

Methodology

This section describes the implementation methodology and experimental setup used in the optimization project.

Algorithm Implementation

Gradient Descent Algorithm

The core algorithm implements the following iterative procedure for unconstrained optimization:

Input: Initial point $x_0 \in \mathbb{R}^d$, step size $\alpha > 0$, tolerance $\epsilon > 0$, maximum iterations $N_{\max} \in \mathbb{N}$

Output: Approximate solution $x^* \approx \arg \min f(x)$

Algorithm 1: Gradient Descent

Initialize: $k \leftarrow 0$, $x_0 \in \mathbb{R}^d$

While $k < N_{\max}$ do:

 Compute gradient: $\nabla f(x_k)$

 Check convergence: if $\|\nabla f(x_k)\|_2 < \epsilon$ then

 Return x_k as approximate solution

 Update: $x_{k+1} \leftarrow x_k - \alpha \nabla f(x_k)$

 Increment: $k \leftarrow k + 1$