Syllabus

Course Description

Course Title	Applied Formal Methods
Course Code	71088
Course Title Additional	
Scientific-Disciplinary Sector	INFO-01/A
Language	English
Degree Course	PhD Programme in Computer Science
Other Degree Courses (Loaned)	
Lecturers	dr. Andrea Mazzullo, Andrea.Mazzullo@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/38537
Teaching Assistant	
Semester	First semester
Course Year/s	2026/27
CP	2
Teaching Hours	20
Lab Hours	0
Individual Study Hours	50
Planned Office Hours	
Contents Summary	The students will develop a deep understanding of technologies based on applying formal methods for the specification and verification of hardware systems. The students will learn the most important techniques based on Model Checking to check the properties of a system. In particular, the students will be able to understand how to formally specify a hardware system by means of transition systems and how to express computation properties by means of formulas in Temporal Logic. Both Linear Temporal Logic (LTL) and Computation Tree Logics (CTL and CTL*) will be studied. A tutorial on NuSMV will introduce the students to one of the most successful software used in industrial applications to

	specify and test synchronous concurrent systems and critical software.
Course Topics	• Modeling systems as transition systems • Temporal logics: LTL, CTL, CTL* • Model checking of temporal formulas • NuSMV to model systems and perform model checking
Keywords	Model Checking, Transition Systems, Temporal Logics
Recommended Prerequisites	
Propaedeutic Courses	A background on propositional logic is welcome.
Teaching Format	Frontal lectures
Mandatory Attendance	Not compulsory but recommended. Non-attending students have to contact the lecturer at the start of the course to agree on the modalities of the independent study
Specific Educational Objectives and Learning Outcomes	Knowledge and understanding • Knowledge of model checking principles and of temporal logics used in applications. Applying knowledge and understanding • To be able to model systems and specify desired properties using transition systems and LTL/CTL formulas. • To be able to use the NuSMV model checker to specify a system and verify temporal properties. Making judgments • To be able to understand the expressivity and the limitations of the temporal formalisms. • To be able to interpret and assess the model checking outputs and counterexamples. Communication skills • To be able to present technical content (project descriptions, research articles) in advanced academic English. • To be able to synthesize knowledge from scientific and technical documentation, and to prepare reports and presentations. Learning skills • To be able to independently read, understand, and produce

	scientific and technical documentation on formal methods.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	To pass the course each student should develop and present either: (A) a small project using the model checker NuSmv; or (B) a set of slides on a topic or research article relevant to the course contents.
Evaluation Criteria	The exam is assessed on a pass/fail basis and is based either on: (A) a NuSMV project delivered and presented at the end of the course; (B) a presentation of a research article or topic relevant to the course contents. The assessment considers the following criteria: - Clarity and effectiveness of communication. - Ability to summarize, critically evaluate, and establish connections between topics. - Ability to apply the tools, methods, and processes introduced during the course to specific cases. The same evaluation criteria apply to non-attending students.
Required Readings	• Principles of Model Checking. Christel Baier and Joost-Pieter Katoen. MIT Press, 2008.
Supplementary Readings	• Logic in Computer Science -- Modelling and Reasoning about Systems. Michael Huth and Mark Ryan. Cambridge University Press, 2004 (second edition). • Model Checking. E. Clarke, O. Grumberg, D. Kroening, D. Peled, and H. Veith. MIT Press, 2018 (second edition).
Further Information	NuSMV (to be downloaded from: https://nusmv.fbk.eu/)
Sustainable Development Goals (SDGs)	Quality education