

# Optimization project

December 8, 2023

## 1 Objective

1. Select a (convex) objective function.
2. Explain its use in data science.
3. Implement between 2 or 3 algorithmic strategies presented in class to minimize the selected objective function. Illustrate the impact of minimizing such an objective function for a data science problem. Compare the evolution of the objective function w.r.t iterations/time.
4. Solve this minimization problem in Pytorch with SGD and ADAM. Compare the evolution of the objective function and the estimated solution for these 2 algorithmic strategies with the one considered in 3.
5. Redo 3 and 4 for several choices of hyperparameters.

## 2 Some examples of objective functions

- Image restoration:  $\min_x \frac{1}{2} \|Ax - z\|_W^2 + \lambda \|Dx\|_1$
- Image restoration:  $\min_x \text{KL}(Ax, z) + \lambda \|Dx\|_1$
- Image restoration:  $\min_x \frac{1}{2} \|Ax - z\|_2^2 + \lambda \|Dx\|_1 + \iota_C(x)$
- Classification:  $\min_\theta \frac{1}{2} \text{hinge}(X\theta, y) + \lambda \|\theta\|$
- Classification:  $\min_\theta \text{logit}(X\theta, y) + \lambda \|\theta\|_1$

## 3 Final files

- **December 15, 2023:** Preliminary Jupyter notebook or Python code + report.
- **January 4, 2024:** Jupyter notebook or Python code + report.
- **January 12, 2024:** oral presentation (presentation:10 min + questions: 10 min).