UCLouvain

lingi1101

2019

Discrete mathematics: logical foundations of computing science

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

5 credits	30.0 h + 30.0 h	Q1

Teacher(s)	Van Roy Peter ;
Language :	French
Place of the course	Louvain-la-Neuve
Main themes	Part I: Propositional logic and predicate logic • Propositional logic (syntax, semantics, proofs) • Predicate logic (quantifiers, bound and free variables, proofs) and application to algorithm analysis • Set theory and application to formal system specification (Z notation) • Relations and applications in computer science (relational databases, overriding, binary relations, ') • Functions and lambda calculus Part II: Discrete structures • Graphs (basic concepts, paths and connectivity) • Applications of graphs, e.g., to model social networks (ties, homophily, closure) • Graphs and properties of graphs used to model Internet-based networks • Introduction to game theory
Aims	Given the learning outcomes of the "Bachelor in Engineering" program, this course contributes to the development, acquisition and evaluation of the following learning outcomes: • AA1.1, AA1.2 • AA2.4 Given the learning outcomes of the "Bachelor in Engineering" program, this course contributes to the development, acquisition and evaluation of the following learning outcomes: • S1.I1, S1.G1 • S2.2 Students completing this course successfully will be able to • convert ordinary language statements into logical expressions using the syntax and semantics of propositional or predicate logic • use rules of inference to construct proofs in propositional or predicate logic • describe how symbolic logic can model real-life situations , such as those encountered in the context of computing (eg analysis algorithms) • identify and define precisely the basic concepts of graphs and trees providing contextualized examples that highlight these concepts • explain various methods of graph paths • model various real-world problems encountered in computer using the appropriate forms of graphs and trees, such as social networks and the Web • explain the key concepts of the theory of games (game type, the type of policy agents) using appropriate examples Students will have developed skills and operational methodology. In particular, they have developed their ability to • define and interpret concepts with rigor and precision • avoid misinterpretation and detect errors in reasoning . - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*

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Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** • short test during the semester • written exam
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** • 2h of lecture / week • 2h of exercise sessions / week

Content	• Preliminaries: sets, relations, and functions; formal systems; deduction, induction, abduction; scientific method.
	• Mathematical logic:
	  • propositional calculus -- syntax, semantics, proof theory, proof algorithm;
	  • first-order predicate calculus -- syntax, semantics, proof theory, proof algorithm;
	  • Prolog programming language and its proof algorithm;
	  • first-order theories -- models, consistency, inclusion, extension, etc.
	• Equational theories: equality, partial orders, lattices, groups.
	• Discrete structures on the Internet: graphs and graph properties, giant components, strong and weak links, triadic closure, structural balance, balance theorem, structure of the Web, PageRank, power laws, the long tail.
	
	Applications to various domains : program verification, specification of abstract data types, automated reasoning, expert systems, robotics, databases, parsing, etc.

Inline resources	LINGI1101 Moodle: https://moodleucl.uclouvain.be/course/view.php?id=8199
Bibliography	• **LINGI1101: Logique et Structures Discrètes** par Peter Van Roy • **Networks, Crowds and Markets: Reasoning About a Highly Connected World** par David Easley and Jon Kleinberg
Other infos	Background : • Elementary discrete mathematics (functions , sets, ...) • Use of different techniques of mathematical proof
Faculty or entity in charge	INFO

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Aims
Master [60] in Computer Science	SINF2M1	5		
Master [120] in Computer Science	SINF2M	5		