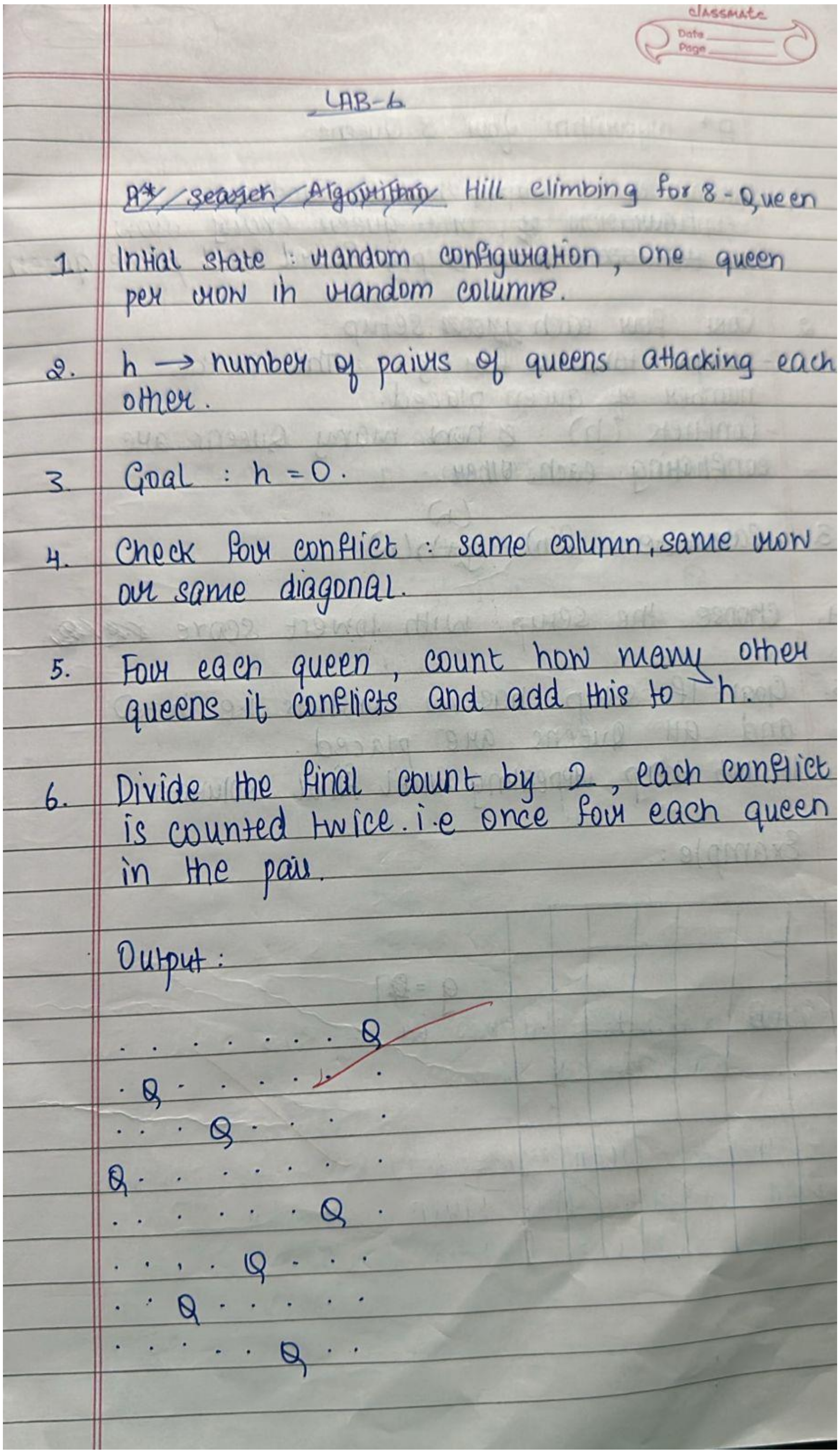
LAB-6 - Implementing A* and Hill Climbing Algorithm on 8 Queens.

Observation book:



classmate
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~~A* search Algorithm~~ Hill climbing for 8-Queen

1. Initial state : random configuration, one queen per row in random columns.

2. h → number of pairs of queens attacking each other.

3. Goal : h = 0.

4. Check for conflict : same column, same row or same diagonal.

5. For each queen, count how many other queens it conflicts and add this to h.

6. Divide the final count by 2, each conflict is counted twice. i.e once for each queen in the pair.

Output :

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

A* algorithm four 8 Queens:

1. Inital state : ~~Empty board~~ ~~Random configuration of, one queen every row in random column~~. Empty Board and place quee

2. Cost four each ~~queen~~ : setup :
- : steps taken so far (g) : This is the number of queen placed.
- Confliets (h) : how many Queens are conflicting each other.

3. Calculate $f(n) = \overset{(n)}{g} + h(n)$

4. Choose the setup with lowest score.

5. Goal : If setup has no conflicts i.e h = 0 and all Queens are placed.
If not keep repeating until final solution.

Example :

Q							

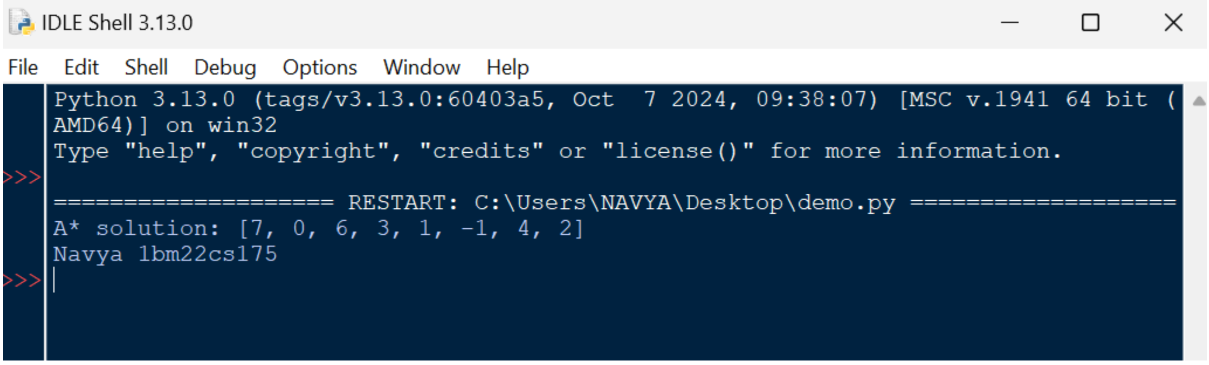
g = 1

A * Code:

```
import numpy as np

import heapq


class Node:

    def __init__(self, state, g, h):

        self.state = state  # current state of the board

        self.g = g  # cost to reach this state

        self.h = h  # heuristic cost to reach goal

        self.f = g + h  # total cost


    def __lt__(self, other):

        return self.f < other.f


def heuristic(state):

    # Count pairs of queens that can attack each other

    attacks = 0

    for i in range(len(state)):

        for j in range(i + 1, len(state)):

            if state[i] == state[j] or abs(state[i] - state[j]) == j - i:

                attacks += 1

    return attacks


def a_star_8_queens():

    initial_state = [-1] * 8  # -1 means no queen placed

    open_list = []
    closed_set = set()
    initial_h = heuristic(initial_state)
    heapq.heappush(open_list, Node(initial_state, 0, initial_h))

    while open_list:
        current_node = heapq.heappop(open_list)
        current_state = current_node.state
        closed_set.add(tuple(current_state))

        # Check if we reached the goal
        if current_node.h == 0:
            return current_state

        for col in range(8):
            for row in range(8):
                if current_state[col] == -1:  # Only place a queen if none is present in this column
                    new_state = current_state.copy()
                    new_state[col] = row
                    if tuple(new_state) not in closed_set:
                        g_cost = current_node.g + 1
                        h_cost = heuristic(new_state)
                        heapq.heappush(open_list, Node(new_state, g_cost, h_cost))

    return None

solution = a_star_8_queens()
```

```
print("A* solution:", solution)

print(“Navya 1bm22cs175”)
```

output:



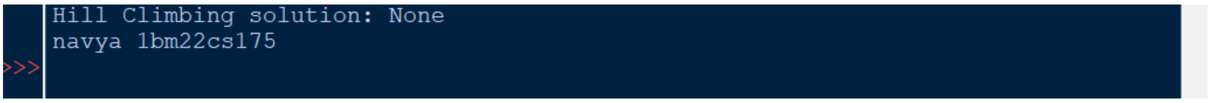
```
Python 3.13.0 (tags/v3.13.0:60403a5, Oct  7 2024, 09:38:07) [MSC v.1941 64 bit (
AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
=================== RESTART: C:\Users\NAVYA\Desktop\demo.py ===================
A* solution: [7, 0, 6, 3, 1, -1, 4, 2]
Navya 1bm22cs175
>>>
```

Hill climbing :

Code:

```
import random


def heuristic(state):

    attacks = 0

    for i in range(len(state)):

        for j in range(i + 1, len(state)):

            if state[i] == state[j] or abs(state[i] - state[j]) == j - i:

                attacks += 1

    return attacks


def hill_climbing_8_queens():

    state = [random.randint(0, 7) for _ in range(8)]  # Random initial state


    while True:
        current_h = heuristic(state)
        if current_h == 0:  # Found a solution
            return state

        next_state = None
        next_h = float('inf')

        for col in range(8):
            for row in range(8):
                if state[col] != row:  # Only consider moving the queen
                    new_state = state.copy()
                    new_state[col] = row
                    h = heuristic(new_state)
                    if h < next_h:
                        next_h = h
                        next_state = new_state

        if next_h >= current_h:  # No better neighbor found
            return None  # Stuck at local maximum

        state = next_state

solution = hill_climbing_8_queens()
print("Hill Climbing solution:", solution)
print(“Navya 1bm22cs175”)
```

Output :



```
Hill Climbing solution: None
navya 1bm22cs175
>>>
```