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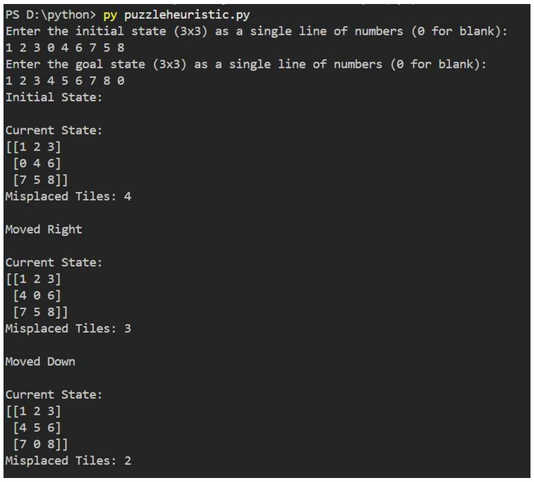
1BM22CS261

8 puzzle using Heuristic approach

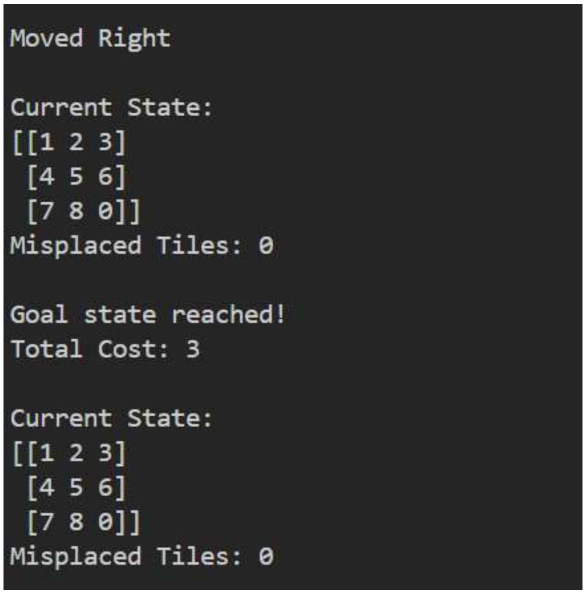
Code:

```
import numpy as np
import heapq
class PuzzleState:
    def __init__(self, board, level, goal):
        self.board = board
        self.level = level
        self.goal = goal
        self.blank_pos = self.find_blank()
        self.cost = self.level + self.misplaced_tiles()

    def find_blank(self):
        return tuple(np.argwhere(self.board == 0)[0])

    def misplaced_tiles(self):
        return np.sum(self.board != self.goal) - (self.board[self.board == 0] != self.goal[self.goal == 0]).sum()

    def get_neighbors(self):
        neighbors = []
        x, y = self.blank_pos
        moves = [(-1, 0), (1, 0), (0, -1), (0, 1)]
        move_names = ['Up', 'Down', 'Left', 'Right']

        for (dx, dy), move_name in zip(moves, move_names):
            new_x, new_y = x + dx, y + dy
            if 0 <= new_x < 3 and 0 <= new_y < 3:
                new_board = self.board.copy()
                new_board[x, y], new_board[new_x, new_y] = new_board[new_x, new_y], new_board[x, y]
                neighbors.append((PuzzleState(new_board, self.level + 1, self.goal), move_name))

        return neighbors

    def __lt__(self, other):
        return self.cost < other.cost

def print_board(state):
    print("\nCurrent State:")
    print(state.board)
    print(f"Misplaced Tiles: {state.misplaced_tiles()}\n")

def a_star(initial_state, goal_state):
    open_set = []
    closed_set = set()
    heapq.heappush(open_set, initial_state)

    print("Initial State:")
    print_board(initial_state)
    while open_set:
        current = heapq.heappop(open_set)
        if np.array_equal(current.board, current.goal):
            print("Goal state reached!")
            print(f"Total Cost: {current.cost}")
            print_board(current)
            return

        closed_set.add(tuple(map(tuple, current.board)))
        neighbors = current.get_neighbors()
        best_neighbor = None

        for neighbor, move_name in neighbors:
            if tuple(map(tuple, neighbor.board)) in closed_set:
                continue

            if best_neighbor is None or neighbor < best_neighbor[0]:
                best_neighbor = (neighbor, move_name)

        if best_neighbor:
            print(f"Moved {best_neighbor[1]}")
            print_board(best_neighbor[0])
            heapq.heappush(open_set, best_neighbor[0])

def main():
    print("Enter the initial state (3x3) as a single line of numbers (0 for blank):")
    initial_state_input = list(map(int, input().split()))
    initial_state = np.array(initial_state_input).reshape(3, 3)

    print("Enter the goal state (3x3) as a single line of numbers (0 for blank):")
    goal_state_input = list(map(int, input().split()))
    goal_state = np.array(goal_state_input).reshape(3, 3)

    initial_puzzle = PuzzleState(initial_state, 0, goal_state)
    a_star(initial_puzzle, goal_state)

if __name__ == "__main__":
    main()
```

OUTPUT:



```
PS D:\python> py puzzleheuristic.py
Enter the initial state (3x3) as a single line of numbers (0 for blank):
1 2 3 0 4 6 7 5 8
Enter the goal state (3x3) as a single line of numbers (0 for blank):
1 2 3 4 5 6 7 8 0
Initial State:

Current State:
[[1 2 3]
 [0 4 6]
 [7 5 8]]
Misplaced Tiles: 4

Moved Right

Current State:
[[1 2 3]
 [4 0 6]
 [7 5 8]]
Misplaced Tiles: 3

Moved Down

Current State:
[[1 2 3]
 [4 5 6]
 [7 0 8]]
Misplaced Tiles: 2
```



```
Moved Right

Current State:
[[1 2 3]
 [4 5 6]
 [7 8 0]]
Misplaced Tiles: 0

Goal state reached!
Total Cost: 3

Current State:
[[1 2 3]
 [4 5 6]
 [7 8 0]]
Misplaced Tiles: 0
```