state[new_i][new_j], new_state[empty_i][empty_j]
        return new_state
    return None
def depth_limited_search(state, goal_state, depth_limit, path):
    if is_goal(state, goal_state):
        return state, path
    if depth_limit == 0:
        return None, []
    empty_i, empty_j = get_empty_position(state)
    for direction in moves:
        new_state = move_tile(state, direction)
        if new_state is not None and new_state not in path:  # Avoid loops
            result, new_path = depth_limited_search(new_state, goal_state, depth_limit - 1, path + [new_state])
            if result:
                return result, new_path
    return None, []
def iterative_deepening_search(initial_state, goal_state):
```

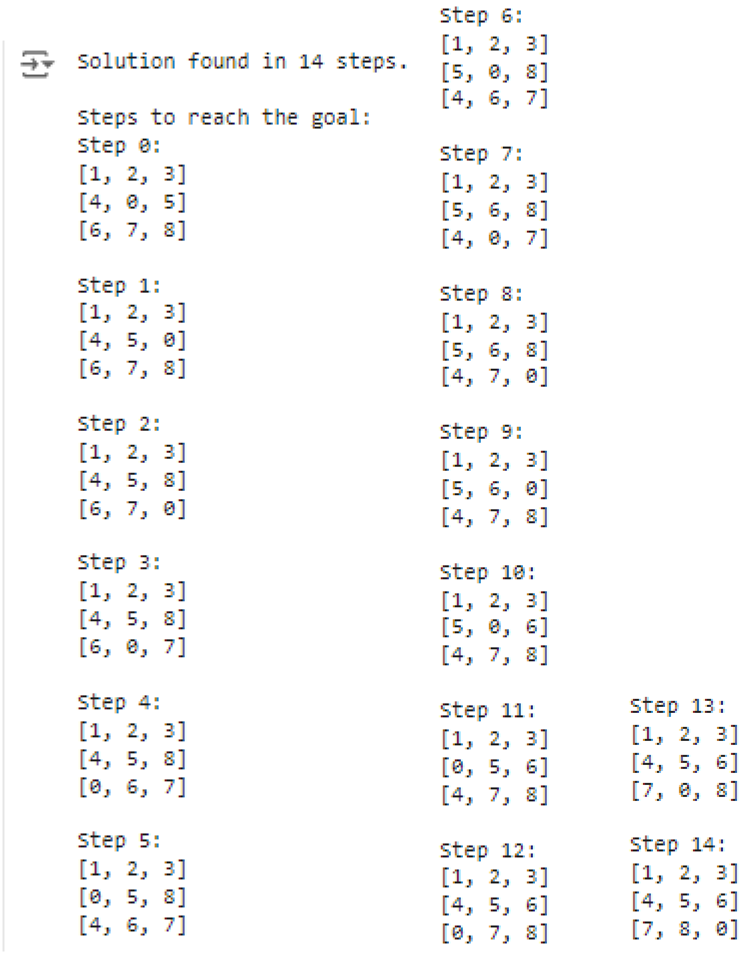


```python
def iterative_deepening_search(initial_state, goal_state):
    depth = 0
    while True:
        result, path = depth_limited_search(initial_state, goal_state, depth, [initial_state])
        if result is not None:
            return path, depth
        depth += 1
def print_state(state):
    for row in state:
        print(row)
    print()
initial_state = [
    [1, 2, 3],
    [4, 0, 5],
    [6, 7, 8]
]
goal_state = [
    [1, 2, 3],
    [4, 5, 6],
    [7, 8, 0]
]
solution_path, depth = iterative_deepening_search(initial_state, goal_state)
print(f"Solution found in {depth} steps.\n")
print("Steps to reach the goal:")
for i, state in enumerate(solution_path):
    print(f"Step {i}:")
    print_state(state)
```

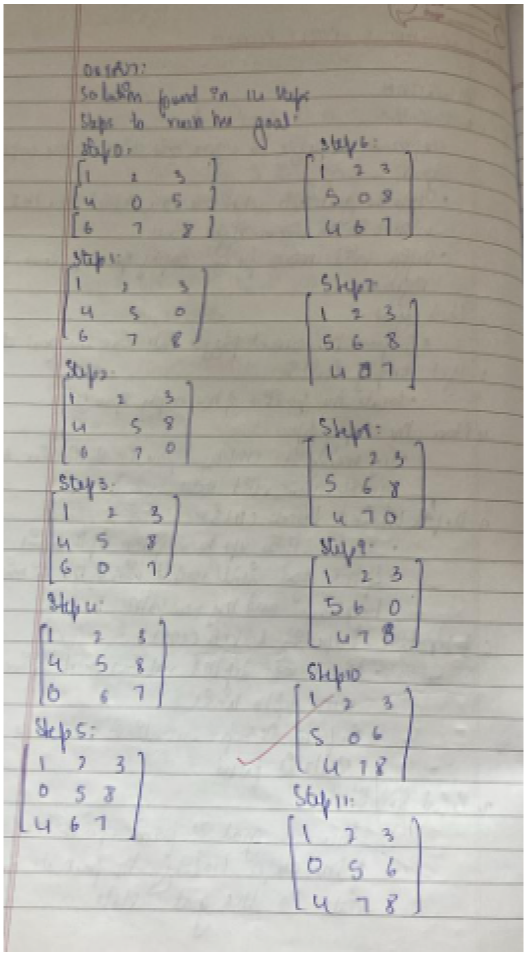
```python
import copy
moves = {'up': (-1, 0), 'down': (1, 0), 'left': (0, -1), 'right': (0, 1)}
```

```python
def is_goal(state, goal_state):
    return state == goal_state
def get_empty_position(state):
    for i in range(3):
        for j in range(3):
            if state[i][j] == 0:
                return i, j
def move_tile(state, direction):
    new_state = copy.deepcopy(state)
    empty_i, empty_j = get_empty_position(state)
    di, dj = moves[direction]
    new_i, new_j = empty_i + di, empty_j + dj
    if 0 <= new_i < 3 and 0 <= new_j < 3:
        new_state[empty_i][empty_j], new_state[new_i][new_j] = new_state[new_i][new_j], new_state[empty_i][empty_j]
        return new_state
    return None
def depth_limited_search(state, goal_state, depth_limit, path):
    if is_goal(state, goal_state):
        return state, path
    if depth_limit == 0:
        return None, []
    empty_i, empty_j = get_empty_position(state)
    for direction in moves:
        new_state = move_tile(state, direction)
        if new_state is not None and new_state not in path:  # Avoid loops
            result, new_path = depth_limited_search(new_state, goal_state, depth_limit - 1, path + [new_state])
            if result:
                return result, new_path
    return None, []
def iterative_deepening_search(initial_state, goal_state):
    depth = 0
    while True:
        result, path = depth_limited_search(initial_state, goal_state, depth, [initial_state])
        if result is not None:
            return path, depth
        depth += 1
def print_state(state):
    for row in state:
        print(row)
    print()
initial_state = [
    [1, 2, 3],
    [4, 0, 5],
    [6, 7, 8]
]
goal_state = [
    [1, 2, 3],
    [4, 5, 6],
    [7, 8, 0]
]
solution_path, depth = iterative_deepening_search(initial_state, goal_state)
print(f"Solution found in {depth} steps.\n")
print("Steps to reach the goal:")
for i, state in enumerate(solution_path):
    print(f"Step {i}:")
    print_state(state)
```

Output:



```
Solution found in 14 steps.

Steps to reach the goal:
Step 0:
[1, 2, 3]
[4, 0, 5]
[6, 7, 8]

Step 1:
[1, 2, 3]
[4, 5, 0]
[6, 7, 8]

Step 2:
[1, 2, 3]
[4, 5, 8]
[6, 7, 0]

Step 3:
[1, 2, 3]
[4, 5, 8]
[6, 0, 7]

Step 4:
[1, 2, 3]
[4, 5, 8]
[0, 6, 7]

Step 5:
[1, 2, 3]
[0, 5, 8]
[4, 6, 7]

Step 6:
[1, 2, 3]
[5, 0, 8]
[4, 6, 7]

Step 7:
[1, 2, 3]
[5, 6, 8]
[4, 0, 7]

Step 8:
[1, 2, 3]
[5, 6, 8]
[4, 7, 0]

Step 9:
[1, 2, 3]
[5, 6, 0]
[4, 7, 8]

Step 10:
[1, 2, 3]
[5, 0, 6]
[4, 7, 8]

Step 11:
[1, 2, 3]
[0, 5, 6]
[4, 7, 8]

Step 12:
[1, 2, 3]
[4, 5, 6]
[0, 7, 8]

Step 13:
[1, 2, 3]
[4, 5, 6]
[7, 0, 8]

Step 14:
[1, 2, 3]
[4, 5, 6]
[7, 8, 0]
```



OUTPUT:

Solution found in 14 steps

Steps to reach the goal:

Step 0:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 0 & 5 \\ 6 & 7 & 8 \end{bmatrix}$$

Step 1:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 0 \\ 6 & 7 & 8 \end{bmatrix}$$

Step 2:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 8 \\ 6 & 7 & 0 \end{bmatrix}$$

Step 3:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 8 \\ 6 & 0 & 7 \end{bmatrix}$$

Step 4:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 8 \\ 0 & 6 & 7 \end{bmatrix}$$

Step 5:

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 5 & 8 \\ 4 & 6 & 7 \end{bmatrix}$$

Step 6:

$$\begin{bmatrix} 1 & 2 & 3 \\ 5 & 0 & 8 \\ 4 & 6 & 7 \end{bmatrix}$$

Step 7

$$\begin{bmatrix} 1 & 2 & 3 \\ 5 & 6 & 8 \\ 4 & 0 & 7 \end{bmatrix}$$

Step 8:

$$\begin{bmatrix} 1 & 2 & 3 \\ 5 & 6 & 8 \\ 4 & 7 & 0 \end{bmatrix}$$

Step 9:

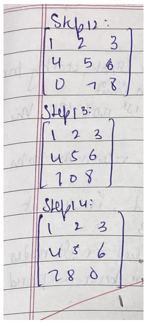
$$\begin{bmatrix} 1 & 2 & 3 \\ 5 & 6 & 0 \\ 4 & 7 & 8 \end{bmatrix}$$

Step 10

$$\begin{bmatrix} 1 & 2 & 3 \\ 5 & 0 & 6 \\ 4 & 7 & 8 \end{bmatrix}$$

Step 11:

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 5 & 6 \\ 4 & 7 & 8 \end{bmatrix}$$



Step 12:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 0 & 7 & 8 \end{bmatrix}$$

Step 13:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 0 & 8 \end{bmatrix}$$

Step 14:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{bmatrix}$$

STATE SPACE TREE: NEXT PAGE

Step 12:

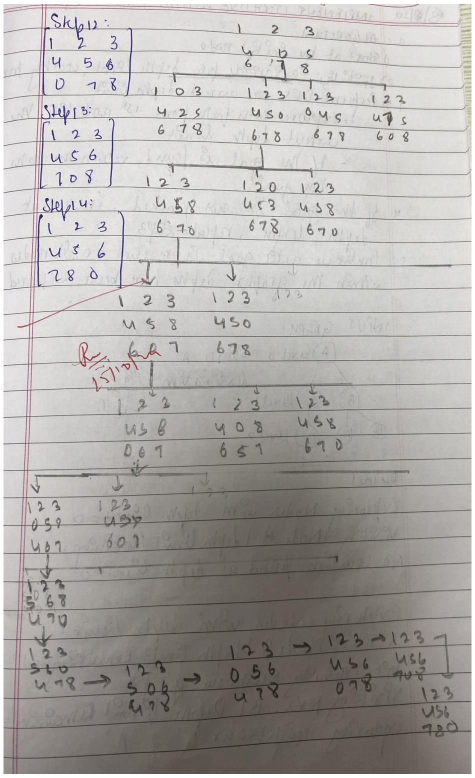
$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 0 & 7 & 8 \end{bmatrix}$$

Step 13:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 0 & 8 \end{bmatrix}$$

Step 14:

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{bmatrix}$$


1 2 3
4 0 5
6 7 8
1 0 3
4 2 5
6 7 8
1 2 3
4 5 0
6 7 8
1 2 3
0 4 5
6 7 8
1 2 3
4 7 5
6 0 8
1 2 3
4 5 8
6 7 0
1 2 0
4 5 3
6 7 8
1 2 3
4 5 8
6 7 0
1 2 3
4 5 8
6 0 7
1 2 3
4 5 0
6 7 8
1 2 3
1 2 3
4 5 6
0 6 7
1 2 3
4 0 8
6 5 7
1 2 3
4 5 8
6 7 0
1 2 3
0 5 8
4 6 7
1 2 3
4 5 8
6 0 7
1 2 3
5 6 8
4 7 0
1 2 3
5 6 0
4 7 8
1 2 3
5 0 6
4 7 8
1 2 3
0 5 6
4 7 8
1 2 3
4 5 6
0 7 8
1 2 3
4 5 6
7 0 8
1 2 3
4 5 6
7 8 0
25/10