3.4. Hill-climbing Local Search and Optimization Strategy

A) Ideas Behind

Specific real-world problems can be explained with the help of the 8-queens problem:

- Integrated circuit designing
- Telecommunications network optimization
- Automatic programming
- Factory-floor layout designing
- Job-shop scheduling
- Vehicle routing
- Portfolio management

…

Important facts :

i) A path to the goal is irrelevant; So, no path cost is considered.

ii) A state with optimum (maximum / minimum) evaluation function/ objective function/ fitness function value should be found.

B) Example:

8							Q	
7				Q				
6	Q							
5			Q					
4					Q			
3						Q		
2								
1		Q						Q
	1	2	3	4	5	6	7	8

I – Initial state

8							Q	
7				Q				
6								
5			Q					
4					Q			
3	Q					Q		
2								
1		Q						Q
	1	2	3	4	5	6	7	8

I1 – a successor of I

- Complete-state formulation of a state, I: 61574381
- Initial state: any placement of queens, but no fixed goal state.
- h: attacking pairs; Needs to be minimized; Global minimum = 0.
- F_1: an objective function, non-attacking pairs; Needs to be maximized; Global maximum = 28; F_1 (I) = 28 – h(I) = 23, F_1 (I1) = ? ….

C) Distinguishing features of Hill-climbing Local Search

1. Uses a single current state;
2. Investigates neighbors generated by the successor function;
3. Terminates if a state with optimal / 'sufficient' value found;
4. Generally does not involve a goal state;
5. Like greedy best-first; Selects from neighbors the one that appears best according to a heuristic function, that is, that appears to lead most quickly to the 'top of the hill';
6. Requires little memory;
7. This may work better than those that consider paths, for very large or potentially infinite search spaces.

D) The <u>environment</u> here is described using a '<u>state space landscape</u>':

……..

i) Features of the environment

a. Hill top: Optimum (global maximum);

b. Foothill top: Not optimum (local maximum), but all successors are less promising than the current state; There may be a lot of foothills and ridges;

c) Plateau top: Not optimum (local maximum), but all successors have the same value;

d) Shoulder: Like a plateau, but at some point, it goes up.

ii) Measures to face the odds of the 'landscape' (environment)

a. Sideways move: Try to go out of a 'shoulder' by insisting on a particular 'direction'.

b. Random restart hill climbing: If stuck up at a local maximum, then begin with a new randomly generated state; Not bad if not so many local maxima out there;

c) Stochastic Hill-climbing: Choose one at random from among the uphill moves.

d) First-choice Hill-climbing: Choose the 1st randomly generated successor that is better than the current state.