Scientific Computing

March 28, 2025

Announcements

→ Homework 4 assigned, see D2L
Due Wednesday, April 2, 11:59pm

Today

→ Hill Climbing
→ Simulated Annealing

Office Hours:

Mon + Fri

9:30am - 10:30am

Cudahy 307

Hill climbing code demos without visualization code

Topic 12 - Simulated Annealing

* Annealing Metal

[youtube video]

* Simulated Annealing is a MH inspired by the physical process.

Hill climbing: only moves that improve score are allowed.

SA: Worsening moves are accepted with some probability

At the start, the system has a high temperature and the prob. of accepting a worse move is high.

Over time, the system cools down (lower temp.) and the probability of accepting a worse move decreases.

Very high temp: basically a random walk, accepting all tweaks

Very low temp: basically hill climbing

Intuition: As the system cools down, you hope to wander onto a good hill and stay there.

[Demo: Cns. Func. #1]

Technical Details:

* Assuming maximizing!

* Acceptance Condition:

Suppose the current temperature is T.

Let $s = \text{tweak}(x)$ and $\Delta = \text{score}(s) - \text{score}(x)$

If $\Delta > 0$, then s is an improvement over x. always accept

If $\Delta \leq 0$, then s is worse than x.

Accept with probability $p = e^{\Delta/T}$.

[$T > 0$, so $\Delta/T \leq 0$, so $0 < e^{\Delta/T} \leq 1$]

High $T \Rightarrow \Delta/T$ close to $0 \Rightarrow e^{\Delta/T}$ close to 1

Why this formula $p = e^{\Delta/T}$?

Comes from the Boltzmann distribution in physics.

(probability a system is in a certain state given its energy)

* If minimizing, add a negative sign: $p = e^{-\Delta/T}$

If minimizing, $p = e^{-\Delta/T}$