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Due: January 26, 2026 at 10:00 p.m.

# Algorithms and Uncertainty

Winter Term 2025/26

Exercise Set 13

*If you would like to present one of your solutions in class, please use the following link to book a presentation slot by Monday evening:*
https://terminplaner6.dfn.de/b/65c21a60547aa92c10a24a892eaa23ec-1567582
*A short meeting to discuss your solution is mandatory before presenting it in class. To book a time slot for this meeting, please use the following link by Monday evening as well:*
https://terminplaner6.dfn.de/b/bad25224e19d243611df4e1b9cb8c474-1567585

**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 $i$.