Study programme(s): Mathematics (M3)

Level: bachelor

Course title: Theory of Automata (M-16)

Lecturer: Igor V. Dolinka

Status: elective

ECTS: 5

Requirements: Algebra 2

Learning objectives

The goal of the course is to introduce the basic concepts of the theory of finite automata and to emphasise their importance within foundations of computer science.

Learning outcomes

Minimal: The ability to apply basic algorithms in automata theory, e.g. the construction of the syntactic monoid of a semiautomaton, analysis and synthesis of automata, and the minimisation algorithm.

Desirable: Students should achieve a high level of understanding the basic automata theory and its applications, as well as the numerous connections with various topics in algebra and discrete mathematics. Students will be able to creatively solve problems related to the notions from the theory.

Syllabus

Theoretical instruction

Words and languages, the free monoid. Algebras of languages. Regular expressions and identities of algebras of languages. Semiautomata, the syntactical monoid. Deterministic and non-deterministic finite automata. The language of an automaton. The equivalence of DFA and NFA. The Kleene theorem: analysis and synthesis of automata. The pumping lemma. Regular languages and (right) congruences of free monoids. The Myhill-Nerode theorem. Minimal automata, the minimisation algorithm.

Practical instruction

The value of a regular expression. Equivalence of regular expressions and basic identities of language algebras. Computations of the syntactical monoid. *Ad hoc* methods for the synthesis and analysis of automata. Transforming a NFA into a deterministic one. Analysis and synthesis of automata by algorithms from the proof of the Kleene theorem. Applications of the pumping lemma. The minimisation algorithm.

Literature

1. R. S. Madaras, S. Crvenković, Uvod u teoriju automata i formalnih jezika, Univerzitet u Novom Sadu, Stylos, Novi Sad, 1995.
2. S. Crvenković, R. S. Madaras, N. Mudrinski, Zbirka zadataka iz teorije automata, Prirodno-matematički fakultet, Novi Sad, 2006.
3. J. E. Hopcroft, R. Motwani, J. D. Ullman, *Introduction to Automata Theory, Languages, and Computation* (2nd edition), Addison-Wesley, Reading, 2001.
4. D. C. Kozen, *Automata and Computability*, Springer-Verlag, New York, 1997.

Weekly teaching load				Other: 0
Lectures: 2	Exercises: 2	Other forms of teaching: 0	Student research: 0	

Teaching methodology

Lectures are presented using classical teaching methods and supported by beamer presentations. Exercises are used to practise and analyse typical problems and their solutions. The understanding of theoretical material is checked on two colloquia. The final exam is written and a student is supposed to demonstrate general understanding of the presented theoretical material and an ability to apply that knowledge in independent solving of problems.

Grading method (maximum number of points 100)

Pre-exam obligations	points	Final exam	points
Colloquia	50	Written final exam	50