

```

1 from heapq import heappush, heappop
2 goal_state = [[1, 2, 3],
3               [4, 5, 6],
4               [7, 8, 0]]
5
6 def find_position(state, value):
7     for i in range(3):
8         for j in range(3):
9             if state[i][j] == value:
10                 return i, j
11
12 def manhattan_distance(state):
13     distance = 0
14     for i in range(3):
15         for j in range(3):
16             val = state[i][j]
17             if val != 0:
18                 goal_i, goal_j = find_position(goal_state, val)
19                 distance += abs(i - goal_i) + abs(j - goal_j)
20
21     return distance
22
23 def get_neighbors(state):
24     neighbors = []
25     x, y = find_position(state, 0)
26     directions = [(-1, 0), (1, 0), (0, -1), (0, 1)]
27     for dx, dy in directions:
28         new_x, new_y = x + dx, y + dy
29         if 0 <= new_x < 3 and 0 <= new_y < 3:
30             new_state = [row[:] for row in state]
31             new_state[x][y], new_state[new_x][new_y] = new_state[new_x][new_y], new_state[x][y]
32             neighbors.append(new_state)
33
34     return neighbors
35
36 def state_to_tuple(state):
37     return tuple(tuple(row) for row in state)

```

```

37 def solve_puzzle(start_state):
38     open_list = []
39     closed_set = set()
40     heappush(open_list, (manhattan_distance(start_state), 0, start_state, []))
41     while open_list:
42         est_total_cost, cost, state, path = heappop(open_list)
43         if state == goal_state:
44             return path + [state]
45         closed_set.add(state_to_tuple(state))
46         for neighbor in get_neighbors(state):
47             if state_to_tuple(neighbor) not in closed_set:
48                 heappush(open_list, (
49                     cost + 1 + manhattan_distance(neighbor),
50                     cost + 1,
51                     neighbor,
52                     path + [state]
53                 ))
54     return None
55
56 def print_state(state):
57     for row in state:
58         print(' '.join(str(x) for x in row))
59     print()
60 start_state = [[1, 2, 3],
61                [5, 0, 6],
62                [4, 7, 8]]
63 solution = solve_puzzle(start_state)
64
65 if solution:
66     print("Steps to solve the 8-puzzle:\n")
67     for step, state in enumerate(solution):
68         print(f"Step {step}:")
69         print_state(state)
70 else:
71     print("No solution found.")
72

```

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>>> %Run -c $EDITOR_CONTENT
```

Steps to solve the 8-puzzle:

Step 0:

```
1 2 3
5 0 6
4 7 8
```

Step 1:

```
1 2 3
0 5 6
4 7 8
```

Step 2:

```
1 2 3
4 5 6
0 7 8
```

Step 3:

```
1 2 3
4 5 6
7 0 8
```

Step 4:

```
1 2 3
4 5 6
7 8 0
```

```
>>>
```