Study programme: Applied Mathematics – Data Science

Level: master

Course title: Theory of algorithms

Lecturer: Boris B. Šobot

Status: elective

ECTS: 6

Requirements: none

Learning objectives: handling basic notions of the theory of recursive functions and Turing machines, as two equivalent formalizations of the notion of algorithm; introduction to some important algorithms and the analysis of their complexity.

Learning outcomes: understanding recursiveness and connected notions with the capability of proving it; understanding the principles of Turing machines and ability to construct machines solving some simple problems; knowledge of some important algoritms and estimating their complexity.

Syllabus

Theoretical instruction: The notions of primitive recursive and recursive functions. Methods for proving recursiveness. The Ackermann function. Recursive and recursively enumerable sets. Turing machines and some modifications. RAM machines. Calculating time and space complexity of an algotithm. Nondeterministic Turing machines. NP-completness. Some important algorithms: Euclid's algorithm, algorithms on graphs, SAT problem and its restrictions.
Practical instruction: Checking primitive recursiveness of functions and sets. Applications to some important arithmetic functions. Some other connections between recursive and recursively enumerable sets. Constructing Turing machines in one element alphabet. Simulating composition, primitive recursion, sums and products and the search operator.

Literature

1. I. Dolinka, *Kratak uvod u analizu algoritama* (serbian), Faculty of Sciences, Novi Sad, 2008.
2. R. Tošić, S. Crvenković, *Zbirka zadataka iz teorije algoritama* (serbian), Department of mathematics, Novi Sad, 1980.
3. C. H. Papadimitriou, *Computational Complexity*, Addison Wesley Longman, 1994.

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

Teaching methodology

Lectures are presented using classical teaching methods. Exercises are used to practice and analyse typical problems and their solutions. The abillity of application of theoretical knowledge is checked through independent solving of exercises on two colloquia. The final exam is oral and a student is supposed to demonstrate general understanding of the presented theoretical material.

Grading method (maximal number of points 100)

Pre-exam obligations	**points**	**Final exam**	**points**
Colloquia	60	Oral exam	40