SYLLABUS

1. Information about the program

1.1 Higher education institution	Universitatea Politehnica Timișoara
1.2 Faculty[1] / Department[2]	Electronics Telecommunications and Information Technologies
1.3 Field of study (name/code[3])	Electronics Telecommunications and Information Technologies Engineering / 20.20.10
1.4 Study cycle	Master
1.5 Study program (name/code/qualification)	Communications Networks

2. Information about discipline

2.1a Name of discipline/The educational classe[4]	Pattern Recognition /DF						
2.1b Name of discipline in Romanian	Recunoastere de tipare						
2.2 Coordinator (holder) of course activities	Prof. Dr. Eng. C. Ancuti						
2.3 Coordinator (holder) of applied activities[5]	Prof. Dr. Eng. C. Ancuti						
2.4 Year of study[6]	I	**2.5** Semester	1	**2.6** Type of evaluation	E	**2.7** Regime of discipline[7]	DCAV

3. Total estimated time (direct activities (fully assisted), partially assisted activities and unassisted activities[8])

3.1 Number of hours fully assisted/week	4 ,of which:	course	2	seminar/laboratory/project			0/1/1
3.1* Total number of hours fully assisted/sem.	56 ,of which:	course	28	seminar/laboratory/project			0/14/14
3.2 Number of on-line hours fully assisted/sem	,of which:	course		seminar/laboratory/project			
3.3 Number of hours partially assisted/week	,of which:	project, research		training		hours designing M.A. dissertation	
3.3* Number of hours partially assisted/ semester	,of which:	project of research		training		hours designing M.A. dissertation	
3.4 Number of hours of unassisted activities/ week	4.93 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field					2
		Study using a manual, course materials, bibliography and lecture notes					1.93
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays					1
3.4* Total number of hours of unasssited asctivities/ semester	69 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field					28
		Study using a manual, course materials, bibliography and lecture notes					27
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays					14
3.5 Total hrs./week[9]	8.93						
3.5* Total hrs./semester	125						
3.6 No. of credits	5						

4. Prerequisites (where applicable)

4.1 Curriculum	• Basic understanding of linear algebra and calculus
4.2 Learning outcomes	• Not the case

5. Conditions (where applicable)

5.1 of the course	• Class setting equipped with projectors

5.2 to conduct practical activities	• Class setting equipped with computers, Python installed, and library support Scikit Learn, Pytorch/TensorFlow • The deadline for laboratory work will be established by the coordinator in agreement with the students.

6. Learning outcomes acquired through this discipline

Knowledge	• C1. The student/graduate knows research methods, techniques and paradigms • C2. The student/graduate understands the principles of electronic circuits and architectures • C3. The student/graduate knows open-source standards and licenses • C4. The student/graduate understands big data concepts and analysis techniques • C5. The student/graduate knows concepts and methodologies from several fields • C6. The student/graduate understands algorithms and structures for data processing • C7. The student/graduate knows the principles of professional communication • C8. The student/graduate knows the terminology and conventions of technical communication • C9. The student/graduate knows ways to integrate knowledge from various fields • C10. The student/graduate understands the concepts of traffic, bandwidth and QoS • C11. The student/graduate knows communication technologies and protocols • C12. The student/graduate understands the principles of scalability and resource allocatio •
Skills	• A1. The student/graduate applies qualitative and quantitative methodologies • A2. The student/graduate develops schemes and integrates hardware/software components • A3. The student/graduate uses collaborative tools and contributes to projects • A4. The student/graduate processes, eliminates or corrects errors in a data set and interprets complex data • A5. The student/graduate integrates interdisciplinary methods and perspectives • A6. The student/graduate programs and optimizes scalable applications • A7. The student/graduate presents ideas and results in academic/professional contexts • A8. The student/graduate explains complex concepts for different audiences • A9. The student/graduate applies complementary approaches in research projects • A10. The student/graduate assesses network needs and optimizes resources • A11. The student/graduate selects and applies communication methods appropriate to the context • A12. The student/graduate configures and optimizes ICT resources • .
Responsibility and autonomy	• RA1 The student/graduate independently manages a research process and critically evaluates the results • RA2 The student/graduate assumes responsibility for the performance and reliability of the designed system • RA3 The student/graduate respects the principles of the open-source community and manages his/her own contributions • RA4 The student/graduate ensures the correctness and relevance of the conclusions drawn • RA5 The student/graduate collaborates and coordinates interdisciplinary teams • RA6 The student/graduate assumes responsibility for the functionality and security of applications • RA7 The student/graduate ensures the quality and compliance with academic norms • RA8 The student/graduate adapts to various professional communication contexts • RA9 The student/graduate coordinates and supports collaboration between different fields • RA10 The student/graduate proposes solutions for streamlining traffic and manages resources • RA11 The student/graduate assumes responsibility for the correct and efficient transmission of information • RA12 The student/graduate is responsible for the stability and performance of systems managed • .

7. Objectives of the discipline (based on the grid of learning outcomes acquired)

- Understanding of core concepts and algorithms within the field of pattern recognition and artificial intelligence.
- Effective application of learned algorithms to solve technical problems in PR and artificial intelligence.
- Awareness of the societal impact of PR artificial intelligence technologies in communications.

- Developing the ability to create computer programs to solve complex problems related to various PR/artificial intelligence applications; Comprehensive Understanding of PR/AI Fundamentals: Students gain an in-depth understanding of foundational concepts and algorithms in AI.
- Problem Decomposition and Algorithm Application: Students develop the ability to break down complex PR/AI problems, identify key components, and apply appropriate algorithms, such as convolutional neural networks (CNNs), to efficiently solve these challenges.
- Programming Skills for Advanced Vision Applications: Students acquire the skills to design and implement sophisticated computer programs that address a wide range of AI applications, from traditional ML to CNNs and Transormer-based techniques.
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8. Content

8.1 Course	Number of hours	Of which online	Teaching methods
Introduction. Nearest neighbor Classification	2		Presentation of theoretical support, students work at computers, discussions, questions
Probability Review (Probability spaces Bayes' rule Random variables Mean and variance Measuring dependence)	2		
Optimization Review (Gradient descent; Stochastic gradient descent; Convex optimization; Duality)	2		
Gaussian Mixture Models	2		
Linear regression; Logistic regression	2		
Support vector machines;	2		
Kernel methods; Decision trees; Random forests	2		
k -means; Hierarchical clustering	2		
Principal component analysis	2		
Autoencoders; From Linear Regression to Deep learning; CNN's	2		
Convolutional Neural Networks	2		
Transformers	2		
Applications of AI in Communications	4		
	Bibliography[10] C. Bishop, Pattern Recognition and Machine Learning, 2006, Springer Andreas C. Mueller and Sarah Guido , "Introduction to Machine Learning with Python", O'Reilly 2016 Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly 2017		

8.2 Applied activities[11]	Number of hours	Of which online	Teaching methods
Individual labs and projects concerning fundametal topics concerning topics from courses 1-7	14		simulation, case study, problem solving, project method
Individual labs and projects concerning fundametal topics concerning topics from courses 8-14	14		

	Bibliography[12] teaching meterials on Virtual Campus

9. Evaluation

Type of activity	**9.1** Evaluation criteria[13]	**9.2** Evaluation methods	**9.3** Share of the final grade
9.4 Course	Knowledge of discipline	Written Exam	1/2
9.5 Applied activities	**S:**		
	L: the level of familiarity with the various algorithms presented and the ability to implement them in a programming language	exam	1/4
	P: results and presentation of the project	Project presentation	1/4
	Pr:		
	Tc-R[14]:		
9.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified[15]			
• To promote the discipline, the minimum standard is to master an average level of information presented in the course and practical activities. Verification modes are those outlined in the Evaluation section of the table above. The minimum promotion mark is 5, separate for each type of examination			

Date of completion	**Course coordinator (signature)**	**Coordinator of applied activities (signature)**
24.09.2025	Prof. Dr. Eng Cosmin Ancuți	Prof. Dr. Eng Cosmin Ancuți
Head of Department (signature)	**Date of approval in the Faculty Council** [16]	**Dean (signature)**
	07.10.2025	