### Course Title
Discrete Mathematics and Logic

### Course Code
75036

### Scientific Sector
M-FIL/02

### Degree
Bachelor in Computer Science and Engineering

### Semester
1st Semester

### Year
2nd

### Credits
8

### Total Lecturing Hours
48

### Total Lab Hours
24

### Prerequisites
There are no formal prerequisites in terms of courses to attend.

### Course Page
- [https://ole.unibz.it/](https://ole.unibz.it/)
- [http://www.inf.unibz.it/~artale/DML/dml.htm](http://www.inf.unibz.it/~artale/DML/dml.htm)

### Specific Educational Objectives
- Type of course: “affini o integrativi” for L-31 and L-08
- Scientific area: “formazione affine” for L-31 and L-08

The aim of the course is to provide students with an understanding of the formal foundations of classical logic languages and related methodologies to reason over formal logical theories. An overview of the proof methods based on logics, and useful in mathematics and computer science, will be given. The course will also demonstrate the ability to use logic as a tool for representation and reasoning in computer science.

The students will be trained to apply the Induction principle to various computer science settings and in particular to check the correctness of Algorithms via the notion of Loop Invariant. Furthermore, methods to analyse and describe the main properties of Relations, Functions, Graphs and Trees will also be studied as well as the principles governing the complex mathematical notion of Cardinality of a set including the notion of countable infinite sets.

### Lecturer
Alessandro Artale, office POS 2.03 Faculty of CS, POS Building, Piazza Domenicani 3, artale@inf.unibz.it, +39 0471 016150

Web Page: [http://www.inf.unibz.it/~artale](http://www.inf.unibz.it/~artale)

Email: [artale@inf.unibz.it](mailto:artale@inf.unibz.it)
<table>
<thead>
<tr>
<th><strong>Scientific Sector of the Lecturer</strong></th>
<th>INF/01</th>
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</thead>
<tbody>
<tr>
<td><strong>Teaching Language</strong></td>
<td>English</td>
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<tr>
<td><strong>Office Hours</strong></td>
<td>During the lecture time span, Office 2.03. To fix an appointment email at <a href="mailto:artale@inf.unibz.it">artale@inf.unibz.it</a></td>
</tr>
<tr>
<td><strong>Teaching Assistant</strong></td>
<td>Elena Botoeva, Piazza Domenicani, 3 – Office 2.06, <a href="mailto:botoeva@inf.unibz.it">botoeva@inf.unibz.it</a> Daniele Porello, Piazza Domenicani, 3, – Office 3.03, <a href="mailto:Daniele.Porello@unibz.it">Daniele.Porello@unibz.it</a></td>
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<td><strong>Office Hours</strong></td>
<td>TBA</td>
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| **List of Topics Covered**           | Functions, Relations, Graphs and Trees  
- One-to-One and Onto Functions  
- Equivalence and Partial Order Relations  
- Trails, Paths, and Circuits (Euler and Hamiltonian) in a Graphs  
- Graph Isomorphism  
Proof Techniques/Induction  
- Loop Invariant  
Set Cardinality  
- Countably infinite sets and Uncountable sets  
Introduction to Logic  
Propositional Logic  
First-Order Logic  
Model Theory  
Proof Theory  
- Tableaux Calculus for Propositional and FOL  
- Soundness and Completeness proofs via Induction |
| **Teaching Format**                  | Frontal lectures, exercises in lab, mid-term exam. |
| **Learning Outcomes**               | **Knowledge and understanding**  
- have a solid knowledge of mathematics and logics that are in support of computer science;  
**Applying knowledge and understanding**  
- be able to use the tools of mathematics and logics to solve problems;  
**Make judgments**  
- be able to collect useful data and to judge information systems and their applicability.  
- be able to work autonomously according to the own level of knowledge.  
**Communication skills**  
- be able to explain a project activity or a scientific study, also to non-experts;  
**Learning skills**  
- be able to learn the innovative features of state-of-the-art technologies and information systems;  
- have developed learning capabilities to pursue further studies with a high degree of autonomy. |
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<tr>
<th><strong>ASSESSMENT</strong></th>
<th>Written exam (with an optional mid-term written exam).</th>
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<td>In the written exam (including the optional mid-term exam) there will be verification questions, transfer of knowledge questions and exercises. The learning outcome related to knowledge and understanding, applying knowledge and understanding and those related to the student ability to learn and the acquired learning skills will be assessed by the written exam.</td>
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<td><strong>ASSESSMENT LANGUAGE</strong></td>
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| **EVALUATION CRITERIA AND CRITERIA FOR AWARDING MARKS** | • Mid-term Written Exam (optional, count as 50% of the full mark)  
• Final Written Exam  
  o 50% covering a reduced program for students who passed the mid-term exam, or  
  o 100% covering the full program in case of failure of the Mid-term.  
|                | Written exam questions will be evaluated in term of correctness, clarity, quality of argumentation, problem solving ability. |
|                | Note: In case of a positive mark the mid-term exam will count for 3 regular consecutive exam sessions. |
| **REQUIRED READINGS** | Mordechai Ben-Ari: Mathematical Logic for Computer Science, Springer-Verlag [Main book for Logic part] |
| **SOFTWARE USED** | NA |