Course Unit Descriptor

Study Programme: Computer Science – Master

Course Unit Title: Advanced Computational Science and Optimization

Course Unit Code: CS757

Name of Lecturer(s): Dušan Jakovetić

Type and Level of Studies: Master Academic Degree

Course Status (compulsory/elective): Elective

Semester (winter/summer): Summer

Language of instruction: Serbian (primary), English (secondary)

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

Number of ECTS Allocated: 6

Prerequisites: Introduction to Computational Science

Course Aims:

- Understanding of a wide range of standard and modern numerical methods, with an emphasis on optimization methods
- Ability to select an appropriate numerical algorithm for the problem at hand
- Ability to implement the taught algorithms in selected programming languages

Learning Outcomes:

- Ability to apply the taught algorithms on real-world problems
- Ability to apply the taught algorithms on research problems from various domains of computer science
- Ability to customize and analyze efficient numerical algorithms for a given application

Syllabus:

Theory

Iterative methods for solving systems of linear equations: Jacobi, Gauss-Seidel, relaxation methods; First order optimization methods: gradient; projected gradient; line search; proximal gradient; accelerated Nesterov gradient; accelerated gradient for non-smooth optimization (FISTA); Second odred optimization methods: Newton; quasi-Newton; Broyden–Fletcher–Goldfarb–Shanno (BFGS); limited memory BFGS; Randomized optimization methods: randomized coordinate gradient; stochastic/online gradient; Parallel and distributed optimization methods: primal decomposition; dual decomposition; augmented Lagrangian; ADMM; distributed gradient.

Practice

Application examples in various domains of computer science; implementation of the taught methods in selected software languages; application of selected methods on real-world examples.

Required Reading:

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

2. J. Nocedal and S. Wright: Numerical Optimization, Springer, 2011

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

Weekly Contact Hours: 4	**Lectures:** 2	**Practical work:** 2

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):			
Pre-exam obligations	points	**Final exam**	points
Colloquia	40	Oral exam	60
The methods of knowledge assessment may differ; the table presents only some of the options: written exam, oral exam, project presentation, seminars, etc.			