COURSE DESCRIPTION – ACADEMIC YEAR 2017/2018

Course title	**Integrated Logic Systems**
Course code	74003
Scientific sector	INF/01
Degree	European Master's Program in Computational Logic (LM-18)
Semester	2
Year	1
Credits	8
Modular	No
University	UniBZ

Total lecturing hours	48
Total lab hours	24
Total exercise hours	--
Attendance	Not compulsory
Prerequisites	Knowledge of syntax and semantics of propositional and first-order logic and relational algebra. Knowledge of the fundamental concepts of the complexity theory. Good programming skills and understanding declarative programming concepts.
Course page	https://ole.unibz.it/

Specific educational objectives	The course belongs to the type "caratterizzanti – discipline informatiche". The course belongs to the mandatory part of the study program and its credits must be acquired by all the students. The course shall meet the demand for more practice-oriented subjects in the curriculum. Although the course has a formal background, it includes strong practical aspects by using automated tools and providing a review of applications. Deduction, proof theory, automated theorem proving for Propositional and First Order Logic will be thoroughly studied. The course will also mention applications of Computational Logic. The students shall get into contact with real applications of logic-based systems and get a feeling for how to apply the theoretical knowledge obtained in the other courses.

Lecturer	Sergio Tessaris
Contact	Piazza Domenicani 3, Room 2.04, tessaris@inf.unibz.it, 0471-016125
Scientific sector of lecturer	INF/01
Teaching language	English
Office hours	Check the home page of the lecturer
Lecturing Assistant (if any)	--
Contact LA	--
Office hours LA	--

List of topics	• Computational Logic and Databases
	• Computational logic, motivations and importance of the field
	• Automated reasoning techniques for Propositional Logic
	  ○ Normal forms
	  ○ DPLL algorithm
	  ○ Propositional tableaux
	  ○ Stålmark's method for propositional logic
	  ○ Binary Decision Diagrams
	• Quantified Boolean Formulae

	• Efficient algorithms for Boolean Satisfiability (SAT)
	  ○ Conflict-Driven Clause-Learning (CDCL) DPLL solvers
	  ○ Heuristics and data structures for CDCL solvers
	• SAT Modulo Theories and their applications
	  ○ SMT lazy solvers and DPLL(T)
	  ○ Examples of theory solvers
	  ○ Combining theories
	• Answer Set Programming techniques
	  ○ ASP language extensions

Teaching format	Frontal lectures, practical labs and projects in teams.

Learning outcomes	Knowledge and understanding • Understand the different application areas of computational logic wrt local and international economical contexts • Deep knowledge of the foundations of automated reasoning and theorem proving • Knowledge of the theoretical aspects of automated reasoning • Broad knowledge of foundational and applicative areas of computer science Applying knowledge and understanding • Ability to adapt an existing technical solution or formal model according to new requirements or context • Ability to comprehend technical documents as conference proceeding, journal articles or technical manuals • Ability to develop planning and decision support systems • Ability to perform empirical tests collecting data on information systems and evaluate hypothesis • Ability to analyse and solve concrete problems within the Computational Logic area • Ability to formalise in an original way using appropriate mathematical tools complex problems formulated using natural language Making judgments • Being able to select the appropriate logic formalism and reasoning task to solve a given problem • Ability to establish achievable objectives considering time and resource constraints • Ability to plan, and possibly re-planning, project activities in order to complete envisaged objectives within time constraints Communication skills • Ability to coordinate the work in a project, identifying activities directed to the achievement of the project goals • Ability to prepare and deliver technical presentations in English • Ability to structure and write technical reports concerning project activities • Ability to do research and collaborate to projects within working groups Learning skills • Ability to extend possibly incomplete knowledge within problem solving activities directed to achieve specific goals • Ability to autonomously broaden acquired knowledge by means of technical and scientific documentation

Assessment	The assessment of the course consists of two parts: • project (40%): assessed on group-based project assignments; • theory (60%): assessed with a written exam. Optional: • midterm (50% of the written exam mark, i.e. 30% of the final mark): assessed with a written midterm exam.
Assessment language	English
Evaluation criteria and criteria for awarding marks	The learning outcomes are assessed by means of a written examination directed to identify the first two areas (knowledge and its application), while the group based project work on a given practical problem is directed to the assessment of the latter areas. The assessment is based on group-based project assignments and a written examination. Final mark is calculated by the weighted average of the project (40%) and written examination (60%) marks. Project assignments is proposed during the course and delivery procedure and deadline will be announced on the course website and in class. The evaluation of the project is based on the group results and the individual contributions. Projects marks will be valid for all the 3 regular exam sessions. Students are offered an optional midterm written examination that contributes to 50% of the written examination marks (i.e. 30% of the final). The midterm will be valid for all the 3 regular exam sessions. During the final written examination candidates with a positive evaluation of the midterm will have the option of selecting between the complete or reduced program. In case that the complete version is selected, the midterm results will be ignored and the examination will contribute to the full 60% of the final marks.

Required readings	Selected chapters from: • Kroening, Daniel, and Ofer Strichman. *Decision procedures : an algorithmic point of view*. Berlin, Germany: Springer, 2016. • Gebser, Martin, Roland Kaminski, and Benjamin Kaufmann. *Answer set solving in practice*. San Rafael: Morgan & Claypool Publishers, 2013
Supplementary readings	Additional material will be provided during the course.