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MODULE HANDBOOK

Module name	**Formal Verification**
Module level	Undergraduate
Code	MII-3207
Courses (if applicable)	Microprocessor
Semester	Spring (Even)
Contact person	Dr.-Ing. Reza Pulungan, M.Sc.
Lecturer	Dr.-Ing. Reza Pulungan, M.Sc. Dr. Suprapto, M.I.Kom
Language	Bahasa Indonesia and English
Relation to curriculum	1. Undergraduate degree program, elective, 4th or 6th semester. 2. International undergraduate program, elective, 4th or 6th semester.
Type of teaching, contact hours	1. Undergraduate degree program: lectures, < 60 students, 2. International undergraduate program: lectures, < 30 students.
Workload	1. Lectures: 3 x 50 = 100 minutes (2 hours 30 minutes) per week. 2. Exercises and assignments: 3 x 60 = 180 minutes (3 hours) per week. 3. Individual study: 3 x 60 = 180 minutes (3 hours) per week.
Credit points	3 credit points (sks).
Requirements according to the Examination regulations	A student must have attended at least 75% of the lectures to sit in the exams.
Recommended prerequisites	Language and Automata
Learning outcomes (course outcomes) and their corresponding PLOs	After completing this module, students are expected to: CO1 Comprehend and be able to explain the basic concepts of formal verification, reactive systems, and how to model, verify and validate them. CO2 Comprehend and be able to explain the syntax and semantics of linear-temporal logic (LTL), its model checking techniques and be able to apply it. CO2 Comprehend and be able to explain the syntax and semantics of computation-tree logic (CTL), its model checking techniques and be able to apply it. CO4 Be able to model problems with middle-level complexity in PROMELA and verify them by using SPIN model checker.

CO5 Be able to explain the state-of-the-art in the field of model checking, contemporary research topics, and the future direction of research and development in this field.

PLO		CO1	CO2	CO3	CO4	CO5
Program Learning Outcome (PLO)	PLO1	√				
	PLO2		√	√		
	PLO3				√	
	PLO4					√
	PLO5					

Contents

(a) Introduction: formal systems, formal methods, formal verification and validation, methods of formal verification.
(b) Modelling reactive systems: transition systems, program graphs, and channel systems.
(c) Verification of regular linear-time properties: omega-regular language, Büchi automata, nested depth-first exploration.
(d) LTL model checking: syntax, semantics, automata, model checking algorithms.
(e) CTL model checking: syntax, semantics, CTL vs LTL, model checking algorithms.
(f) Model checker for LTL and CTL: SPIN.

Study and examination requirements and forms of examination

Evaluation is done in 4 forms, namely:
1. Two examinations, mid-term and final,
2. Two individual assignments,
3. Two modelling assignments in groups, and
4. Two discussion and presentations in groups.

Assessment is done using benchmark assessment, with the aim of measuring the level of students' understanding related to the target and class rank.

Media employed

LCD, blackboard, and websites.

Assessments and Evaluation

Type	Percentage	CO1	CO2	CO3	CO4	CO5
Individual assignment 1	5%	√	√	√		
Modelling 1 (group)	15%		√		√	
Discussion and presentation 1 (group)	10%				√	√
Mid-term exam	20%	√	√	√		
Individual assignment 2	5%	√	√	√		
Modelling 2 (group)	15%			√	√	
Discussion and presentation 2 (group)	10%				√	√
Final exam	20%	√	√	√		
Total	100%					

Reading List

1. Christel Baier and Joost-Pieter Katoen: Principles of Model Checking, MIT Press, 2008.

	2. Edmund M. Clarke, Thomas A. Henzinger, Helmut Veith, and Roderick Bloem: Handbook of Model Checking, 1st ed. Springer, 2018. 3. Luca Aceto, Anna Ingólfsdóttir, Kim G. Larsen, and Jiri Srba: Reactive Systems: Modelling, Specification and Verification, Cambridge University Press, 2007.

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