

Algorithms and Uncertainty

Winter Term 2024/25

Exercise Set 12

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)

Consider $f : \mathbb{R}^2 \rightarrow \mathbb{R} : \mathbf{x} \mapsto \mathbf{x}^T \mathbf{x}$. Show that f is convex.

Exercise 2:

(3 Points)

Let $\mathcal{X}$ be a convex set. Prove the following statement: If a function $f : \mathcal{X} \rightarrow \mathbb{R}$ is convex, then any local minimum of f in $\mathcal{X}$ is also a global minimum.

Exercise 3:

(5 Points)

Show that Follow-the-Regularized-Leader with Entropical regularization in the experts setting is equivalent to the Multiplicative Weights algorithm.

Hint: It can be helpful to use a Lagrange multiplier, which works in this special case as follows: For $\mathbf{x}$ to be a local optimum of F subject to $\sum_{i=1}^d x_i = 1$, it is necessary that there exists a $\lambda \in \mathbb{R}$ such that $\frac{\partial F}{\partial x_i}(\mathbf{x}) - \lambda = 0$ for all i .