Study programme(s): Applied Mathematics – Data Science

Level: Master studies

Course title: Fundamentals of numerical optimization

Lecturer: Nataša Krejić

Status: obligatory

ECTS: 6

Requirements:

Learning objectives

The objective of this course is to introduce the basic understanding of optimality conditions for unconstrained and constrained optimization as well as the main algorithms for solvong nonlinear optimization problems. Practical implementation of the algorithms is also an objective of the course.

Learning outcomes

Functional knowledge of optimality conditions and the main algrithms for unconstrained and constrained optimization - smooth, semi-smooth and stochastic.

Syllabus

Theoretical instruction: Linear programming problems. Optimality conditions for unconstrained nonlinear optimization. Gradient type methods. Newton type methods. Optimality conditions for constrained problems. Methods of the first and second order. Large scale problems. Semi-smooth problems, optimality conditions. Sub-gradient methods. Newton type methods for semi-smooth problems. Stochastic optimization - Sample Average Approximation and Stochastic Approximation methods.

Practical instruction: Practical implementation of the methods covered by theoretical instructions in Python.

Literature

1. Nocedal, J., Wright, S., Numerical Optimization, Springer, 2011
2. D. Bertsekas, Convex Optimization Algorithms, Athena Scientific, 2015.
3. Qi, L., Sun, D., Ulbrich, M., Semismooth and Smoothing Newton Methods, Springer 2016.
4. Shapiro, A., Dentcheva, D., Ruszcynski, A., Introduction to stochastic Programming, SIAM 2014.

Weekly teaching load				Other: 0
Lectures: 2	Exercises: 3	Other forms of teaching: 0	Student research: 0	

Teaching methodology

Lectures; revisions of the material; active students' participation in problem solving; lab reports, application of the taught material on real-world examples

Grading (maximum number of points 100)

Pre-exam obligations	**Points**	**Final exam**	**points**
Lab reports	40	Oral exam	60