Optimization Methods in Machine Learning
Homework Assignment 2

Code and solve the tasks from the Jupyter notebook and submit a .ipynb file. Solve Problem 2 and Problem 3 in LaTeX format and submit a PDF file before the deadlines.

Soft Deadline: +1 week after the release date: 14 Nov 2024, 23:59
Hard Deadline: +2 weeks after the release date (but with a 25% penalty in points): 21 Nov 2024, 23:59

Problem 1

Solve the problems and run experiments from the Jupyter notebook. [8 points]

Problem 2

Consider Lemma 12 from the lecture notes: Let f be a differentiable, L-smooth function. Then

$$f(x) \leq \underbrace{f(y) + \langle \nabla f(y), x - y \rangle + \frac{L}{2}\|x - y\|^2}_{g(x) :=}.$$

for all $x, y \in \mathbb{R}^d$. Find the optimal x that minimizes the upper bound $g(x)$. [2 points]

Problem 3

Consider Theorem 21 and the corresponding proof from the lecture notes. How would the result change if, instead of L–smoothness (implies Lemma 12), the function f satisfies the inequality

$$f(x) \leq f(y) + \langle \nabla f(y), x - y \rangle + \frac{L}{2}\|x - y\|^2 + \delta$$

for all $x, y \in \mathbb{R}^d$ and some $\delta \geq 0$? (Theorem 21 is true when $\delta = 0$. What if $\delta > 0$?) [2 points]