

ARTIFICIAL INTELLIGENCE

ASSIGNMENT #2

Hill climbing search algorithm is a local search algorithm, that starts with a initial state and attempts to find a better state in terms of heuristics value of the problem. If it finds a better state then, better state becomes the initial state and so on until there is no better state. The main problem is it can stuck in local maxima and can not find the solution of problem since algorithm can not make decreasing step. There are several variations of algorithm to increase the probability of finding solution.

Stochastic hill climbing chooses randomly from the uphill moves to decrease the stuck rate in some cases but it converges more slowly than steepest ascent.

Random restart hill climbing making steepest ascent climbing until the solution found, if it stuck in local maxima it restarts from a random state and try again.

Analyze of the 10 randomly generated problems, for more details see the attached file "problems.html".

Random restart climbing find solution to all 10 of the problems as expected, with a maximum of 11 restarts and 39 moves and minimum of 0 restarts and 4 moves.

Steepest hill climb find solution to only 2 of the problems with 4 moves and 5 moves. In the other problems there is 1 or 2 conflicting queens left. In most cases it finishes in 2 to 6 moves whether it solves or not.

Stochastic hill climb couldn't find solution to any of the problems. Left 1 or 2 queens in problems within 3 to 8 moves.

```

Initial board
- - - - -
- Q - - -
- - Q - -
- - Q - - Q
Q - - - -
- - - Q Q - Q
- - - - -
- - - - -
h=8 Queens Conflicting

Random Restart Hill Climb
h=0 Queens Conflicting
2 restarts, 9 moves

Steepest Hill Climb
h=2 Queens Conflicting
3 moves

Stochastic Hill Climb
h=1 Queens Conflicting

```

```

Initial board
- - - - -
Q - - - - Q
- - - - - Q
- - - - -
- - Q Q - -
- - - - -
- Q - - Q -
- - - - Q -
h=11 Queens Conflicting

Random Restart Hill Climb
h=0 Queens Conflicting
0 restarts, 5 moves

Steepest Hill Climb
h=0 Queens Conflicting
5 moves

Stochastic Hill Climb
h=2 Queens Conflicting

```

6 moves

Initial board

```
- - - - -  
- - - - -  
- - Q - - Q  
- - Q - - Q -  
- - - - -  
- Q - - - -  
- - - Q Q - -  
Q - - - - -
```

h=6 Queens Conflicting

Random Restart Hill Climb

h=0 Queens Conflicting

11 restarts, 39 moves

Steepest Hill Climb

h=1 Queens Conflicting

2 moves

Stochastic Hill Climb

h=1 Queens Conflicting

4 moves

Initial board

```
- Q - - - Q  
- - Q - Q - -  
- - - Q - - -  
- - - - - Q -  
Q - - - - -  
- - - - -  
- - - - -  
- - - - Q - -
```

h=7 Queens Conflicting

Random Restart Hill Climb

h=0 Queens Conflicting

1 restarts, 6 moves

Steepest Hill Climb

h=2 Queens Conflicting

4 moves

Stochastic Hill Climb

h=2 Queens Conflicting

3 moves

6 moves

Initial board

```
- - - - - Q -  
Q - - - - -  
- - - Q - - -  
- - - - -  
- - - - -  
- Q - - - -  
- - - - -  
- - Q - Q Q - Q
```

h=7 Queens Conflicting

Random Restart Hill Climb

h=0 Queens Conflicting

2 restarts, 11 moves

Steepest Hill Climb

h=2 Queens Conflicting

2 moves

Stochastic Hill Climb

h=2 Queens Conflicting

4 moves

Initial board

```
- - - Q - - -  
- Q - - Q Q - -  
- - - - - Q  
- - - - -  
Q - - - - -  
- - - - - Q -  
- - Q - - - -  
- - - - -
```

h=5 Queens Conflicting

Random Restart Hill Climb

h=0 Queens Conflicting

0 restarts, 4 moves

Steepest Hill Climb

h=1 Queens Conflicting

3 moves

Stochastic Hill Climb

h=1 Queens Conflicting

4 moves

```

Initial board
- - - Q - - Q -
- - Q - - - - Q
- - - - - - - -
- - - - - - - -
- - - - - Q - -
Q - - - - - - -
- - - - Q - - -
- Q - - - - - -
h=6 Queens Conflicting

Random Restart Hill Climb
h=0 Queens Conflicting
4 restarts, 16 moves

Steepest Hill Climb
h=1 Queens Conflicting
3 moves

Stochastic Hill Climb
h=1 Queens Conflicting
4 moves

Initial board
- - - - - - - -
- - - - - - - -
- - - - Q - - -
- - - Q - - - -
Q - - - - Q - -
- Q - - - - - Q
- - Q - - - - -
- - - - - Q - -
h=9 Queens Conflicting

Random Restart Hill Climb
h=0 Queens Conflicting
8 restarts, 28 moves

Steepest Hill Climb
h=0 Queens Conflicting
4 moves

Stochastic Hill Climb
h=2 Queens Conflicting
5 moves

```

```

Initial board
- - Q - Q Q - -
Q - - Q - - - Q
- - - - - - - -
- - - - - - - -
- - - - - - - -
- Q - - - - - -
- - - - - Q - -
- - - - - - - -
h=8 Queens Conflicting

Random Restart Hill Climb
h=0 Queens Conflicting
2 restarts, 9 moves

Steepest Hill Climb
h=2 Queens Conflicting
3 moves

Stochastic Hill Climb
h=1 Queens Conflicting
7 moves

Initial board
- - - - - - - -
- - - Q - Q - -
- - - - Q - - Q
- Q - - - - - -
- - - - - - - -
- - - - - - - -
Q - - - - - - -
- - Q - - - Q -
h=9 Queens Conflicting

Random Restart Hill Climb
h=0 Queens Conflicting
5 restarts, 17 moves

Steepest Hill Climb
h=1 Queens Conflicting
3 moves

Stochastic Hill Climb
h=1 Queens Conflicting
8 moves

```

Resources

S. Russell and P. Norvig *Artificial Intelligence: A Modern Approach* Prentice Hall, 2010, Third Edition, p.122-124

Introduction to Hill Climbing, <https://www.geeksforgeeks.org/introduction-hill-climbing-artificial-intelligence/>