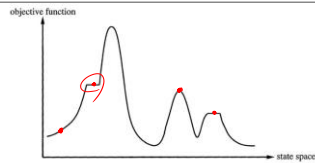


Hill-climbing

Problems?



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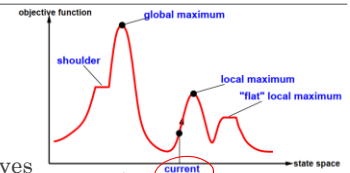
Hill-climbing

Problems

- Local maxima
- Shoulder
- Plateau

Solutions

- Random sideways moves
 - escape from shoulders, but loop on flat maxima
- Random-restart hill climbing
 - overcomes local maxima
 - trivially complete



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Random-restart hill climbing

- If at first you don't succeed, try, try again.
- If each hill-climbing search has a probability p of success; then the probability that the k^{th} trial (out of k trials) is the first success is

$$P_r(X = k) = \underset{\substack{\uparrow \\ \text{first success}}}{(1-p)^{k-1}} \cdot p \quad \text{Geometric Dist.}$$

- Expected number of restarts;

$$E(X) = \frac{1}{p}$$

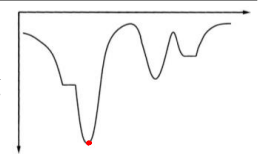
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Hill-declining(?)

Goal

- Finding a global minimum
- Traditionally, we use the term 'Hill-climbing' even for finding a minimum

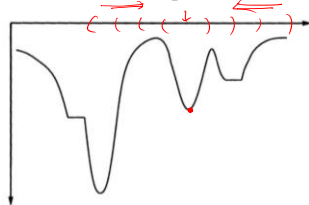


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Simulated annealing

- Escape local maxima by allowing some "bad" moves
- Random-restart in limited space

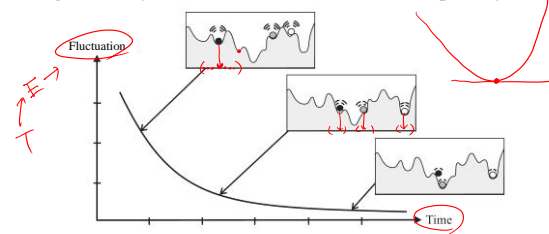


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Simulated annealing

- Escape local maxima by allowing some "bad" moves
- but gradually decrease their size and frequency

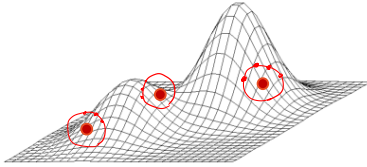


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K parallel hill-climbing

- Idea
 - Run k independent hill-climbing searches
- Can we improve this idea?

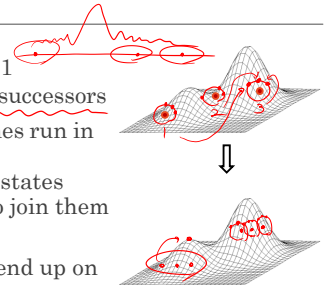


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Local beam search

- Idea
 - keep k states instead of 1
 - choose top k of all their successors
- Not the same as k searches run in parallel
 - Searches that find good states recruit other searches to join them
- Problem
 - quite often, all k states end up on same local hill

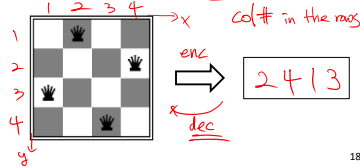


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Genetic algorithms

- Local beam search + generate successors from pairs of states
- GAs require states encoded as strings
- The objective function h is the number of NONE attacking pairs
- Goal: maximizing h



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