Optimization and Introduction to Machine Learning
Exam Questions

The exam for the "Optimization and Introduction to Machine Learning" course will be a 15-minute oral exam. At the beginning of the exam, you will draw one of 9 known questions (see below for a list), and then use approximately 7 minutes on addressing the question. The remaining time will be used for general questions within the curriculum.

You can bring your laptop to the exam and use it to present your answers to the questions. You can, of course, also use the blackboard or a combination of both.

- **Question 1**: Explain what is meant by a convex optimization problem and how to determine if an optimization problem is convex. You can use Exercise 1 connected to the lecture "Convex optimization" as a guide for your explanation.

- **Question 2**: Explain the steepest (or gradient) descent algorithm and the Newton (Raphson) algorithm. You can use Exercise 1 connected to the lecture "Gradient methods" as a guide for your explanation.

- **Question 3**: Explain the Gauss-Newton method. You can use Exercise 3 connected to the lecture "Gradient methods" as a guide for your explanation.

- **Question 4**: Explain how to solve convex optimization problems using the Karush-Kuhn-Tucker condition. You can use Exercise 1 connected to the lecture "Constrained Optimization II" as a guide for your explanation.

- **Question 5**: Name a parametric method and a nonparametric method with an explanation on the major differences between them. You can use Exercise 1 connected to the lecture "Parametric and Nonparametric Methods" as a guide to your explanation.

- **Question 6**: Explain the general model of linear regression with different possible regularizations. You can use Exercise 1 connected to the lecture "Linear Regression" as a guide to your explanation.

- **Question 7**: Explain the general model of logistic regression and the importance of feature selection. You may use Exercise 1 connected to the lecture "Linear Classification" as a guide to your explanation.

- **Question 8**: Explain the general model of multilayer perceptrons and their expressive power. Mention an algorithm to train them. You can use Exercise 2 from the lecture connected to "Introduction to Neural Networks" as a guide to your explanation.

- **Question 9**: Explain the general concept of Principal Component Analysis (PCA) and how it can be computed using the Singular Value Decomposition (SVD). You can use Exercise 1 connected to the lecture "PCA and SVD" as a guide to your explanation.