

Simulated Annealing

Simulated annealing

- An algorithm which combines hill climbing with random walk to yield both efficiency and
- Completeness
- A ΔE variable is introduced to calculate the probability of worsened. A second parameter T is introduced to determine the probability, which measures temperature.
- This algorithm was developed using *annealing process* the process of gradually cooling a liquid until it freezes.
- The function VALUE corresponds to the total energy of the atoms in the material and T corresponds to the temperature. The variable schedule determines the rate at which the temperature is lowered

Simulated annealing

Property of simulated annealing search

- If T decreases slowly enough then simulated annealing search will find a global optimum
- with probability approaching one.

Applications

- VLSI layout
- Airline scheduling

Algorithm

```
function SIMULATED-ANNEALING(problem, schedule) returns a solution state
  inputs: problem, a problem
           schedule, a mapping from time to “temperature”
  local variables: current, a node
                    next, a node
                    T, a “temperature” controlling the probability of downward steps
  current ← MAKE-NODE(NITIAL-STATE[problem])
  for t ← 1 to ∞ do
    T ← schedule[t]
    if T=0 then return current
    next ← a randomly selected successor of current
     $\Delta E$  ← VALUE[next] - VALUE[current]
    if  $\Delta E > 0$  then current ← next
    else current ← next only with probability  $e^{\Delta E/T}$ 
```

Local beam search

- It uses K states and generates successors for K states in parallel instead of one state and its successors in sequence. The useful information is passed among the K parallel threads
- path based algorithm

Algorithm

- Keep track of K states rather than just one.
- Start with K randomly generated states.
- At each iteration, all the successors of all K states are generated.
- If any one is a goal state stop; else select the K best successors from the complete list and repeat.

Drawback & Solution

- This search will suffer from lack of diversity among K states. Therefore a variant named as stochastic beam search selects K successors at random, with the probability of choosing a given successor being an increasing function of its value.