Algorithms and Uncertainty
Summer Term 2021
Exercise Set 11

Exercise 1: (3 Points)
Prove Observation 24.4: If $R$ is $\sigma$-strongly convex and $f_1, f_2, \ldots$ are convex then $R + \sum_t f_t$ is $\sigma$-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 $S = \{w \in \mathbb{R}^2 \mid \|w\|_2 \leq r\}$.

Exercise 3: (4 Points)
Derive a regret bound for Follow-the-Regularized-Leader if the Lipschitz constant depends on the time step, that is,

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