AI505 – Optimization

Sheet 03, Spring 2025

Exercises with the symbol $^+$ are to be done at home before the class. Exercises with the symbol * will be tackled in class. The remaining exercises are left for self training after the exercise class. Some exercises are from the text book and the number is reported. They have the solution at the end of the book.

Exercise 1* Consider the natural evolutionary strategy for an univariate function. Assume the univariate normal distribution as proposal distribution $p(x \mid \theta) = \mathcal{N}(x \mid \mu, \sigma^2)$.

- Derive the update rule for θ

- If after a number of iterations the value of μ becomes equal to x^*, that is, the minimum of f, what will be the update rule for σ^2 and what will be the difficulty encountered by the algorithm?

Exercise 2* (8.4)

The maximum likelihood estimates are the parameter values that maximize the likelihood of sampling the points $\{x_1, \ldots, x_m\}$.
Derive the maximum likelihood estimate for the cross-entropy method that uses multivariate normal distributions: $\mathcal{N}(x \mid \mu, \Sigma)$.

Exercise 3*

Implement Simulated Annealing. Set the initial temperature such that the initial acceptance ratio is 0.2 and the annealing plan to exponential with coolring rate $\gamma = 0.99$. Apply the algorithm to the Rosenbrock function and plot the value of the function and the temperature throughout the iterations.