2. solve 8 puzzle problems using DFS and BFS:

```
import sys
import numpy as np



class Node:
        def __init__(self, state, parent, action):
                self.state = state
                self.parent = parent
                self.action = action



class StackFrontier: (DFS)
        def __init__(self):
                self.frontier = []

        def add(self, node):
                self.frontier.append(node)

        def contains_state(self, state):
                return any((node.state[0] == state[0]).all() for node in self.frontier)

        def empty(self):
                return len(self.frontier) == 0

        def remove(self):
                if self.empty():
                        raise Exception("Empty Frontier")
                else:
                        node = self.frontier[-1]
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                self.frontier = self.frontier[:-1]
                return node


class QueueFrontier(StackFrontier):  (AI)
    def remove(self):
        if self.empty():
            raise Exception("Empty Frontier")
        else:
            node = self.frontier[0]
            self.frontier = self.frontier[1:]
            return node


class Puzzle:
    def __init__(self, start, startIndex, goal, goalIndex):
        self.start = [start, startIndex]
        self.goal = [goal, goalIndex]
        self.solution = None

    def neighbors(self, state):
        mat, (row, col) = state
        results = []

        if row > 0:
            mat1 = np.copy(mat)
            mat1[row][col] = mat1[row - 1][col]
            mat1[row - 1][col] = 0
            results.append(('up', [mat1, (row - 1, col)]))
        if col > 0:
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                mat1 = np.copy(mat)
                mat1[row][col] = mat1[row][col - 1]
                mat1[row][col - 1] = 0
                results.append(('left', [mat1, (row, col - 1)]))
        if row < 2:
                mat1 = np.copy(mat)
                mat1[row][col] = mat1[row + 1][col]
                mat1[row + 1][col] = 0
                results.append(('down', [mat1, (row + 1, col)]))
        if col < 2:
                mat1 = np.copy(mat)
                mat1[row][col] = mat1[row][col + 1]
                mat1[row][col + 1] = 0
                results.append(('right', [mat1, (row, col + 1)]))

        return results

def print(self):
        solution = self.solution if self.solution is not None else None
        print("Start State:\n", self.start[0], "\n")
        print("Goal State:\n",  self.goal[0], "\n")
        print("\nStates Explored: ", self.num_explored, "\n")
        print("Solution:\n ")
        for action, cell in zip(solution[0], solution[1]):
                print("action: ", action, "\n", cell[0], "\n")
        print("Goal Reached!!")

def does_not_contain_state(self, state):
        for st in self.explored:
                if (st[0] == state[0]).all():
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                return False
        return True

def solve(self):
        self.num_explored = 0

        start = Node(state=self.start, parent=None, action=None)
        frontier = QueueFrontier()
        frontier.add(start)

        self.explored = []

        while True:
                if frontier.empty():
                        raise Exception("No solution")

                node = frontier.remove()
                self.num_explored += 1

                if (node.state[0] == self.goal[0]).all():
                        actions = []
                        cells = []
                        while node.parent is not None:
                                actions.append(node.action)
                                cells.append(node.state)
                                node = node.parent
                        actions.reverse()
                        cells.reverse()
                        self.solution = (actions,  cells)
                        return
```
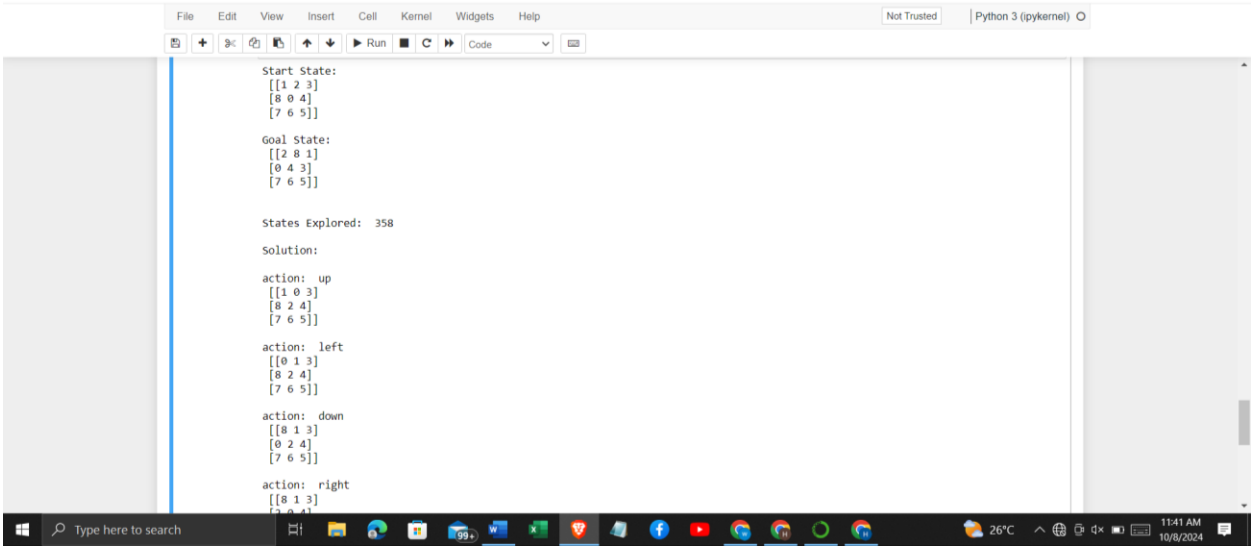

```
                    self.explored.append(node.state)

                    for action, state in self.neighbors(node.state):
                        if not frontier.contains_state(state) and
self.does_not_contain_state(state):
                            child = Node(state=state, parent=node, action=action)
                            frontier.add(child)



start = np.array([[1, 2, 3], [8, 0, 4], [7, 6, 5]])
goal = np.array([[2, 8, 1], [0, 4, 3], [7, 6, 5]])



startIndex = (1, 1)
goalIndex = (1, 0)



p = Puzzle(start, startIndex, goal, goalIndex)
p.solve()
p.print()
```

OUTPUT:


File Edit View Insert Cell Kernel Widgets Help
Not Trusted
Python 3 (ipykernel)
Run
Code
Start State:
[[1 2 3]
[8 0 4]
[7 6 5]]
Goal State:
[[2 8 1]
[0 4 3]
[7 6 5]]
States Explored: 358
Solution:
action: up
[[1 0 3]
[8 2 4]
[7 6 5]]
action: left
[[0 1 3]
[8 2 4]
[7 6 5]]
action: down
[[8 1 3]
[0 2 4]
[7 6 5]]
action: right
[[8 1 3]
Type here to search
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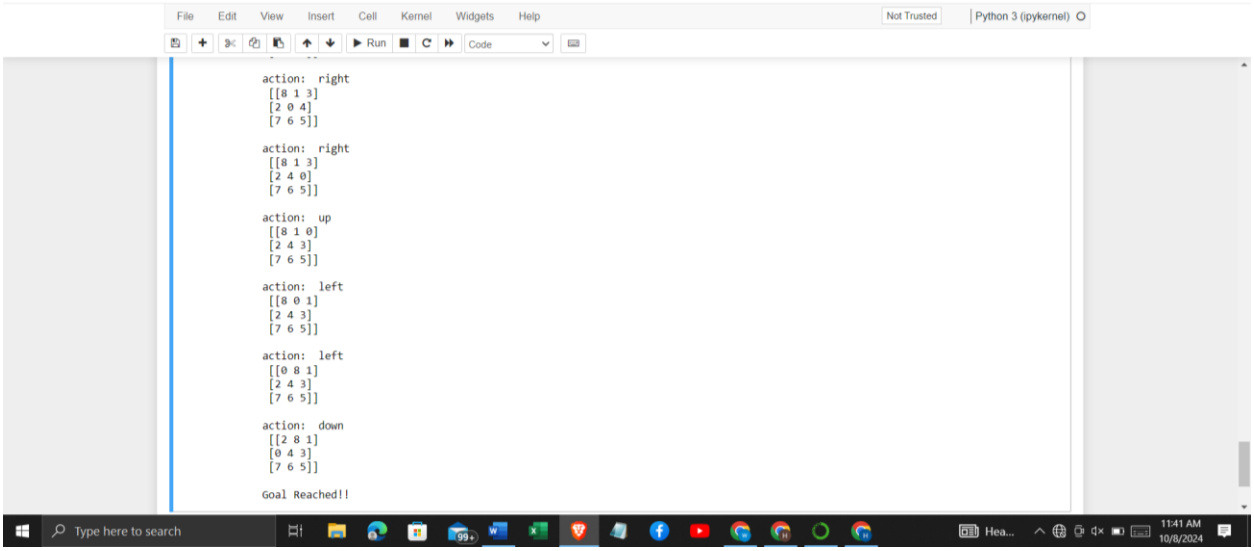
File Edit View Insert Cell Kernel Widgets Help
Not Trusted
Python 3 (ipykernel)
Run
Code
action: right
[[8 1 3]
[2 0 4]
[7 6 5]]
action: right
[[8 1 3]
[2 4 0]
[7 6 5]]
action: up
[[8 1 0]
[2 4 3]
[7 6 5]]
action: left
[[8 0 1]
[2 4 3]
[7 6 5]]
action: left
[[0 8 1]
[2 4 3]
[7 6 5]]
action: down
[[2 8 1]
[0 4 3]
[7 6 5]]
Goal Reached!!
Type here to search
Hea...
11:41 AM
10/8/2024