LAB-5: Simulated Annealing Algorithm

Observation book:

Date 22/10/2024
Page

Simulated Annealing :

Algorithm :

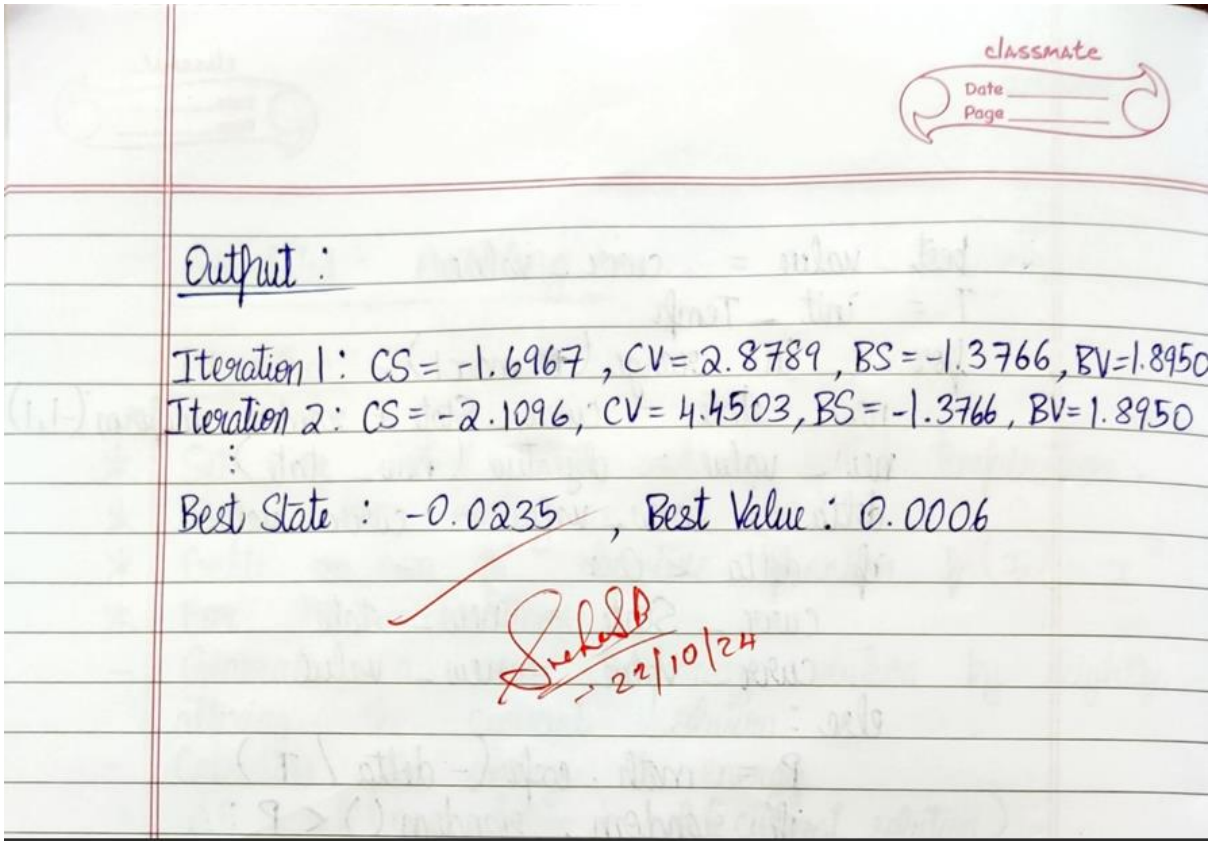
* Set an initial state and an initial temperature.
* Define the cooling rate (α)
* Create an objective function $f(x) = x^2$
* For 'n' iterations :
  - Generate a new temporary solution by slightly altering the current solution
  - Calculate the change in energy
    - $\Delta E = f(\text{new solution}) - f(\text{current solution})$
  - If $\Delta E < 0$, current solution = new solution
  - If $\Delta E > 0$, accept the new solution with a probability : $P = e^{-\left(\frac{\Delta E}{KT}\right)}$ { K → Boltzmann Constant }
  - Decrease the temperature based on the cooling rate
    - $T = T \times \alpha$
* Return the best solution found during the iterations.

Code :

Shreshth 22/10/24

```
import math
import random

def objective(x):
    return x**2 # Objective Function

def SA(init_State, init_Temp, CR, maxI):
    curr_State = init_State
    curr_value = objective(curr_state)
    best_state = curr_state
```

```
    best_value = curr_value
    T = init_Temp
    for i in range (max1):
        new_state = curr_State + random.uniform(-1,1)
        new_value = objective(new_state)
        delta = new_value - curr_value
        if delta < 0:
            curr_State = new_state
            curr_Value = new_value
        else:
            P = math.exp(-delta / T)
            if random.random() < P:
                curr_State = new_state
                curr_Value = new_value
        if curr_Value < best_value:
            best_state = curr_State
            best_value = curr_Value
        T *= CR
        print(f"Iteration {i+1}: Current State = {curr_State:
              0.4f}, Current Value = {curr_Value:.4f},
              Best State = {best_state:.4f}, Best Value =
              {best_value:.4f}")
    return best_state, best_value

IS = random.uniform(-10,10)
IT = 100
CRI= 0.95
MAX2= 50

BS, BV = SA(IS,IT, CRI, MAX2)
print(f"\n Best State : {BS:.4f}, Best Value : {BV:.4f}")
```



Output:

```
Enter the initial state (starting point): 15
Enter the initial temperature: 10
Enter the cooling rate (between 0 and 1): 0.5
Enter the number of iterations: 4
Iteration 1: Current State = 15.8992, Current Energy = 252.7846, Temperature = 5.0000
Iteration 2: Current State = 15.4894, Current Energy = 239.9222, Temperature = 2.5000
Iteration 3: Current State = 15.4894, Current Energy = 239.9222, Temperature = 1.2500
Iteration 4: Current State = 14.4963, Current Energy = 210.1414, Temperature = 0.6250
Best State: 14.4963, Best Energy: 210.1414
Nikhilesh 1BM22CS181
```