Study programme(s): Computer Science

Level: master

Course title: Advanced Computational Science and Optimization

Lecturer: Dušan Jakovetić

Status: elective

ECTS: 6

Requirements: Introduction to Computational Science

Learning objectives

- 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

Theoretical instruction:

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.

Practical instruction:

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.

Literature

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 teaching load

Lectures:	Exercises:	Practical Exercises:	Student research:	Other:
2	0	2	0	**0**

Teaching methodology

Lectures; revisions of the material; active students' participation in problem solving; knowledge tests – colloquia; application of the taught material on real world examples.

Grading method (maximal number of points 100)

Pre-exam obligations	**Points**	**Final exam**	**points**
2 Colloquia	40	Final exam	60