

# Optimization Methods in Machine Learning

## Homework Assignment 3

Code and solve the tasks from the Jupyter notebook and submit a .ipynb file. Solve Problems 2-4 in LaTeX format and submit a PDF file before the deadlines.

Soft Deadline: +1 week after the release date: 21 Nov 2024, 23:59

Hard Deadline: +2 weeks after the release date (but with a 25% penalty in points): 28 Nov 2024, 23:59

### Problem 1

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

### Problem 2

Solve Exercise 4 from the lecture notes [1 point]

### Problem 3

Solve Exercise 5 from the lecture notes [1 point]

### Problem 4

Consider Theorem 31 and the corresponding proof from the lecture notes. Try to modify the theorem and the proof, assuming that the inequality

$$\mathbb{E} \left[ \|\nabla f(x; \xi) - \nabla f(x)\|^2 \right] \leq \sigma^2 + B \|\nabla f(x)\|^2$$

holds for all  $x \in \mathbb{R}^d$  and  $B \geq 0$  instead of (18) from Assumption 24. [4 points]

(i) Note that Theorem 31 is true when  $B = 0$ .; (ii) Hint: you will have to add one more constraint on  $\gamma$  such that  $\gamma \leq c \times \frac{1}{LB}$ , where  $c$  is some constant; (iii) You can get points for this task even if you won't solve the problem but provide a reasonable attempt.