COIS 4550H: Assignment 2

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Chinedu Anwusi

069570

Analysis of Random-Restart and First-Choice Hill Climbing Algorithms for N-Queens Problem

Random-Restart Hill Climbing

Random-Restart Hill Climbing - Run 1:

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:**0.010827302932739258 seconds

Random-Restart Hill Climbing - Run 2 :

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.0067598819732666016 seconds

Random-Restart Hill Climbing - Run 3 :

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.005666971206665039 seconds

Random-Restart Hill Climbing - Run 4 :

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.007451534271240234 seconds

Random-Restart Hill Climbing - Run 5 :

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0

- **Total Time:** 0.005621671676635742 seconds

Random-Restart Hill Climbing - Run 6 :

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.01604747772216797 seconds

Random-Restart Hill Climbing - Run 7 :

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.01748180389404297 seconds

Random-Restart Hill Climbing - Run 8 :

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.031099796295166016 second

Random-Restart Hill Climbing - Run 9 :

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.018150091171264465 seconds

Random-Restart Hill Climbing - Run 10:

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** .0030374526977539062 seconds

First-Choice Hill Climbing

First-Choice Hill Climbing - Run 1:

- **Final Board Configuration:**

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

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.005464315414428711 seconds

First-Choice Hill Climbing - Run 2:

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.0029859542846679688 seconds

First-Choice Hill Climbing - Run 3:

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.006294965744018555 seconds

First-Choice Hill Climbing - Run 4:

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.005174875259399414 seconds

First-Choice Hill Climbing - Run 5 :

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.0027709007263183594 seconds

First-Choice Hill Climbing - Run 6:

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.016725778579711914 seconds

First-Choice Hill Climbing - Run 7:

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.0014164447784423828 seconds

First-Choice Hill Climbing - Run 8 :

- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.0023119449615478516 seconds

First-Choice Hill Climbing - Run 9:

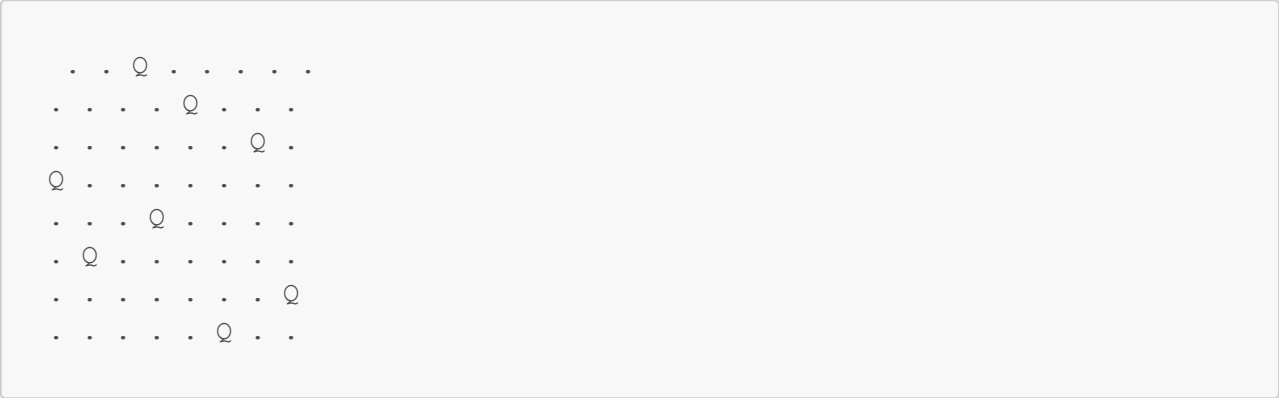
- **Final Board Configuration:**

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

- **Number of Attacking Pairs:** 0
- **Total Time:** 0.012225866317749023 seconds

First-Choice Hill Climbing - Run 10:

- **Final Board Configuration:**



- **Number of Attacking Pairs:** 0
- **Total Time:** 0.0021703243255615234 seconds

Random-Restart Hill Climbing Averages:

- Average time taken for 10 runs: 0.012214398384094239 seconds
- Average number of attacking pairs in final states: 0.0

First-Choice Hill Climbing Averages:

- Average time taken for 10 runs: 0.00575413703918457 seconds
- Average number of attacking pairs in final states: 0.0

Which program is producing more solutions with 0 conflicts?

In every execution, both of the programs effectively produce solutions with zero conflicts. Random-Restart Hill Climbing and First-Choice Hill Climbing algorithms, seem to have the the number 0 when it comes to the attacking pairs in the final states in all of the runs. This is probably becuase of the effectiveness of hill climbing algorithms are designed to make moves that will to avoid conflicts and prioritize moves that improve the current state, they consistently searching for the best soution.

Which program is faster? why?

In terms of speed and the number of attacking pairs in the final states, the First-Choice Hill Climbing algorithm is far better than the Random-Restart Hill Climbing method.

The average time taken for 10 runs of First-Choice Hill Climbing (0.00575 seconds) is significantly lower than that of Random-Restart Hill Climbing (0.0122 seconds). This indicates that, on average, First-Choice Hill Climbing is faster.

The First-Choice Hill Climbing algorithm demonstrates a faster performance, than Random-Restart Hill Climbing algorithm.The First-Choice algorithm's more effective approach of choosing the first enhancing

move seen, which reduces needless state exploration, is responsible for its faster runtime.

Nevertheless, this is seen with a faster average runtime via the First-Choice Hill Climbing algorithm. This shows that instead of wasting time on redundant states, the First-Choice navigates the search space to identify better solutions.

conclusion

In this instance, the First-Choice Hill Climbing algorithm is a superior choice to address the N-Queens problem because it is more efficient and produces higher-quality solutions. In contrast to the Random-Restart Hill Climbing algorithm,which can be seen as second option since the First-Choice Hill Climbing algorithm is more preferable alternative because it combines effectiveness and efficiency.