

DOCTORAL (PHD) STUDIES
COURSE UNIT DESCRIPTION

Course unit title	Scientific areas	Faculty	Institute, department
Formal semantics and specification methods for software-based systems	Informatics (N009)	Faculty of Mathematics and Informatics	Institute of Computer Science

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

Summary
<p>The course overviews various formal semantics and logics of programming languages and software-based systems, which constitute the mathematical basis for modelling and verification of such systems. On the basis of these semantics, we can mathematically define the structure and requirements of software-based systems, their static and dynamic characteristics, or the associated elements of programming languages, as well as rigorously prove the derived system properties.</p> <p>The main course topics:</p> <ul style="list-style-type: none"> - What is formal semantics of programming systems and/or languages? Denotational and operational semantics; - Programming system as an abstract state machine or a state transition system. Forward (relational), backward (weakest precondition), and operational semantics for state-based systems; - The notion of system correctness and refinement. Refinement Calculus as a formal method for reasoning about computer programs; - Finite-state machines (automata). Petri nets; - A programming system as communicating dynamic processes; Process algebras (CSP, CCS,...) - Temporal logics (LTL, CTL, TLA+). Temporal system properties; - Overview of specification languages and logics (Z, VDM, B, Refinement Calculus, TLA+, Petri nets, UNITY, CSP, pi-calculus, Uppaal, etc.) <p>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.</p>

Main literature
D. Bjorner, M. Henson (eds.), „Logics of Specification Languages“, Springer, 2008
E. Borger, R. Stark, „Abstract State Machines“, Springer, 2003
R.-J. Back, J. von Wright, „Refinement Calculus: A Systematic Introduction“, Springer, 2000
R. Harper, „Practical Foundations for Programming Languages“, Cambridge University Press, 2016

Lecturer(s) (name, surname)	Science degree	Main publications
Prof. Linas Laibinis	Dr.	http://www.elaba.mb.vu.lt/mif/?aut=Linas+Laibinis
Prof. Romas Baronas	Dr.	http://www.elaba.mb.vu.lt/mif/?aut=Romas+Baronas
Assoc. Prof. Karolis Petrauskas	Dr.	http://www.elaba.mb.vu.lt/mif/?aut=Karolis+Petrauskas