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January 8, 2024
Due: January 15, 2024 at 10:00 p.m.

Algorithms and Uncertainty

Winter Term 2023/24

Exercise Set 12

If you want to hand in your solutions for this problem set, please send them via email to anna.heuser@uni-bonn.de *by Monday evening – make sure to send a pdf-file which contains your name and your email address. 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 anna.heuser@uni-bonn.de *containing the* ***task*** *which you would like to present and in* ***which of the tutorials*** *you would like to do so. Deadline for the email is Monday, 10:00 pm. Please note that the tasks will be allocated via a first-come-first-served procedure, so sending this email earlier than Monday evening is highly recommended.*

Exercise 1: (3 Points)

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

Exercise 2: (3 Points)

Let $\mathcal{X}$ be a convex set. Prove the following statement: If a function $f : \mathcal{X} \to \mathbb{R}$ 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.