Course Unit Descriptor

Study Programme: Applied Mathematics – Data Science

Course Unit Title: Fundamentals of numerical optimization

Course Unit Code: MDS04

Name of Lecturer(s): Nataša Krejić

Type and Level of Studies: Master studies

Course Status (compulsory/elective): Compulsory

Semester (winter/summer): Winter

Language of instruction: English

Mode of course unit delivery (face-to-face/distance learning): Face-to-face

Number of ECTS Allocated: 6

Prerequisites: none

Course Aims: 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:

Theory

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.

Practice

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

Required Reading:

Nocedal, J., Wright, S., Numerical Optimization, Springer, 2011

D. Bertsekas, Convex Optimization Algorithms, Athena Scientific, 2015.

Qi, L., Sun, D., Ulbrich, M., Semismooth and Smoothing Newton Methods, Springer 2016.

Shapiro, A., Dentcheva, D., Ruszcynski, A., Introduction to stochastic Programming, SIAM 2014.

Weekly Contact Hours:	**Lectures: 2**	**Practical work: 3**

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

Knowledge Assessment (maximum of 100 points): 100			
Pre-exam obligations	points	**Final exam**	points
Active class participation		written exam	
Practical work	40	oral exam	60
Preliminary exam(s)		Course project	
Seminar(s)			
The methods of knowledge assessment may differ; the table presents only some of the options: written exam, oral exam, project presentation, seminars, etc.			