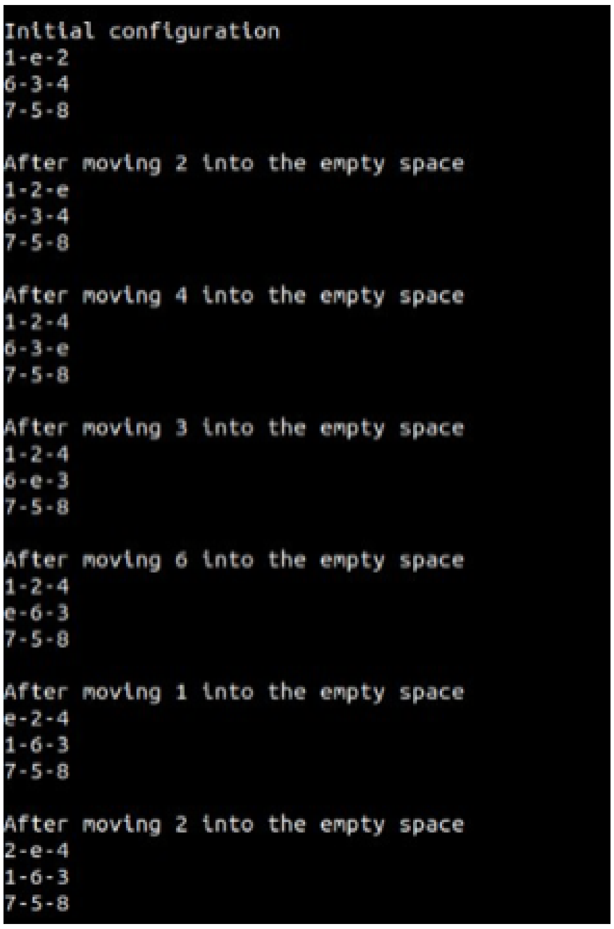
8PUZZLE SOLVER:

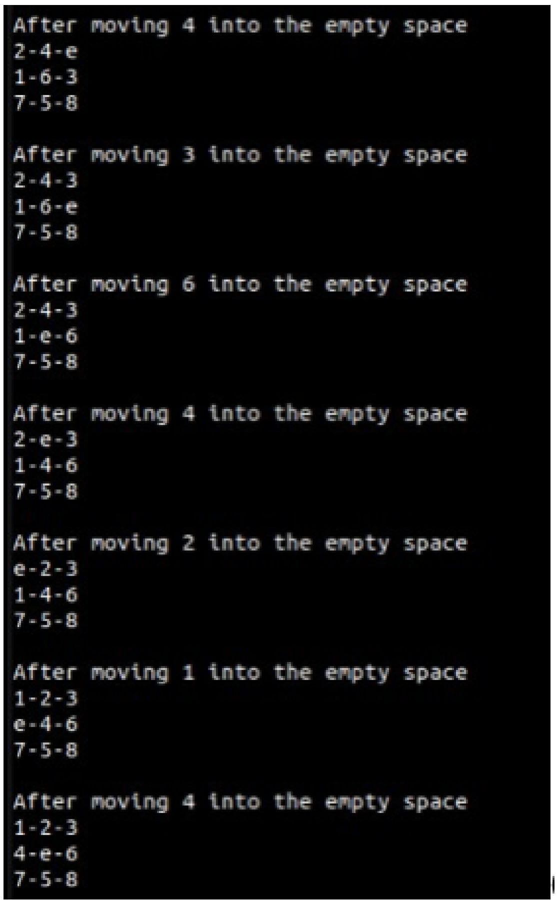
```
from simpleai.search import astar, SearchProblem
class PuzzleSolver(SearchProblem):
    def actions(self, cur_state):
        rows = string_to_list(cur_state)
        row_empty, col_empty = get_location(rows, 'e')
        actions = []
        if row_empty > 0:
            actions.append(rows[row_empty - 1][col_empty])
        if row_empty < 2:
            actions.append(rows[row_empty + 1][col_empty])
        if col_empty > 0:
            actions.append(rows[row_empty][col_empty - 1])
        if col_empty < 2:
            actions.append(rows[row_empty][col_empty + 1])
        return actions
    def result(self, state, action):
        rows = string_to_list(state)
        row_empty, col_empty = get_location(rows, 'e')
        row_new, col_new = get_location(rows, action)
        rows[row_empty][col_empty], rows[row_new][col_new] = \
            rows[row_new][col_new], rows[row_empty][col_empty]
        return list_to_string(rows)
    def is_goal(self, state):
        return state == GOAL
    def heuristic(self, state):
        rows = string_to_list(state)
        distance = 0
        for number in '12345678e':
            row_new, col_new = get_location(rows, number)
            row_goal, col_goal = goal_positions[number]
            distance += abs(row_new - row_goal) + abs(col_new - col_goal)
        return distance
def list_to_string(input_list):
    return '\n'.join(['-'.join(x) for x in input_list])
def string_to_list(input_string):
    return [x.split('-') for x in input_string.split('\n')]
def get_location(rows, input_element):
    for i, row in enumerate(rows):
        for j, item in enumerate(row):
            if item == input_element:
                return i, j
GOAL = '''1-2-3
4-5-6
7-8-e'''
```

```
INITIAL = '''1-e-2
6-3-4
7-5-8'''
goal_positions = {}
rows_goal = string_to_list(GOAL)
for number in '12345678e':
 goal_positions[number] = get_location(rows_goal, number)
result = astar(PuzzleSolver(INITIAL))
for i, (action, state) in enumerate(result.path()):
 print()
 if action is None:
 print('Initial configuration')
 elif i == len(result.path()) - 1:
 print('After moving', action, 'into the empty space. Goal achieved!')
 else:
 print('After moving', action, 'into the empty space')
 print(state)
```

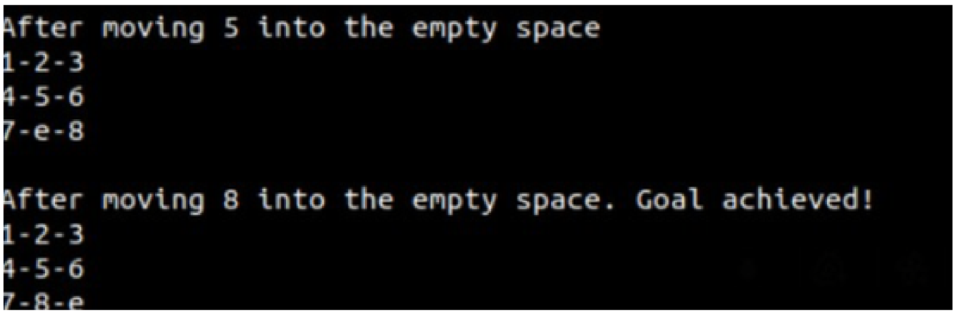
OUTPUT:



```
Initial configuration
1-e-2
6-3-4
7-5-8

After moving 2 into the empty space
1-2-e
6-3-4
7-5-8

After moving 4 into the empty space
1-2-4
6-3-e
7-5-8

After moving 3 into the empty space
1-2-4
6-e-3
7-5-8

After moving 6 into the empty space
1-2-4
e-6-3
7-5-8

After moving 1 into the empty space
e-2-4
1-6-3
7-5-8

After moving 2 into the empty space
2-e-4
1-6-3
7-5-8
```



```
After moving 4 into the empty space
2-4-e
1-6-3
7-5-8

After moving 3 into the empty space
2-4-3
1-6-e
7-5-8

After moving 6 into the empty space
2-4-3
1-e-6
7-5-8

After moving 4 into the empty space
2-e-3
1-4-6
7-5-8

After moving 2 into the empty space
e-2-3
1-4-6
7-5-8

After moving 1 into the empty space
1-2-3
e-4-6
7-5-8

After moving 4 into the empty space
1-2-3
4-e-6
7-5-8
```



```
After moving 5 into the empty space
1-2-3
4-5-6
7-e-8

After moving 8 into the empty space. Goal achieved!
1-2-3
4-5-6
7-8-e
```