Introduction to Artificial Intelligence

Course 16 :198 :440

Recitation 5:

Local Search

RUTGERS

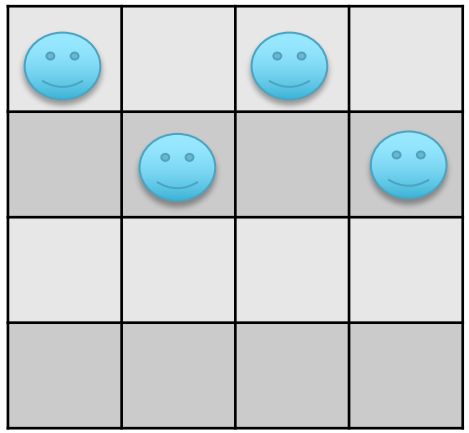
Example of Local Search

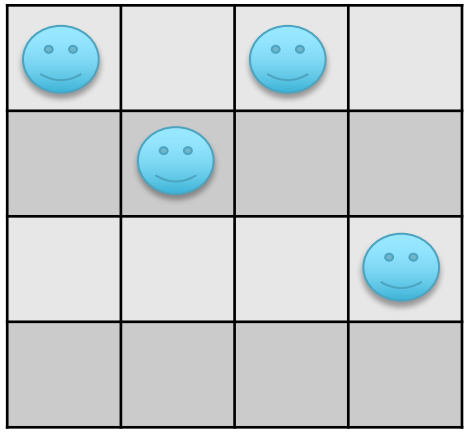
- While we've seen the utility of A*, there are many instances when classical search, both informed and not, is unsuitable.
- For optimization problems with a defined objective function over some state space (even infinite), we can often apply **local search**.

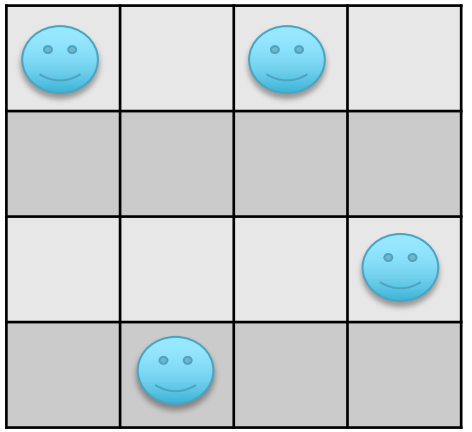
No memory issue as we only care about current state

The Traveling Salesman Problem

4-Queens Problem



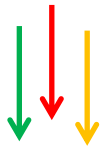




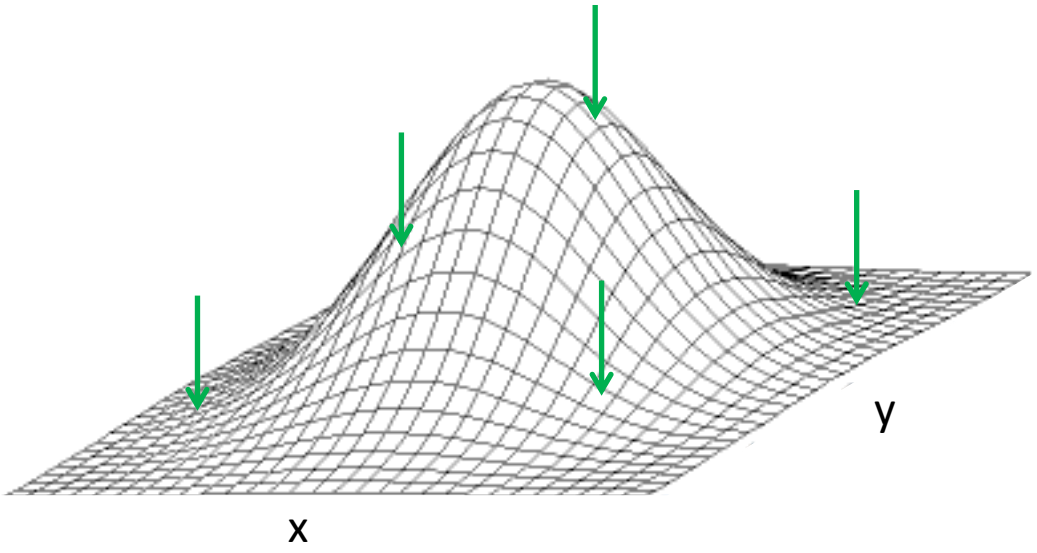
Greedy Hill Climb

Consider the following surfaces…

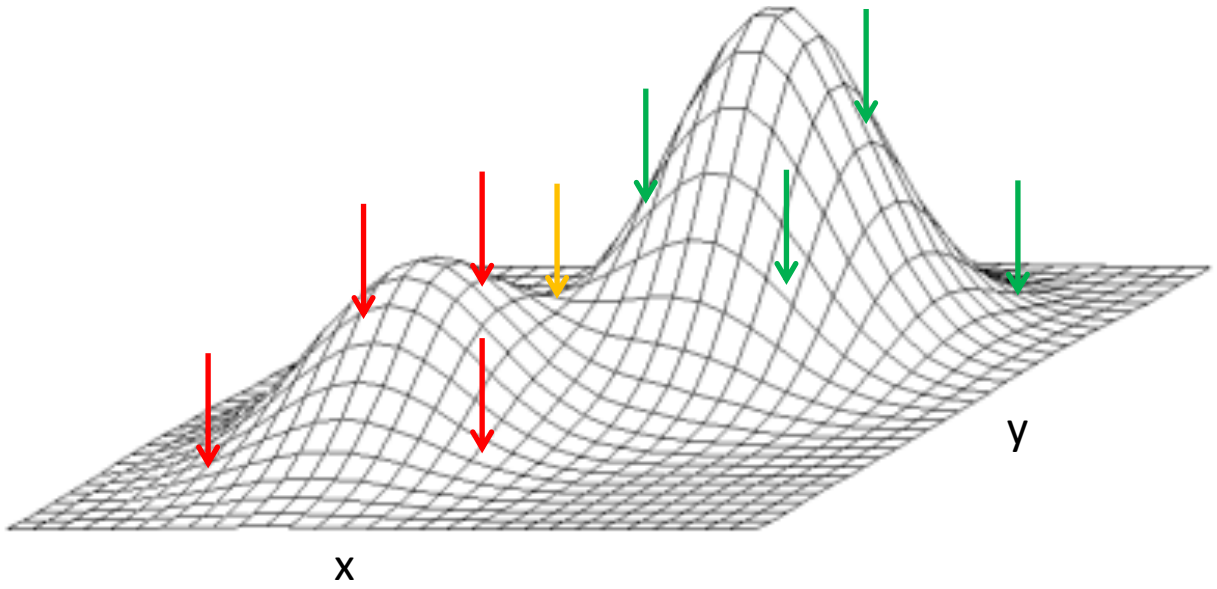
what initial states would lead to the optimal solutions?



: initial states of (x,y) plane



Case 1 - ideal



Case 2 – not so much

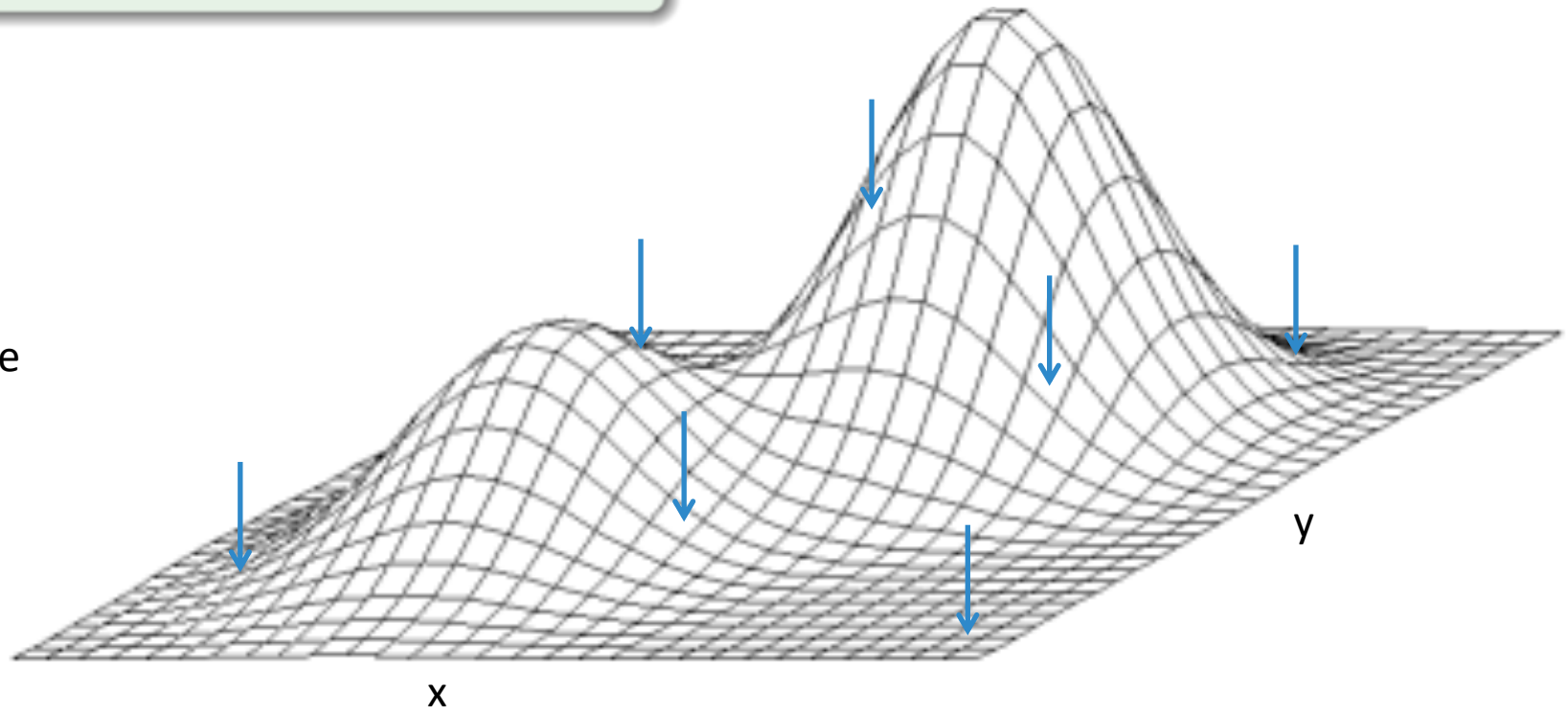
Improving Hill Climb – with stochasticity

Imagine performing hill climb on the following graph using…

Random-restart hill-climbing

- Repeats the hill-climbing from a randomly generated initial state, until a solution is found.
- Guaranteed to eventually find a solution if the state space is finite.
- The expected number of restarts is $\frac{1}{p}$ if hill-climbing succeeds with probability p at each iteration.

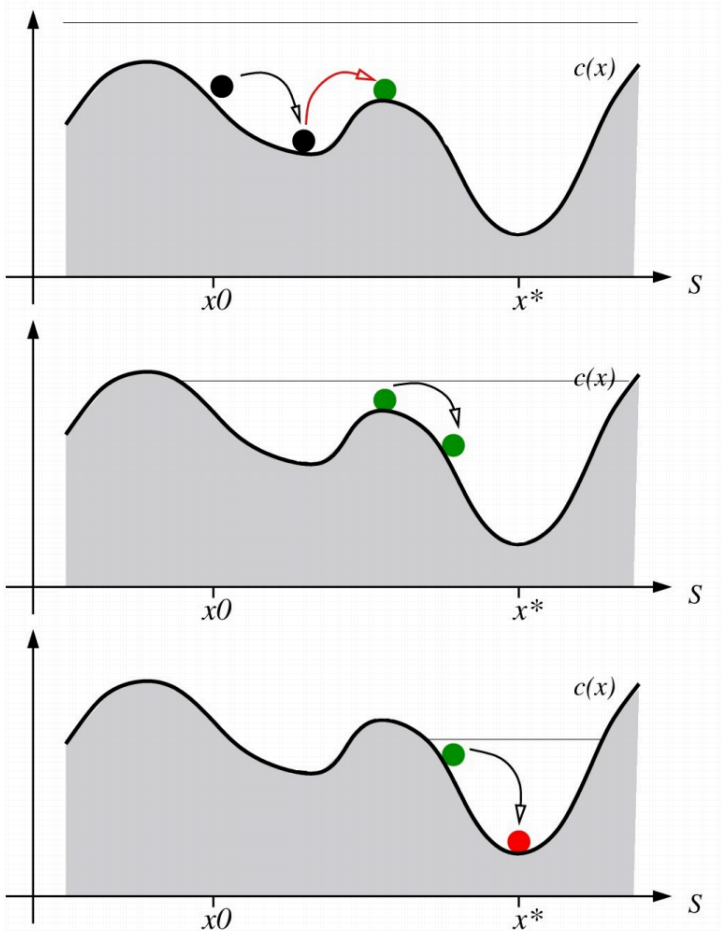
↓ Given initial states of (x,y) plane



Simulated Annealing

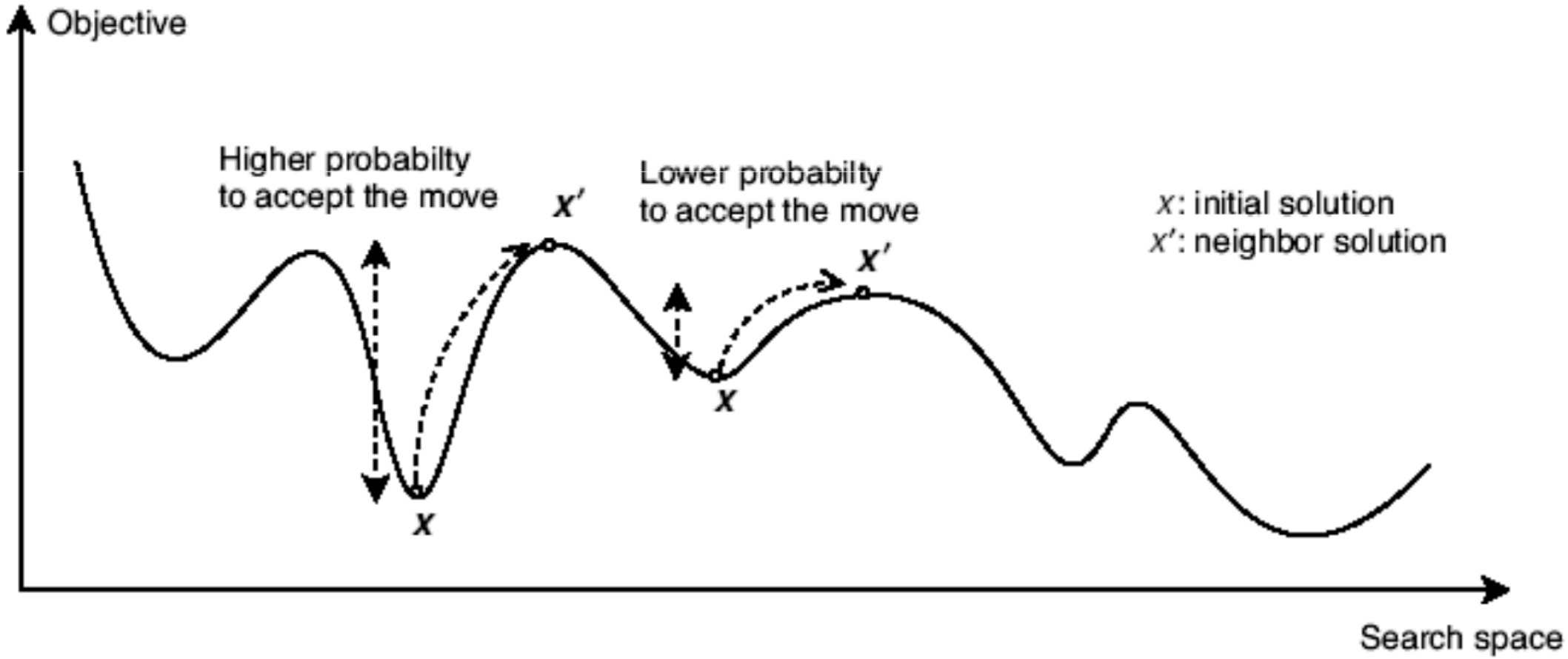
Simulated Annealing

1. Step 1 : Initialize the search with a randomly chosen state, and set the temperature T to a high value.
2. Step 2 : Move in a random direction for a fixed distance.
3. Step 3 : Calculate the value of the objective function in the new state and compare it to the value in the old state.
4. Step 4 : If the value has increased, then stay in the new state. Else, stay in the new state with a probability that is proportional to the change in value, otherwise move back to the old state.
5. Step 5 : Decrease the temperature and go back to step 2.



Simulated Annealing

Decreased temperature means?



Beam Search

Local Beam Search

If k=1 then it's same as gradient hill climbing

- Start with k randomly chosen initial states.
- At each step, generate all the successors of the k states, and retain the k best ones.
- Stop when a goal state is reached or when no further local improvement is possible.

**NOT equivalent to k independent hill climbs*

Backwards: may quickly concentrated in a small region of state space.

Stochastic Beam Search: randomly choose k