

main.py

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Output

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```
1 # 8-puzzle A* solver (Manhattan heuristic)
2 # State: tuple of 9 ints, 0 = blank, row-major order
3 # Goal: (1,2,3,4,5,6,7,8,0)
4
5 import heapq
6
7 GOAL = (1, 2, 3, 4, 5, 6, 7, 8, 0)
8 GOAL_POS = {val: (i // 3, i % 3) for i, val in enumerate(GOAL)}
9
10 def manhattan(state):
11     total = 0
12     for idx, val in enumerate(state):
13         if val == 0:
14             continue
15         r, c = divmod(idx, 3)
16         gr, gc = GOAL_POS[val]
17         total += abs(r - gr) + abs(c - gc)
18     return total
19
20 def neighbors(state):
21     z = state.index(0)
22     r, c = divmod(z, 3)
```

Start state:

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

Solved in 24 moves; expanded 3248 nodes; solution cost 24

Step 0:

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

Move: Up

Step 1:

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

Move: Up

Step 2:

```
_ 6 5
1 2 8
```

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```
8 print(f"Move disk {n} from {source} → {destination}")
9 return
10
11 # Move n-1 disks from source → auxiliary
12 hanoi(n-1, source, destination, auxiliary)
13
14 # Move last disk from source → destination
15 print(f"Move disk {n} from {source} → {destination}")
16
17 # Move n-1 disks from auxiliary → destination
18 hanoi(n-1, auxiliary, source, destination)
19
20 # -----
21 # MAIN PROGRAM
22 # -----
23
24 if __name__ == "__main__":
25     n = int(input("Enter number of disks: "))
26
27     print("\nSequence of moves:\n")
28     hanoi(n, 'A', 'B', 'C')
29
```

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```
Enter number of disks: 3

Sequence of moves:

Move disk 1 from A → C
Move disk 2 from A → B
Move disk 1 from C → B
Move disk 3 from A → C
Move disk 1 from B → A
Move disk 2 from B → C
Move disk 1 from A → C

=== Code Execution Successful ===
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🔄

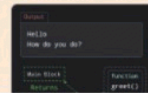
📄

```
1 from collections import deque
2
3 def bfs(graph, start):
4     visited = set()
5     queue = deque([start])
6
7     print("BFS Traversal:", end=" ")
8
9     while queue:
10         node = queue.popleft()
11
12         if node not in visited:
13             print(node, end=" ")
14             visited.add(node)
15
16             # Add all neighbors
17             for neigh in graph[node]:
18                 if neigh not in visited:
19                     queue.append(neigh)
20
21 # -----
22 # MAIN PROGRAM
```

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```
Graph: {0: [2, 1, 3], 1: [], 2: [4], 3: [], 4: []}
BFS Traversal: 0 2 1 3 4
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```
1 # Monkey and Banana Problem
2
3 class Monkey:
4     def __init__(self):
5         self.monkey_pos = "door"
6         self.box_pos = "window"
7         self.banana_pos = "middle"
8         self.on_box = False
9
10    def move(self, place):
11        print(f"Monkey moves from {self.monkey_pos} to {place}.")
12        self.monkey_pos = place
13
14    def push_box(self, place):
15        print(f"Monkey pushes box from {self.box_pos} to {place}.")
16        self.box_pos = place
17        self.monkey_pos = place
18
19    def climb_box(self):
20        if self.monkey_pos == self.box_pos:
21            self.on_box = True
22            print("Monkey climbs onto the box.")
```

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Monkey moves from door to window.
Monkey pushes box from window to middle.
Monkey climbs onto the box.
Monkey takes the banana! 🍌

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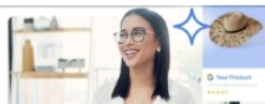
```
1 # Eight Queens Problem using Backtracking
2
3 board_size = 8
4 solution = []
5
6 def is_safe(row, col, solution):
7     for r, c in solution:
8         if c == col or r == row or abs(r - row) == abs(c - col):
9             return False
10    return True
11
12 def solve(row=0):
13     if row == board_size:
14         return True
15
16     for col in range(board_size):
17         if is_safe(row, col, solution):
18             solution.append((row, col))
19             if solve(row + 1):
20                 return True
21             solution.pop()
```

Solution for 8 Queens:

```
Q . . . . . .
. . . . Q . .
. . . . . . Q
. . . . Q . .
. . Q . . . .
. . . . . . Q
. Q . . . . .
. . . Q . . .

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

```
DFS Traversal starting from node 1:
1 2 4 8 3 5 7
=== Code Execution Successful ===
```



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```
1 # Water Jug Problem (4-gallon and 3-gallon)
2
3 from collections import deque
4
5 def water_jug():
6     # state = (jug4, jug3)
7     start = (0, 0)
8     goal = (2, 0)
9     visited = set([start])
10    queue = deque([start, []])
11
12    while queue:
13        (a, b), path = queue.popleft()
14
15        if (a, b) == goal:
16            print("Steps to reach 2 gallons in 4-gallon jug:\n")
17            for step in path:
18                print(step)
19            print(f"\nFinal state: {a} gallons in 4-gallon jug, {b}
20                in 3-gallon jug.")
21            return
```

Steps to reach 2 gallons in 4-gallon jug:

Fill 3-gallon jug => (0, 3)
Pour from 3-gallon to 4-gallon => (3, 0)
Fill 3-gallon jug => (3, 3)
Pour from 3-gallon to 4-gallon => (4, 2)
Empty 4-gallon jug => (0, 2)
Pour from 3-gallon to 4-gallon => (2, 0)

Final state: 2 gallons in 4-gallon jug, 0 in 3-gallon jug.

=== Code Execution Successful ===