UNIVERSIDADE LUSÍADA
LISBOA

Course Unit Program
Computation Theory

Academic Year 2025/2026

1. Organic Unit

Faculty of Business and Economic Sciences

2. Course

Computer Engineering

3. Cycle

1st

4. Course Unit

Computation Theory (L9030)

5. Scientific Area

6. Curricular Year

3rd

7. Type of Curricular Unit / Semester

1st Semester

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8. Class type and workload (work time)

Theoretical classes:	
Practical classes:	
Theoretical-Practical Classes	30,00
Tutorial Guidance:	20,00

9. ECTS Credits

6,00

10. Scientific Area Coordinator

11. Regent

Prof. Doutor RAUL EDUARDO CAPELA TELLO RATO

12. Assistants

13. Teaching Language

Portuguese

14. General Objectives

To Introduce the theoretical and practical foundations of the Theory of Computation, emphasizing the application of automata and grammars in the solution of computational problems. Students will be able to understand, model and simulate computational systems using automata and formal languages. Introduction to Quantum Computing.

15. Specific Objectives

Explore the basic concepts of deterministic and non-deterministic finite automata, enabling students to build and simulate models in JFLAP.
Investigate automata models with output (Moore and Mealy), highlighting their applications and fundamental differences.
Introduce context-free languages (CLLs) and context-free grammars (CLGs), giving students the ability to build and simplify these models in JFLAP.
Train students in the practical application of Chomsky and Greibach normal forms for simpl

16. Skills to be acquired

Build and simulate finite automata (deterministic and nondeterministic) in JFLAP. Apply Moore and Mealy models to practical problems. Develop and simplify context-free grammars using normal forms. Use pushdown automata and JFLAP files to validate strings and simulate languages. Understand and apply the fundamentals of Computation Theory with accuracy, autonomy, and critical thinking.

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17. Teaching Methodology

Presentation of theoretical content, followed by the analysis and discussion of representative examples. Guidance for the completion of practical assignments to be carried out independently by students, complementing classroom sessions and promoting the consolidation of the topics covered.

18. Course Unit Program

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1 Introduction to the Theory of Computation and the use of JFLAP
- 1.1 Basic concepts of computer theory
  - Definition of automata and their importance in computer science.
  - Motivation and applications in computing.
- 1.2 Introduction to JFLAP
  - Initial configuration of JFLAP.
  - User interface and basic navigation.
  - Initial example of creating a simple automaton.

2. Deterministic Finite Automata (AFDs)
- 2.1 Definition and Structure of AFDs
  - States, alphabet, transition function and initial/acceptance state.
- 2.2 Examples and Simulations in JFLAP
  - Step-by-step construction of an AFD in JFLAP.
  - Practical examples.

3. Non-deterministic Finite Automata (NFAs)
- 3.1 Introduction to AFNs
  - Definition and comparison with AFDs.
- 3.2 Simulations in JFLAP
  - Building and simulating AFNs in JFLAP.
  - Examples of problems that can be modeled by AFNs.

4. Automata with output: Moore and Mealy models
- 4.1 Moore automata
  - Definition, structure and practical example in JFLAP.
- 4.2 Mealy automata
  - Definition, structure and practical example in JFLAP.
- 4.3 Comparing Models
  - Differences in output between Moore and Mealy.

5. Context Free Languages (CLLs)
- 5.1 Introduction to CLLs
  - Definition and importance in computer theory.
- 5.2 Context-Free Grammars (CLGs)
  - Definition and relation to CLLs.
  - Building GLCs in JFLAP.

6. Simplification of GLCs
- 6.1 Chomsky Normal Form
  - Definition and transformation examples.
- 6.2 Greibach Normal Form
  - Definition and examples of transformation.
- 6.3 Applications and examples in JFLAP
  - Practical implementation of normal forms in JFLAP.

7. Stack Automata
- 7.1 Definition and Structure of APs
  - States, alphabet, transition function, stack and initial/acceptance state.

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- 7.2 Examples and Simulations in JFLAP
  - Practical examples.
- 7.3 Examples of Applications in Computing
  - Use of automata for string validation, natural language processing, among others.

19. Assessment Methods

The methodology is based on theoretical exposition combined with practical exercises using JFLAP. Attendance, active participation, and the completion of practical assignments throughout the semester are valued. Assessment includes two written tests focused on the application of theoretical concepts and the resolution of problems involving automata and grammars.

20. Didactic Resources

The classes will be given, whenever possible, using visual presentations.
Computers in practical classes with JFLAP.
Theoretical-practical lectures and exercises.

21. Sustainability Objectives

To contribute to Sustainable Development Goals (SDGs) 4 and 9 by promoting digital literacy and the development of computational thinking. The study of automata, formal languages, and grammars fosters a deep understanding of computational theory. Using JFLAP allows students to apply these concepts, develop computational models, and simulate solutions in a sustainable way, with accuracy, rigour, and creativity.

22. Keywords

Theory of computation
Automata
Languages
Grammar

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23. Main Bibliography

Author(s):	Michael Sipser		
Title:	Introduction to the Theory of Computation		
Edition:	3	Year:	2021
Local:	United states		
Publisher:	CENGAGE LEARNING, INC		

Author(s):	Daniel I. A. Cohen		
Title:	Introduction to Computer Theory		
Edition:	2	Year:	1996
Local:	United States		
Publisher:	Wiley		

Author(s):	Hopcroft, John E.		
Title:	Introdução à teoria de autômatos, linguagens e computação		
Edition:		Year:	2016
Local:			
Publisher:	Ed Campus		

24. Complementary Bibliography

Author(s):	Vivek Kulkarni, Adam Rogalewicz, and others		
Title:	Theory of Computation (Oxford University Press		
Edition:		Year:	2013
Local:			
Publisher:	Prentice Hall		

Author(s):	Susan Rodger and Thomas Finley		
Title:	JFLAP Version 7.1		
Edition:		Year:	
Local:	On-line		
Publisher:	https://www.jflap.org/		

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Ficha técnica MIP / MIP Datasheet	
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Autor / Author	Prof. Doutor RAUL EDUARDO CAPELA TELLO RATO
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