

Algorithms and Uncertainty

Winter Term 2024/25

Exercise Set 13

If you want to hand in your solutions for this problem set, please send them via email to rlehming@uni-bonn.de by Monday evening. Of course, submitting solutions in groups is also possible.

*If you would like to present one of the solutions in class, please also send an email to rlehming@uni-bonn.de stating **which task** you would like to present in **which of the tutorials**. Deadline for the email is Monday, 10:00 pm. Please note that the tasks will be allocated on a first-come-first-serve basis, so sending this email earlier than Monday evening is highly recommended.*

Exercise 1: (3 Points)

Prove Observation 24.4: If R is σ -strongly convex and f_1, f_2, \dots are convex then $R + \sum_t f_t$ is σ -strongly convex.

Exercise 2: (4 Points)

We consider Online Linear Regression as introduced in the lecture. Recall that

$$f_t(w_1, w_2) = (w_1 x^{(t)} + w_2 - y^{(t)})^2.$$

Derive a regret bound for Follow-the-Regularized-Leader with Euclidean regularization under the assumption that $|x^{(t)}|, |y^{(t)}| \leq 1$ for all t and $S = \{\mathbf{w} \in \mathbb{R}^2 \mid \|\mathbf{w}\|_2 \leq r\}$.

Exercise 3: (4 Points)

Derive a regret bound for Follow-the-Regularized-Leader if the Lipschitz constant depends on the time step, that is,

$$f_t(\mathbf{u}) - f_t(\mathbf{v}) \leq L_t \|\mathbf{u} - \mathbf{v}\| \quad \text{for all } \mathbf{u}, \mathbf{v} \in S.$$