

SYLLABUS / FIȘA DISCIPLINEI

1. Information on the study programme / Date despre programul de studii

1.1. Institution / Instituția de învățământ superior	Universitatea de Vest din Timișoara
1.2. Faculty / Facultatea	Matematică și Informatică
1.3. Department / Departamentul	Computer Science (Informatică)
1.4. Study program field	Computer Science (Informatică)
1.5. Study cycle/ Ciclul de studii	Bachelor / licență
1.6. Study programme / Programul de studii / calificarea*	Computer Science / Informatică în limba engleză / Database administration / <i>Administrator baze de date - 252101; Computer network administration / Administrator de rețea de calculatoare - 252301; Analyst / Analist - 251201; Research assistant in computer science / Asistent de cercetare în informatică - 214918; Teacher in secondary schools / Profesor în învățământul gimnazial - 233002; Programmer / Programator - 251202; Software systems designers / Proiectant sisteme informatice - 251101</i>

2. Information on the course / Date despre disciplină

2.1. Title of the course / Denumirea disciplinei	Formal Methods in Software Development						
2.2. Teacher in charge of the course / Titularul activităților de curs	Madalina Erascu						
2.3. Teacher in charge of the seminar / Titularul activităților de seminar	Madalina Erascu						
2.4. Study year / Anul de studii	3	2.5. Semester / Semestrul	1	2.6. Examination type / Tipul de evaluare: E(xam)/C(olloquim)	C	2.7. Course type / Regimul disciplinei: M(andatory)/ E(lective)/ F(acultative)	DO

3. Estimated study time (number of hours per semester) /Timpul total estimat (ore pe semestru al activităților didactice)

3.1. Attendance hours per week / Număr de ore pe săptămână	3	out of which din care: 3.2 lecture/ curs	2	3.3. seminar/laborator	1
3.4. Attendance hours per semester / Total ore din planul de învățământ	42	out of which: 3.5 lecture / curs	28	3.6. seminar/laborator	14
Distribution of the allocated amount of time / Distribuția fondului de timp*					hours/ ore
Individual study /Studiu după manual, suport de curs, bibliografie și notițe					30
Supplementary documentation at library or using electronic repositories / Documentare suplimentară în bibliotecă, pe platformele electronice de specialitate					10
Preparing for laboratories, homework, reports etc. /Pregătire seminarii/laboratoare, teme,					20

referate, portofolii și eseuri	
Exams / Examinări	2
Tutoring / Tutorat	2
3.7. Total number of hours of individual study / Total ore studiu individual	130
3.8. Total number of hours per semester / Total ore pe semestru	60
3.9. Number of credits (ECTS) / Număr de credite	5

4. Prerequisites (if it is the case) / Precondiții (acolo unde e cazul)

4.1. curriculum / de curriculum	Computational logic, algorithmics
4.2. skills / de competențe	Mathematical knowledge and problem solving skills

5. Requirements (if it is the case) / Condiții (acolo unde e cazul)

5.1. for the lecture / de desfășurare a cursului	Classroom with blackboard and video projector
5.2. for the seminar, laboratory / de desfășurare a seminarului/laboratorului	Classroom with blackboard, video projector and computers. We will install a virtual machine with the needed software.

6. Acquired skills / Competențe specifice acumulate

Professional skills / Competențe profesionale	Presentation and understanding of (1) the importance of logical theories in the verification of programs, (2) static analysis of programs, (3) particularities of Java programs verification. Since the students have the option of choosing a research topic, this implies competences in the understanding of new concepts, their synthesis and presentation (final report and presentation).
Transversal skills / Competențe transversale	The ability of communicating knowledge about different notions from formal methods of software.

7. Objectives of the course / Obiectivele disciplinei (reieșind din grila competențelor specifice acumulate)

7.1. General objective / Obiectivul general al disciplinei	Understanding of different notions from formal methods of software (static program analysis).
7.2. Specific objectives / Obiectivele specifice	<i>Knowledge objectives:</i> understanding and usage propositional and predicate logic, loop invariants, termination terms, program specification, with emphasis on Java programs. <i>Abilitation objectives:</i> usage of dedicated software RISC

	<p>Program Explorer și RISC Proof Navigator.</p> <p><i>Attitudinal objectives:</i> motivation and argumentation of the importance of formal verification of software.</p>
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8. Content / Conținuturi*

8.1. Lecture / Curs	Teaching strategies / Metode de predare	Remarks, details / Observații
<p>C1 - C3 (6h).</p> <p>Introduction. Importance of program verification. Propositional logic. First-order predicate logic. Basic proof techniques.</p>	Lecture, conversation, illustration	<p>References:</p> <ul style="list-style-type: none"> • Madalina Erascu – lecture notes • A. Bradley, Z. Manna. The Calculus of Computation. Decision procedures with Applications to Verification. Springer 2007
<p>C4 - C6 (6h)</p> <p>Specification and verification of sequential programs. Hoare method. Generation of the verification conditions and their proof. Termination.</p>	Lecture, conversation, illustration	Same as above
<p>C7 - C8 (4h)</p> <p>Specification and verification of Java programs.</p>	Lecture, conversation, illustration	Same as above
<p>C9 - C13 (10h)</p> <p>Presentation of different actual research in formal methods and closely related to the topics in C1-C8. Suggestions of topics are: model checking, SAT and SMT solving, quantifier elimination for different logical theories.</p>	Lecture, conversation, illustration	Same as above

Recommended bibliography / Bibliografie

- [1] C.-L. Chang, R. C. T. Lee. *Symbolic Logic and Mechanical Theorem Proving*. Computer Science Classics
- [2] C.A.R. Hoare. *An axiomatic Basis for Computer Programming*.
- [3] M. Huth, M. Ryan. *Logic in Computer Science. Modelling and Reasoning about Systems*.
- [4] L. de Moura, N. Bjorner. *Satisfiability Modulo Theories: Introduction and Applications*.
- [5] J. Woodcock et al. *Formal Methods: Practice and Experience*
- [6] Formal Verification of Object-Oriented Software: <http://www.cost-ic0701.org/>
- [7] A. Biere, M. Heule, H. Van Maaren, T. Walsh. *Handbook of Satisfiability*. IOS Press 2009
- [8] A. Bradley, Z. Manna. The Calculus of Computation. Decision procedures with Applications to

Verification. Springer 2007		
[9] D. Kroening, O. Strichman. <i>Decision Procedures An Algorithmic Point of View</i> . Springer 2008		
8.2. Seminar, lab / Seminar, laborator	Teaching/learning strategies / Metode de predare/ învățare	Remarks, details / Observații
1. Exercises involving the specification and verification of programs, invariant generation and termination term synthesis, using the notions presented in the lecture. 2. Practical exercises using tools like RISC Program Explorer and RISC ProofNavigator.	Questioning, dialogue, collaborative learning	Based on the notions presented in the lecture, the students will be able to access the homework from the course website. They have to prepare it. It will then will be discussed in the class.
Recommended bibliography / Bibliografie [1] C.-L. Chang, R. C. T. Lee. <i>Symbolic Logic and Mechanical Theorem Proving</i> . Computer Science Classics [2] C.A.R. Hoare. <i>An axiomatic Basis for Computer Programming</i> . [3] M. Huth, M. Ryan. <i>Logic in Computer Science. Modelling and Reasoning about Systems</i> . [4] L. de Moura, N. Bjorner. <i>Satisfiability Modulo Theories: Introduction and Applications</i> . [5] J. Woodcock et al. <i>Formal Methods: Practice and Experience</i> [6] Formal Verification of Object-Oriented Software: http://www.cost-ic0701.org/ [7] A. Biere, M. Heule, H. Van Maaren, T. Walsh. <i>Handbook of Satisfiability</i> . IOS Press 2009 [8] A. Bradley, Z. Manna. <i>The Calculus of Computation. Decision procedures with Applications to Verification</i> . Springer 2007 [9] D. Kroening, O. Strichman. <i>Decision Procedures An Algorithmic Point of View</i> . Springer 2008		

9. Correlations between the content of the course and the requirements of the IT field / Coroborarea conținuturilor disciplinei cu așteptările reprezentanților comunității epistemice, asociațiilor profesionale și angajatorilor reprezentativi din domeniul aferent programului

The content of the lecture is similar to others, on the same topic, from other universities. It covers the fundamental notions for understanding why formal methods for software development are so important. Currently, the lecture seems to be not that useful for ordinary IT companies in Romania. However, formal methods are necessary for safety-critical systems (avionics, cars, medical devices) becoming mandatory. We foresee a need of them in the next decade in Romania, too.

10. Evaluation / Evaluare*

Activity / Tip de activitate	10.1. Evaluation criteria / Criterii de evaluare**	10.2. Evaluation methods / Metode de evaluare***	10.3. Weight in the averaged mark / Pondere din nota finală
10.4. Lecture /	Evaluation of the knowledge	Written exam in the last	50%

Curs	acquired from the lectures C1-C7 laboratory L1-L7, except syntax notions of the tools used: RISC Proof Navigator and RISC Program Explorer.	lecture of the semester or presentation (oral and written report).	
10.5. Seminar/ lab	Solving the homeworks which involve the notions presented in the lectures (theoretical and practical).	Homeworks	40%
10.6. Minimal knowledge for passing / Standard minim de performanță			
<p>Minimal knowledge for passing (grade 5)</p> <ul style="list-style-type: none"> acquire a fundamental understanding of methods of formal methods (specification, invariants, termination terms, verification conditions) <p>The final grade is computed as a weighted average of the grades given for the components specified in 10.4 and 10.5. The exam is passed if the average is less than 5 (not necessary that each note to be greater than 5). At each exam sessions (including reexamination and improvements) score is calculated by the same rule. In reexamination/improvements session, only the grade from the written exam can be improved.</p> <p>Note: Students may attend office hours (2 modules / week according to the schedule set out at the beginning of the semester) where the lecturer (course/seminar) answers students' questions and provides further explanations related to course content, applications from seminary themes.</p>			

Date/ Data completării

07.10.2016

 Signature (lecture) /
 Semnătura titularului de curs
 Madalina Erascu

 Signature (seminar)
 Semnătura titularului de seminar
 Madalina Erascu

 Signature (director of the department)
 Semnătura directorului de departament
 Conf.dr. Victoria Iordan