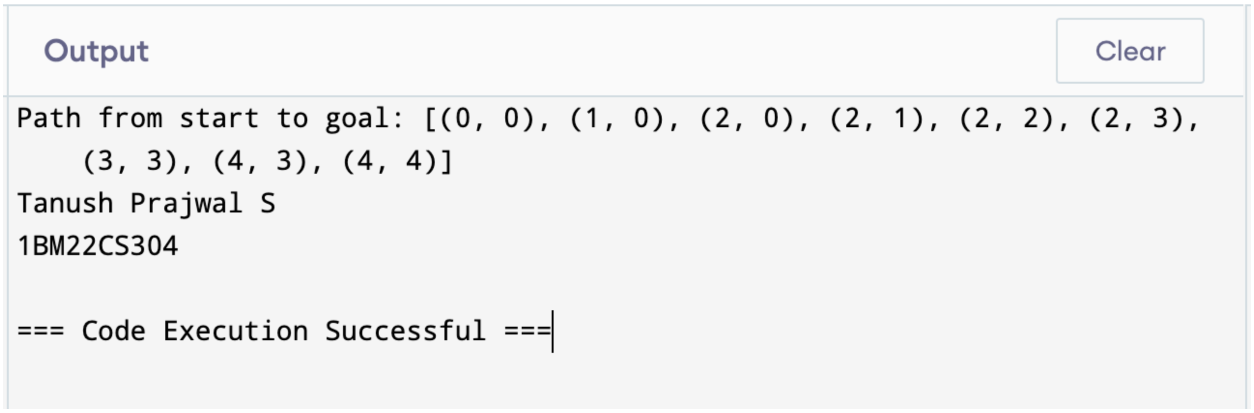
Manhattan A* Search Algorithm

```
import heapq
class Node:
def __init__(self, position, parent=None):
self.position = position
self.parent = parent
self.g = 0 # Cost from start to this node
self.h = 0 # Heuristic cost from this node to target
self.f = 0 # Total cost
def __lt__(self, other):
return self.f < other.f
def heuristic(a, b):
# Manhattan distance
return abs(a[0] - b[0]) + abs(a[1] - b[1])
def astar(start, goal, grid):
open_list = []
closed_list = set()
start_node = Node(start)
goal_node = Node(goal)
heapq.heappush(open_list, start_node)
while open_list:
current_node = heapq.heappop(open_list)
closed_list.add(current_node.position)# Goal check
if current_node.position == goal:
path = []
while current_node:
path.append(current_node.position)
current_node = current_node.parent
return path[::-1] # Return reversed path
# Generate neighbors
neighbors = [
(current_node.position[0] + dx, current_node.position[1] + dy)
for dx, dy in [(-1, 0), (1, 0), (0, -1), (0, 1)]
]
for next_position in neighbors:
# Check if within bounds and not a wall (assuming 0 is free space)
if (0 <= next_position[0] < len(grid) and
0 <= next_position[1] < len(grid[0]) and
grid[next_position[0]][next_position[1]] == 0):
if next_position in closed_list:
continue
neighbor_node = Node(next_position, current_node)
neighbor_node.g = current_node.g + 1
neighbor_node.h = heuristic(next_position, goal)
neighbor_node.f = neighbor_node.g + neighbor_node.h
# Check if this neighbor is already in the open listif any(neighbor.position == neighbor_node.position and
neighbor.f <= neighbor_node.f for
neighbor in open_list):
continue
heapq.heappush(open_list, neighbor_node)
return [] # Return empty path if no path found
# Example usage
if __name__ == "__main__":
grid = [
[0, 0, 0, 0, 0],
[0, 1, 1, 1, 0],
[0, 0, 0, 0, 0],
[0, 1, 1, 0, 0],
[0, 0, 0, 0, 0]
]
start = (0, 0)
goal = (4, 4)
path = astar(start, goal, grid)
print("Path from start to goal:", path)
print("Tanush Prajwal S")
print("1BM22CS304")
```



```
Path from start to goal: [(0, 0), (1, 0), (2, 0), (2, 1), (2, 2), (2, 3),
    (3, 3), (4, 3), (4, 4)]
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=== Code Execution Successful ===
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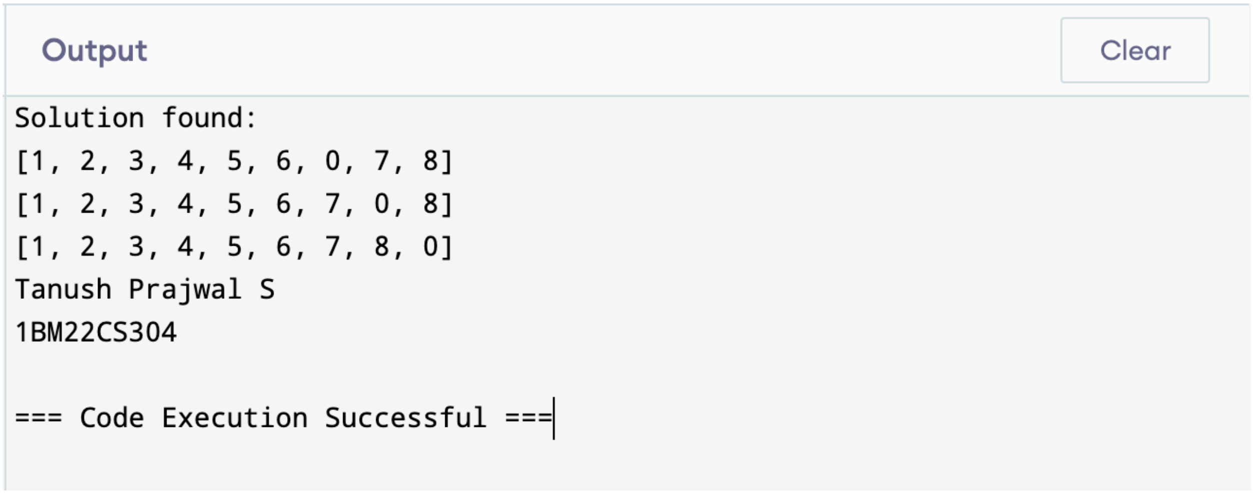
Misplaced Tiles A* Search Algorithm

```
#misplaced titles
import heapq
class PuzzleState:
def __init__(self, board, g=0):
self.board = board
self.g = g # Cost from start to this state
self.zero_pos = board.index(0) # Position of the empty space
def h(self):
# Calculate the number of misplaced tiles
return sum(1 for i in range(9) if self.board[i] != 0 and self.board[i] != i + 1)
def f(self):
return self.g + self.h()
def get_neighbors(self):
neighbors = []
x, y = divmod(self.zero_pos, 3)
directions = [(-1, 0), (1, 0), (0, -1), (0, 1)] # Up, Down, Left, Right
for dx, dy in directions:
new_x, new_y = x + dx, y + dy
if 0 <= new_x < 3 and 0 <= new_y < 3:
new_zero_pos = new_x * 3 + new_y
new_board = self.board[:]
# Swap zero with the neighboring tile
```

```
new_board[self.zero_pos], new_board[new_zero_pos] = new_board[new_zero_pos],
new_board[self.zero_pos]
neighbors.append(PuzzleState(new_board, self.g + 1))
return neighborsdef a_star(initial_state, goal_state):
open_set = []
heapq.heappush(open_set, (initial_state.f(), 0, initial_state)) # Add a unique identifier (0 in this
case)
came_from = {}
g_score = {tuple(initial_state.board): 0}
while open_set:
current_f, _, current = heapq.heappop(open_set)
if current.board == goal_state:
return reconstruct_path(came_from, current)
for neighbor in current.get_neighbors():
neighbor_tuple = tuple(neighbor.board)
tentative_g_score = g_score[tuple(current.board)] + 1
if neighbor_tuple not in g_score or tentative_g_score < g_score[neighbor_tuple]:
came_from[neighbor_tuple] = current
g_score[neighbor_tuple] = tentative_g_score
heapq.heappush(open_set, (neighbor.f(), neighbor.g, neighbor))
return None
def reconstruct_path(came_from, current):
path = []
while current is not None:
path.append(current.board)
current = came_from.get(tuple(current.board), None)
return path[::-1]# Example usage
initial_state = PuzzleState([1, 2, 3, 4, 5, 6, 0, 7, 8])
goal_state = [1, 2, 3, 4, 5, 6, 7, 8, 0]
solution = a_star(initial_state, goal_state)
if solution:
for step in solution:
print(step)
else:
print("No solution found")
print("Tanush Prajwal S")
print("1BM22CS304")
```



```
Solution found:
[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]
Tanush Prajwal S
1BM22CS304

=== Code Execution Successful ===
```