Course Unit	Advanced Programming Techniques	Field of study	Computer Science
Master in	Informatics	School	School of Technology and Management
Academic Year	2025/2026	Year of study	2
Level	2-2	ECTS credits	6.0
Type	Semestral	Semester	1
Code	5060-858-2102-00-25		

Workload (hours)	Contact hours	T	TP	PL	TC	S	E	OT	O
162		-	60	-	-	-	-	-	-

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Maria João Tinoco Varanda Pereira

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Understand the principles and applications of DSLs.
2. Analyze the role of language design and processing in building DSLs.
3. Gain hands-on experience constructing lexical analyzers, parsers and syntax-directed translation.
4. Develop prototypes of DSLs and evaluate their effectiveness in specific use cases such as data validation and transformation.
5. Understand the principles of low-code and no-code platforms as model-based programming and their role in modern software development.

Prerequisites

Before the course unit the learner is expected to be able to:
Knowledge about Programming Languages

Course contents

Introduction to DSLs; Language Processing Concepts; Construction of Lexical Filters using regular expressions; Construction of Parsers using context-free grammars and syntax-driven translators. Implementation of DSLs using Ply and Lark (Python); Low-Code and No-Code Platforms and their relationship with the implementation of DSLs.

Course contents (extended version)

1. (Module 1) Introduction to the concept of Domain-Specific Languages:
   - Analysis of different types of DSLs;
   - Use of DSL-based tools.
2. (Module 2) Language Processing Concepts ;
   - Concepts of Lexical Analysis, Syntactic Analysis, Semantic Analysis, Code Generation and Execution.
   - Formalisms based on grammars and regular expressions.
   - Finite automata and parsing algorithms.
   - Tools and frameworks for language processing (e.g., Flex, Bison, Ply, Lark or ANTLR).
   - Constructing Lexical Filters using regular expressions for tokenization using Ply.
   - Constructing Parsers using context-free grammars and syntax-directed translation using Ply and Lark.
3. (Module 3) Information Extraction and Data Transformation using DSLs:
   - Using DSLs for structuring and extracting information;
   - Implementing syntax-directed translation;
   - Developing real-world examples.
4. (Module 4) Low-code and No-code platforms:
   - Characteristics of low-code/no-code platforms;
   - Relationship between low-code platforms and DSLs;
   - Case studies: Scratch, Bubble, Mendix, and OutSystems;
   - Study on the future of these types of platforms.

Recommended reading

1. M. J. Pereira, N. Oliveira, D. Cruz, and P. Henriques, "An effective way to teach language processing courses", IGI Global, 2014.
2. A. Aho, R. Sethi, and J. Ullman, "Compilers: Principles, Techniques, and Tools", Addison-Wesley, 1986.
3. M. Fowler, “Domain-Specific Languages”, Pearson Education, 2010, ISBN: 9780131392809
4. D. Beazley, "PLY (Python Lex-Yacc)," [Online]. Available: https://www.dabeaz.com/ply/ply.html. [Accessed: Jan. 8, 2025].
5. Lark, "Lark Documentation," [Online]. Available: https://lark-parser.readthedocs.io/en/stable/. [Accessed: Jan. 8, 2025].

Teaching and learning methods

The pedagogical model adopted for this course actively engages students in the construction of knowledge through hands-on activities, collaborative problem-solving, and reflective learning. This is a student-centered method that prioritizes learning based on the development of domain-specific language processors.

Assessment methods

1. Normal and Appeal season evaluation - (Regular, Student Worker) (Final, Supplementary)
   - Practical Work - 10% (Latex report on the creation and specification of a new DSL.)
   - Intermediate Written Test - 40% (Online midterm test on Language Processing fundamentals.)
   - Practical Work - 30% (DSL development and implementation project.)
   - Development Topics - 20% (Technical summary about a low-code or no-code platform.)
2. Special Season - (Regular, Student Worker) (Special)
   - Final Written Exam - 100% (Online Exam)

Language of instruction

English

Electronic validation

Maria João Tinoco Varanda Pereira	Tiago Miguel Ferreira Guimaraes Pedrosa	José Eduardo Moreira Fernandes	José Carlos Rufino Amaro
03-11-2025	04-11-2025	04-11-2025	11-11-2025