UNIVERSITÀ DI PISA

FOUNDATIONS OF COMPUTER SCIENCE

ALESSIO CONTE

Anno accademico	2022/23
CdS	COMPUTER SCIENCE
Codice	728AA
CFU	9

Moduli	Settore/i	Tipo	Ore	Docente/i
FONDAMENTI DELL'INFORMATICA	INF/01	LEZIONI	72	ALESSIO CONTE ROBERTO GROSSI

Learning outcomes

Knowledge
The course aims to provide the basic knowledge for the study of computer science: fundamental structures (such as sets, graphs, trees), specification and proof techniques (such as recursion and induction) and the logical-mathematical language.

Assessment criteria of knowledge
Continuous assessment with biweekly online tests, completed by a written and an oral exam.

Skills
At the end of the course, students will be able to understand the use of discrete mathematical structures for problem modeling, the use of induction and recursion for the definition of functions, and the use of mathematical logic for the formalization of properties. They will also have developed deductive skills useful for solving simple problems.

Assessment criteria of skills
The online tests will allow to verify the students' level of understanding of the topics introduced in the course. The written and oral exams will be useful to verify the deductive skills in solving simple problems.

Behaviors
During the exercises students will be able to develop problem solving skills in groups.

Assessment criteria of behaviors
Assesement criteria of behaviours are not envisaged.

Prerequisites
Mathematics taught in high schools.

Teaching methods

- The course consists of lectures, group exercises and assessment tests delivered on the Moodle platform. If necessary, the lessons are streamed and recorded.
- The lectures are held with the use of slides.
- The exercises take place in the classroom (or virtual classroom): students solve the exercises, even in groups, under the supervision of the teacher and assistants.
- Assessment tests are offered every two weeks, and are taken online with a computer or smartphone. In preparation for these tests, the teacher will publish a similar "self-assessment test" in the days preceding each test, which students can take an unlimited number of times.
- The interaction with the teacher takes place through interviews (during office hours or by appointment) and by e-mail.
- The slides presented in each lesson are progressively published on the course web page (on the Moodle platform), with references to the corresponding topics in the lecture notes. The texts of the proposed exercises and the self-assessment tests are also published, as well as any recordings of the lessons.

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Syllabus

Set Theory: Extensional and intensional notation; notable sets; inclusion and equality; operations on sets; Euler-Venn diagrams; laws on sets and proofs by substitution; sets of sets; Cartesian product.

Relations: Relations as subsets; operations on relations; opposite relation, identity relation; composition of relations and laws; properties of relations (total, single valued, injective and surjective); characterization theorems; functions and bijections; sequences of fixed length and of arbitrary length.

Relations on a set: reflexive, transitive, symmetric and anti-symmetric properties; reflexive, symmetric and transitive closure; equivalence relations and partitions; ordering relations; lexicographic ordering.

Graphs: Connection with relations; directed and undirected graphs; neighborhood and degree of nodes; handshaking lemma; graphical representation, representation with matrices and adjacency lists; isomorphisms; paths and connectivity; Eulerian and Hamiltonian paths; trees; directed acyclic graphs (DAG); distances.

Induction and Recursion: Definition of sets and functions by induction; induction principle on natural numbers; induction on strings, lists, trees and expressions; structural induction principle; recursive functions; well founded relations and well given recursive definitions.

Combinatorics: Cardinality of a set; bijections and cardinality theorem; cardinality of notable sets; cardinality of the set of functions, relations and permutations; pigeonhole principle; simple combinations; binomial coefficient; combinations with repetitions; inclusion-exclusion principle; counting on trees and graphs.

Formal Languages: Alphabets, words and languages; operations on languages; deterministic and non-deterministic automata; context free grammars; ambiguity; relations between automata and grammars.

Elements of Mathematical Logic: propositional calculus, syntax and semantics; truth tables and tautologies; formalization of statements; laws and proofs by substitution; proof systems; proof techniques and tautologies; elements of predicate logic; quantifiers; syntax; formalization of statements; interpretations and semantics; proofs of validity of formulas.

Bibliography

Lecture notes of the course: Version of September 2022.

Assessment methods

- Biweekly online assessment test
- Written exam
- Oral exami

Students who fail to pass the assessment tests will have to take an additional online test before written and oral exam.

Class web page

https://elearning.di.unipi.it/course/view.php?id=320

Additional web pages

Webpage AY 2022/23:
https://elearning.di.unipi.it/course/view.php?id=320
Webpage QUIZ:
https://elearning.di.unipi.it/course/view.php?id=315

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