SYLLABUS

FUNCTIONAL AND LOGIC PROGRAMMING

University year 2025/2026

1. Information regarding the programme

1.1. Higher education institution	Babeş-Bolyai University
1.2. Faculty	Mathematics and Computer Science
1.3. Department	Computer Science
1.4. Field of study	Computer Science
1.5. Study cycle	Bachelor
1.6. Study programme/Qualification	Computer Science
1.7. Form of education	Full time studies

2. Information regarding the discipline

2.1. Name of the dis	ciplir	e Function a	Functional and Logic Programming				de MLE	5009
2.2. Course coordinator				Prof. dr. Horia F. Pop				
2.3. Seminar coordinator				Prof. dr. Horia F. Pop				
2.4. Year of study	2	2.5. Semester	3	2.6. Type of evaluatio	n <u>C</u>	2.7. Discipline regime	Comp	ulsory

3. Total estimated time (hours/semester of didactic activities)

3.1. Hours per week	4	of which: 3.2 course	2	3.3 seminar/laboratory/project	2
3.4. Total hours in the curriculum	56	of which: 3.5 course	28	3.6 seminar/laboratory/project	28
Time allotment for individual study (ID) and self-study activities (SA)					
Learning using manual, course support, bibliography, course notes (SA)					22
Additional documentation (in libraries, on electronic platforms, field documentation)					18
Preparation for seminars/labs, homework, papers, portfolios and essays					27
Tutorship					11
Evaluations					16
Other activities:					
3.7. Total individual study hours94					
3.8. Total hours per semester150					
3.9. Number of ECTS credits 6					

4. Prerequisites (if necessary)

I ()	
	MLE5005: Programming Fundamentals
4.1. curriculum	MLE5055: Computational Logic
	MLE5022: Data Structures and Algorithms
4.2. competencies	Average programming skills in a high level programming language

5. Conditions (if necessary)

	Students will attend the course with their mobile phones shut down	
5.1. for the course	Students will attend the course with their laptops shut down; students with special	
	needs will discuss these at the beginning of the semester	
	Students will attend the lab with their mobile phones shut down	
5.2. for the seminar /lab activities	Laboratory with computers; high level declarative programming language	
	environment (CLisp, SWIProlog)	

6.1. Specific competencies acquired ¹

Professional/essential Competencies	 advanced programming skills in high-level programming languages use of theoretical foundations of computer science as well as of formal models
Transversal competencies	 application of organized and efficient work rules, of responsible attitudes towards the didactic-scientific field, to bring creative value to own potential, with respect for professional ethics principles and norms use of efficient methods and techniques to learn, inform, research and develop the abilities to bring value to knowledge, to adapt at the requirements of a dynamical society and to communicate efficiently in Romanian language and in an international language

6.2. Learning outcomes

Knowledge	 The graduate has the necessary knowledge for using computers, developing software programs and applications, information processing. The graduate knows multiple programming languages and is able to write applications in compiled, interpreted or dynamic languages with the ability to choose the appropriate programming language for the specific application to be developed.
Skills	 The graduate is able to present and explain methods, algorithms, paradigms and techniques used in various branches of computer science. The graduate has the ability to apply general rules to specific problems and produce relevant solutions.
Responsibility and autonomy:	 The graduate has the ability to choose and use programming paradigms (procedural, object-oriented, functional) to develop software applications appropriate for the specific domain of the application being developed. The graduate has the ability to understand and communicate information effectively.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	Get accustomed with basic notions, concepts, theories and models of new programming paradigms (functional and logic programming)
7.2 Specific objective of the discipline	Get accustomed with a programming language for each of these paradigms (Common Lisp and SWI Prolog) Acquire the idea of using these programming paradigms based on the applications necessities Assure the necessary base for approaching certain advanced courses Ability to apply declarative programming techniques to different real life problems Ability to model phenomena using declarative techniques

¹ One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

8. Content		
8.1 Course	Teaching methods	Remarks
Basic elements of Prolog. Facts and rules in	Exposure: description, explanation,	
Prolog. Goals. The control strategy in Prolog.	examples, discussion of case	
Variables and composed propositions.	studies	
Anonymous variables. Rules for matching. The		
flow model. Sections of a Prolog program.		
Examples		
The Prolog program. Predefined domains.	Exposure: description, explanation,	
Internal and external goals. Multiple arity	examples, discussion of case	
predicates. The IF symbol (Prolog) and the IF	studies	
instruction (other languages). Compiler		
directives. Arithmetic expressions and		
comparisons. Input/output operations. Strings		
Backtracking. The backtracking control. The	Exposure: description, explanation,	
"fail" and "!"(cut) predicates. Using the "!"	examples, discussion of case	
predicate. Type of cuts. The "not" predicate.	studies	
Lists in Prolog. Recursion. Examples for		
backtracking in Prolog. Finding all solutions in		
the same time. Examples of predicates in Prolog.		
Composed objects and functors Unifying	Europumo description ourlangtion	
composed objects and junctors. Unifying	exposure: description, explanation,	
hataroganaous lists. Comparisons for composed	studios	
objects Backtracking with cycles Fyamples of	studies	
recursive procedures. The stack frame		
Ontimization using the "tail recursion" Ilsing		
the "cut" predicate in order to keep the "tail		
recursion".		
Recursive data structures. Trees as data	Exposure: description, explanation,	
structures. Creating and traversing a tree.	examples, discussion of case	
Search trees. The internal database of Prolog.	studies	
The "database" section. Declaration of the		
internal database. Predicates concerning		
operations with the internal database.		
Advanced issues of Backtracking in Prolog. Files	Exposure: description, explanation,	
management in Prolog.	examples, proofs, debate, dialogue	
Programming and programming languages.	Exposure: description, explanation,	
Imperative programming vs. declarative	examples, discussion of case	
programming. Introduction. The importance of	studies	
the functional programming as a new		
programming methodology. History and		
presentation of LISP	Francisco description contemption	
Basic elements in Lisp. Dynamic data structures.	Exposure: description, explanation,	
Syntactic und semantic rules. Functions in Lisn	studios	
Rasic predicates in Lisp.	studies	
Predicates for lists: for numbers Logic and	Evnosure: description evplanation	
arithmetic functions Defining user functions	examples discussion of case	
The conditional form. The collecting variable	studies	
method. Examples		
Symbols' managing. Other functions for lists'	Exposure: description. explanation.	
accessing. OBLIST and ALIST. Destructive	examples, discussion of case	
functions. Comparisons. Other interesting	studies	
functions. Examples		
Definitional mechanisms. The EVAL form.	Exposure: description, explanation,	
Functional forms; the functions FUNCALL and	examples, discussion of case	
APPLY. LAMBDA expressions, LABEL expressions.	studies	
Generators, functional arguments. MAP		
functions. Iterative forms. Examples		
Other elements in Lisp. Data structures. Macro-	Exposure: description, explanation,	

definitions. Optional arguments. Examples	examples, discussion of case studies					
1314. Graded paper in Logic and Functional Programming	Written test					
Basic elements of Prolog. Facts and rules in	Exposure: description, explanation,					
Prolog. Goals. The control strategy in Prolog.	examples, discussion of case					
Variables and composed propositions.	studies					
Anonymous variables. Rules for matching. The						
flow model. Sections of a Prolog program.						
Examples						
Bibliography						
1. CZIBULA G., POP H.F., Elemente avansate de pro	gramare in Lisp si Prolog. Aplicatii in 1	Inteligenta Artificiala, Editura				
Albastra, Cluj-Napoca, 2012						
2. POP H.F., SERBAN G., Programare in Inteligenta	Artificiala - Lisp si Prolog, Editura Alk	astra, ClujNapoca, 2003				
3. http://www.ifcomputer.com/PrologCourse, Lec	ture on Prolog					
4. http://www.lpa.co.uk, Logic Programming						
5. FIELD A., Functional Programming, Addison We	sley, New York, 1988.					
6. WINSTON P.H., Lisp, Addison Wesley, New York, A	2nd edition, 1984.					
8.2 Seminar / laboratory	Teaching methods	Remarks				
S1. Recursion	Explanation; Conversation;					
	Modelling; Case studies					
S2. Lists in Prolog	Explanation; Conversation;					
	Modelling; Case studies					
S3. Processing of heterogeneous lists in Prolog	Explanation; Conversation;					
	Modelling; Lase studies					
S4. Backtracking in Prolog	Explanation; Conversation;					
	Modelling; Lase studies					
55. Lists processing in LISP	Explanation; Conversation;					
S6 MAD functions in LISD	Modelling; Case studies					
<i>30. MAF junctions in LISP</i>	Explanation, Conversation, Modelling: Case studies					
S7 Recan	Fynlanation: Conversation:					
57. Recup	Modellina [.] Case studies					
Biblioaranhy						
1. CZIBULA G., POP H.F., Elemente avansate de pro	gramare in Lisp si Prolog. Aplicatii in J	Inteligenta Artificiala, Editura				
Albastra, Cluj-Napoca, 2012						
2. POP H.F., SERBAN G., Programare in Inteligenta	2. POP H.F., SERBAN G., Proaramare in Inteligenta Artificiala - Lisp si Proloa. Editura Albastra. CluiNapoca. 2003					
3. Product documentation: Gold Common Lisp 1.02	1 si 4.30, XLisp, Free Lisp, CLisp.					
4. Product documentation: Turbo Prolog 2.0, Logic	c Explorer, Sicstus Prolog, SWI Prolog.					
8.3 Laboratory	Teaching methods	Remarks				
Lab 1: Recursive algorithms in Pseudocode	Explanation, dialogue, testing data	Problem given at lab 1 and				
	discussion, case studies	submitted at lab 1				
Lab 2: Lists in Prolog	Explanation, dialogue, testing data	Problem given at lab 1 and				
	discussion, case studies	submitted at lab 2				
Lab 3: Trees in Prolog. Lists management in	Explanation, dialogue, testing data	Problem given at lab 2 and				
Prolog.	discussion, case studies	submitted at lab 3				
Lab 4: Backtracking in Prolog	Explanation, dialogue, testing data	Problem given at lab 3 and				
	discussion, case studies	submitted at lab 4				
Lab 4: Practical test in Prolog	Practical test	One hour				
Lab 5: Recursive programming in Lisp	Explanation, dialogue, testing data	Problem given at lab 4 and				
	discussion, case studies	submitted at lab 5				
Lab 6: Recursive programming in Lisp	Explanation, dialogue, testing data	Problem given at lab 5 and				
	discussion, case studies	submitted at lab 6				
Lab 7: Using MAP functions in Lisp.	Explanation, dialogue, testing data	Problem given at lab 6 and				
	discussion, case studies	submitted at lab 7				
Lab 7: Practical test in Lisp	Practical test	Une hour				
Bibliography						

1. CZIBULA G., POP H.F., Elemente avansate de programare in Lisp si Prolog. Aplicatii in Inteligenta Artificiala, Editura Albastra, Cluj-Napoca, 2012

2. POP H.F., SERBAN G., Programare in Inteligenta Artificiala - Lisp si Prolog, Editura Albastra, ClujNapoca, 2003

3. Product documentation: Gold Common Lisp 1.01 si 4.30, XLisp, Free Lisp, CLisp. 4. Product documentation: Turbo Prolog 2.0, Logic Explorer, Sicstus Prolog, SWI Prolog.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

The course respects the IEEE and ACM Curricula Recommendations for Computer Science studies;

The course exists in the studying program of all major universities in Romania and abroad;

The content of the course ensures the fundamental knowledge necessary for logical and functional programming at employers;

The content of the course is concordant with partial competencies for possible occupations from the Grid 1 - RNCIS.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade		
10.4 Course	 know the basic principle of the domain; apply the course concepts problem solving 	Written test in Logic and Functional Programming (during weeks 13 and 14)	60%		
	- activity at seminaries	Evaluation of seminaries activity	BONUS 5%		
10 5 Coming a llaboratory	- be able to implement course concepts and	Programs documentation and delivery	10%		
10.5 Seminar/laboratory	algorithms - apply techniques for	Practical test in Prolog (one hour at lab 4)	15%		
	different classes of programming languages	Practical test in Lisp (one hour at lab 7)	15%		
10.6 Minimum standard of performance					

Each student has to prove that (s)he acquired an acceptable level of knowledge and understanding of the subject, that (s)he is capable of stating these knowledge in a coherent form, that (s)he has the ability to establish certain connections and to use the knowledge in solving different problems.

In order to pass the course, the following minimal criteria apply collectively: at least grade 5 (from a scale of 1 to 10) at the written test; at least grade 5 (from a scale of 1 to 10) computed as final grade average, attendance of at least 5 seminars and at least 6 labs as scheduled during the semester. The semester activity cannot be redone in the sessions. All requirements for the resit exam are identical to the above

11. Labels ODD (Sustainable Development Goals)²

Not applicable.

² Keep only the labels that, according to the <u>Procedure for applying ODD labels in the academic process</u>, suit the discipline and delete the others, including the general one for Sustainable Development – if not applicable. If no label describes the discipline, delete them all and write "Not applicable.".

Date: 10/04/2025 Signature of course coordinator

Prof. dr. Horia F. Pop

Signature of seminar coordinator Prof. dr. Horia F. Pop

Date of approval:

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Signature of the head of department

Assoc.prof.phd. Adrian STERCA