Study programmes: Master studies - Informatics

Course name: R306 - Automated reasoning

Lecturers: Filip Marić and other professors of the Computer science department

Status: Optional

ECTS: 8

Attendance prerequisites: No preconditions

Course aims: Introduction to main areas of automated reasoning and its applications.

Course outcome: After the course the student can understand, construct and implement basic algorithms for automated reasoning.

Course content:

- Propositional logic and SAT problem: Tseitin transformation to CNF, classic DPLL procedure, CDCL SAT solvers, resolution method for propositional logic, tableaux.
- First order logic: Herbrand's theorem and Gilmore's method, resolution with unification (connections with Herbrand's theorem, lifting lemma, soundness and completeness), tableaux with unification.
- Deductive systems (Hilbert's systems, natural deduction, sequent calculus, interactive theorem proving).
- First order logic with equality: equality axioms, normal models, Birkhoff's system and Birkhoff's theorem, congruent closure and Nelson-Oppen CCC procedure, rewriting (confluence, reduction orderings, Knuth-Bendix completion procedure).
- Decidability, decision procedures and SMT solvers: quantifier elimination (RCF, ACF), DPLL(T), SMT theories and procedures (LRA/LIA, Fourier-Motzkin procedure, Simplex, EUF, BVA), applications of SMT sovers.
- Reasoning in other domains. Limitations of automated reasoning.

Literature:

1. John Harrison, Handbook of Practical Logic and Automated Reasoning, Cambridge University Press, 2009.
2. Predrag Janičić, Matematička logika u računarstvu, Математички факултет, 2004.
3. Alan Bundy, The Computer Modelling of Mathematical Reasoning, Academic Press, 1983.
4. Alan Robinson, Andrei Voronkov, eds. Handbook of Automated Reasoning, MIT press, 2001.
(teacher can choose other literature)

Number of hours: 7	**Lectures: 2**	**Tutorials: 3**	**Laboratory: -**	**Research: 2**

Teaching and learning methods: Frontal, group, individual, practical.

Assessment (maximal 100 points)

Course assignments	points	Final exam	points
Lectures	5	Written exam	-
Exercises / Tutorials	10	Oral exam	-
Colloquia	20	Written-oral exam	50
Essay / Project	15		