On Simulated Annealing

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Biologically-Inspired Intelligent Systems

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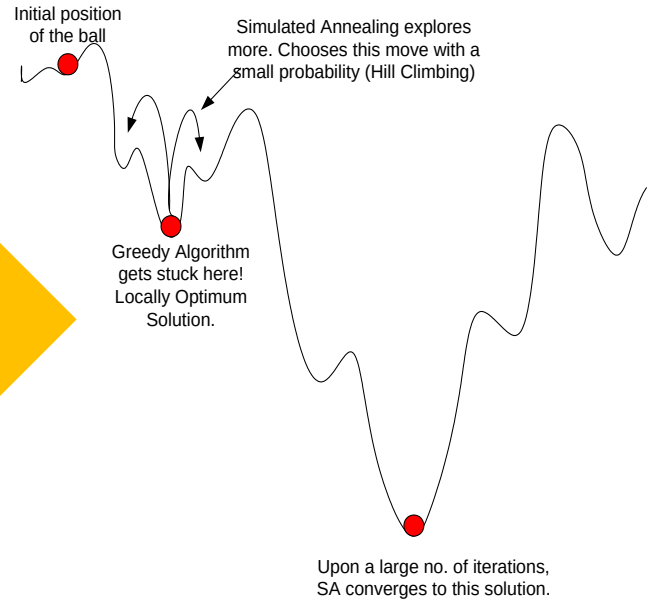
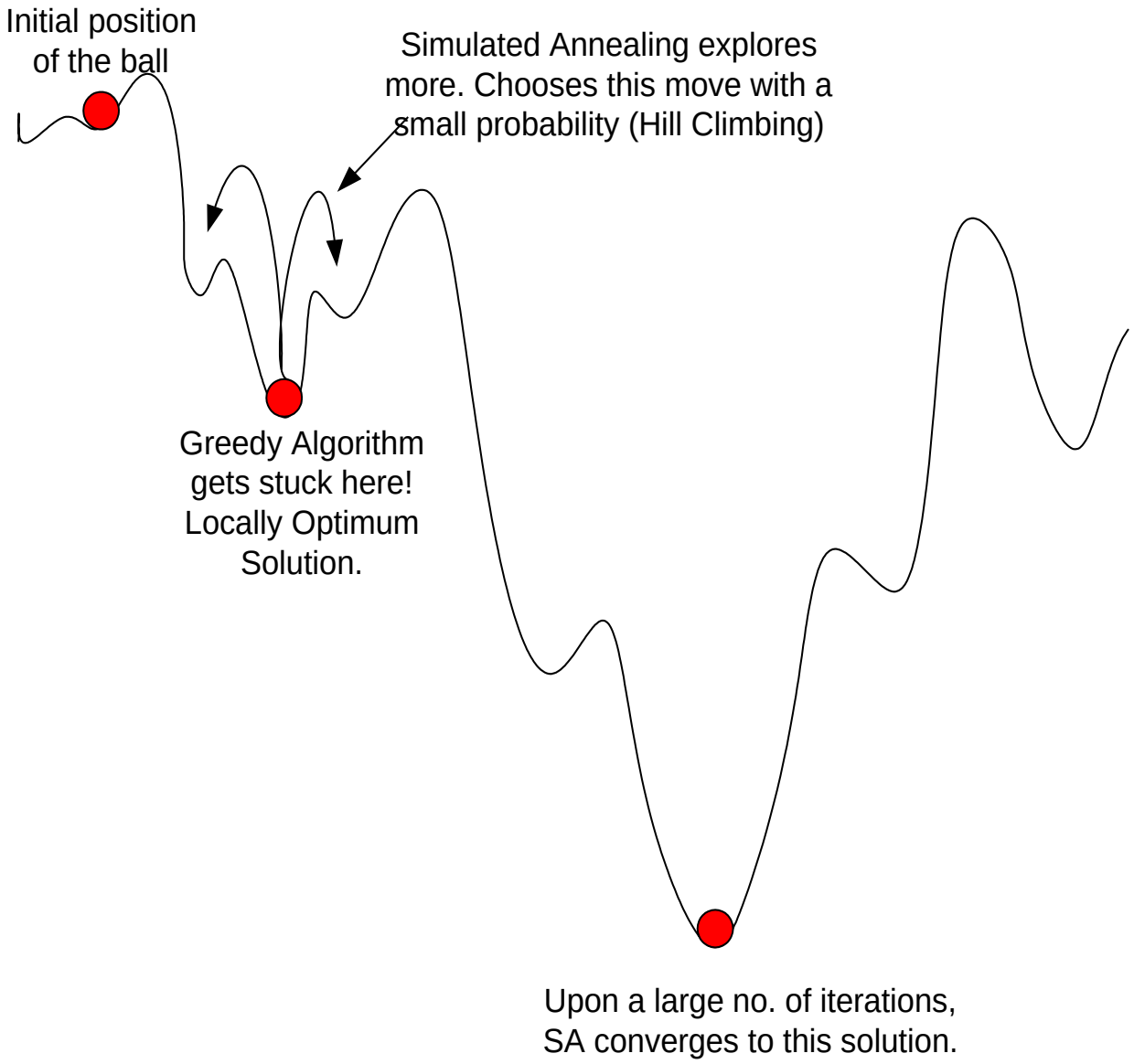
Simulated Annealing (SA)

- The “shaking algorithm”
- Hill-climbing + controlled random walks
  - Accept all good moves and some bad ones (over time, controlled by temperature *T*)



“Ball on Terrain” Example – SA vs Greedy Hill-Climbing



Simulated Annealing Mechanics

Simulated Annealing Algorithm

Objective function $f(\boldsymbol{x})$, $\boldsymbol{x} = (x_1, ..., x_d)^T$
Initialize the initial temperature T_0 and initial guess $\boldsymbol{x}_{(0)}$
Set the final temperature T_f and the max number of iterations N
Define the cooling schedule $T \mapsto \alpha T$, $(0 < \alpha < 1)$
while ($T > T_f$ and $t < N$)
    Drawn $\boldsymbol{\epsilon}$ from a Gaussian distribution
    Move randomly to a new location: $\boldsymbol{x}_{t+1} = \boldsymbol{x}_t + \boldsymbol{\epsilon}$ (random walk)
    Calculate $\Delta f = f_{t+1}(\boldsymbol{x}_{t+1}) - f_t(\boldsymbol{x}_t)$
    Accept the new solution if better
    if not improved
        Generate a random number r
        Accept if $p = \exp[-\Delta f/T] > r$
    end if
    Update the best $\boldsymbol{x}_*$ and f_*
    $t = t + 1$
end while

Questions?