Course Unit Descriptor

Study Programme: Applied Mathematics – Data Science

Course Unit Title: Distributed optimization with applications

Course Unit Code: MDS07

Name of Lecturer(s): Nataša M. Krklec Jerinkić

Type and Level of Studies: Master studies

Course Status (compulsory/elective): Compulsory

Semester (winter/summer): Summer

Language of instruction: English

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

Number of ECTS Allocated: 6

Prerequisites: Basics of optimization, multivariate calculus, linear algebra, and probability

Course Aims: Understanding of a wide range of modern optimization methods for large scale, parallel, and distributed optimization

- Ability to select appropriate algorithms for the problem at hand
- Ability to implement the taught algorithms in MATLAB

Learning Outcomes:

- Ability and experience in applying the taught algorithms on real-world problems
- Ability to apply the taught algorithms on research problems from a wide variety of application areas
- Ability to synthesize and analyze efficient distributed algorithms for a given application

Syllabus:

Theory

Modern first-order methods for large-scale optimization: proximal gradient; accelerated Nesterov gradient; accelerated gradient for non-smooth optimization (FISTA); Randomized methods: randomized coordinate gradient; stochastic/online gradient; online gradient method under privacy constraints; Parallel and distributed methods: primal decomposition; dual decomposition; augmented Lagrangian; ADMM; distributed gradient; distributed dual averaging; distributed approximate Newton.

Practice

Application examples in telecom, electric grid (smart grid), machine learning, sensor networks, etc.; Implementation of the taught methods in MATLAB; Application of selected methods on real-world examples through the course project.

Required Reading:

Selected papers in the field of distributed optimization

S. Boyd and L. Vandenberghe: Convex Optimization, Cambridge University Press, 2004

D. Bertsekas, Nonlinear Programming, Athena Scientific, 2004

D. Bertsekas and J. Tsitsiklis: Parallel and Distributed Computation: Numerical Methods, Prentice-Hall, 1989

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

Teaching Methods: Lectures; revisions of the material; active students' participation in problem solving; knowledge tests – colloquia; 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	40
Practical work	30	oral exam	
Preliminary exam(s)	30	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.