DOCTORAL (PHD) STUDIES

COURSE UNIT DESCRIPTION

Course unit title	Scientific areas	Faculty	Institute, department
Automated verification and validation methods	Informatics (N009)	Faculty of Mathematics and Informatics	Institute of Computer Science

Study method	Number of credits	Study method	Number of credits
Lectures	1 (spring semester)	Consultations	1
Individual works	4	Seminars	1

Summary

The course overviews various automated methods for verification and validation of software-based systems, which are based on automated and interactive theorem proving, model checking, and static verification techniques. During the course there will be discussed the existing automated verification and validation environments, their mathematical foundations and practical applications, with respect to the considered domain model and its properties.

The main course topics:

- What is automated verification and/or validation of system models? The types of system models, their semantics, and the corresponding verification or validation techniques. The system properties that can be verified, validated, or simulated;
- Verification by automated theorem proving. The notion of automated proof. Forward and backward proofs. Inference rules and proof tactics. Other proof techniques;
- Automated proof environments (proof assistants), their structure and integrated means for automated and interactive verification, as well as the programmable ways to extend their capabilities. Overview of concrete tools: Isabelle, Rocq, etc;
- Verification by model checking. Different modelling languages and techniques used in model checking. The state explosion problem and its solutions. Statistical model checking;
- Automated model checking environments (tools). Overview of concrete tools: Promela/Spin, Uppaal, PRISM, etc.
- Static system verification. Using the Dafny framework for static verification.

During course seminars and consultations, (read in advance) articles and book chapters will be discussed. Students will also present their solutions for given practical tasks.

Main literature

C. Baier, J.-P.Katoen “Principles of Model Checking”, MIT Press, 2008.

R. Leino „Program Proofs“, MIT Press, 2023

J. Harrison, „Handbook of Practical Logic and Automated Reasoning“, Cambridge Press, 2009

Lecturer(s) (name, surname)	Science degree	Main publications
Prof. Linas Laibinis	Dr.	http://www.elaba.mb.vu.lt/mif/?aut=Linas+Laibinis
Prof. Rimas Vaicekauskas	Dr.	http://www.elaba.mb.vu.lt/mif/?aut=Rimas+Vaicekauskas
Asist. Haroldas Giedra	Dr.	http://www.elaba.mb.vu.lt/mif/?aut=Haroldas+Giedra