Universitatea Națională de Știință și Tehnologie Politehnica București
Facultatea de Electronică, Telecomunicații și
Tehnologia Informației

COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	**National University of Science and Technology Politehnica Bucharest**
1.2 Faculty	**Electronics, Telecommunications and Information Technology**
1.3 Department	**Applied Electronics and Information Engineering**
1.4 Domain of studies	Electronic Engineering, Telecommunications and Information Technology
1.5 Cycle of studies	Masters
1.6 Programme of studies	Advanced Techniques for Digital Imaging

2. Date despre disciplină

2.1 Course name (ro) (en)				Sisteme de codare şi analiză video			
2.2 Course Lecturer				Prof. Dr. Ruxandra-Georgiana TAPU			
2.3 Instructor for practical activities				Prof. Dr. Ruxandra-Georgiana TAPU			
2.4 Year of studies	2	2.5 Semester	I	2.6. Evaluation type	E	2.7 Course regime	Op
2.8 Course type		DA	2.9 Course code	UPB.04.M3.A.15-03		2.10 Tipul de notare	Nota

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week	3	Out of which: 3.2 course	2.00	3.3 seminary/laboratory	1
3.4 Total hours in the curricula	42.00	Out of which: 3.5 course	28	3.6 seminary/laboratory	14
Distribution of time:					hours
Study according to the manual, course support, bibliography and hand notes Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					54
Tutoring					0
Examinations					4
Other activities (if any):					0

3.7 Total hours of individual study	58.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Machine Learning Systems Fundamentals Image Processing and Computer Vision Operating Systems

4.2 Results of learning	General knowledge of one-dimensional and two-dimensional signals, object-oriented programming, and working with dedicated libraries.

5. Necessary conditions for the optimal development of teaching activities (where applicable)

5.1 Course	The course will take place in a room equipped with a projector and computer.
5.2 Seminary/ Laboratory/Project	The laboratory will be conducted in a specifically equipped room, which must include: high-performance computers equipped with the necessary graphics cards for parallel data processing, a projector or TV with a minimum diagonal of 179 cm, and a graphics tablet.

6. General objective *(Reffering to the teachers' intentions for students and to what the students will be thought during the course. It offers an idea on the position of course in the scientific domain, as well as the role it has for the study programme. The course topics, the justification of including the course in the currcula of the study programme, etc. will be described in a general manner)*

This discipline falls within the area of electronics, telecommunications, and information technology and is designed for the Master's program in Advanced Techniques for Digital Imagining. Its purpose is to introduce and familiarize students with key approaches, models, and explanatory theories in the field of static image and video sequence compression. Additionally, it aims to cover image and video stream indexing techniques, as well as the use of artificial intelligence in solving practical applications and specific problems. Thus, it contributes to stimulating the learning process by addressing a diverse range of applications and practical scenarios, reflecting the real challenges of the field and preparing students for effective involvement in the industry.

7. Competences *(Proven capacity to use knowledge, aptitudes and personal, social and/or methodological abilities in work or study situations and for personal and proffesional growth. They refflect the empolyers requirements.)*

Specific Competences	Demonstrate basic/advanced knowledge in the field of artificial intelligence. Correlate and apply practical knowledge of machine learning systems using deep neural network architectures. Apply basic knowledge, concepts, and methods related to programming language sand techniques. Develop programs in an object-oriented programming language, starting from specifying requirements to execution, debugging, and interpreting results in correlation with the used processor. Oral and written communication in the Romanian language: Use scientific vocabulary specific to the field for effective communication, both in writing and orally. Oral and written communication in a foreign language (English): Demonstrate an understanding of the vocabulary related to the field in a foreign language.

Transversal (General) Competences	Works in a team and communicates effectively, coordinating efforts with others to solve moderately complex problem situations. Autonomy and critical thinking: the ability to think in scientific terms, independently seek and analyze data, as well as draw and present conclusions/identify solutions. Analytical and synthetic skills: presents knowledge synthetically as a result of a systematic analysis process. Adheres to academic ethics principles: correctly cites the bibliographic sources used in research activities. Applies elements of emotional intelligence in the appropriate socio-emotional management of real-life/academic/professional situations, demonstrating self-control and objectivity in decision-making or stressful situations. Systematic analysis of issues encountered in the activity, identifying elements for which established solutions exist, thereby ensuring the fulfillment of professional tasks.

8. Learning outcomes *(Synthetic descriptions for what a student will be capable of doing or showing at the completion of a course. The learning outcomes reflect the student's acomplishments and to a lesser extent the teachers' intentions. The learning outcomes inform the students of what is expected from them with respect to performance and to obtain the desired grades and ECTS points. They are defined in concise terms, using verbs similar to the examples below and indicate what will be required for evaluation. The learning outcomes will be formulated so that the correlation with the competences defined in section 7 is highlighted.)*

Knowledge	*The result of knowledge aquisition through learning. The knowledge represents the totality of facts, priciples, theories and practices for a given work or study field. They can be theoretical and/or factual.* This discipline falls within the domain of electronics, telecommunications, and information technology, targeting the Master's program in Advanced Techniques for Digital Imagining. Its purpose is to introduce and familiarize students with key approaches, models, and explanatory theories in the field of static image and video sequence compression. Additionally, it aims to cover image and video stream indexing techniques, as well as the utilization of artificial intelligence in solving practical applications and specific problems. Thus, it contributes to stimulating the learning process by addressing a diverse range of applications and practical scenarios, reflecting the real challenges of the field, and preparing students for effective involvement in the industry.
Skills	*The capacity to apply the knowledge and use the know-how for completing tasks and solving problems. The skills are described as being cognitive (requiring the use of logical, intuitive and creative thinking) or practical (implying manual dexterity and the use of methods, materials, tools and intrumentation).* Demonstrate basic/advanced knowledge in the field of artificial intelligence. Correlate and apply practical knowledge of machine learning systems using deep neural network architectures. Apply basic knowledge, concepts, and methods related to programming languages and techniques. Develop programs in an object-oriented programming language, starting from specifying requirements to execution, debugging, and interpreting results in correlation with the used processor. Oral and written communication in the Romanian language: Use scientific vocabulary specific to the field for effective communication, both in writing and orally. Oral and written communication in a foreign language (English): Demonstrate an understanding of the vocabulary related to the field in a foreign language.

Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* Works in a team and communicates effectively, coordinating efforts with others to solve moderately complex problem situations. Autonomy and critical thinking: the ability to think in scientific terms, independently seek and analyze data, as well as draw and present conclusions/identify solutions. Analytical and synthetic skills: presents knowledge synthetically as a result of a systematic analysis process. Adheres to academic ethics principles: correctly cites the bibliographic sources used in research activities. Applies elements of emotional intelligence in the appropriate socio-emotional management of real-life/academic/professional situations, demonstrating self-control and objectivity in decision-making or stressful situations. Systematic analysis of issues encountered in the activity, identifying elements for which established solutions exist, thereby ensuring the fulfillment of professional tasks.

9. Teaching techniques *(Student centric techniques will be considered. The means for students to participate in defining their own study path, the identification of eventual fallbacks and the remedial measures that will be adopted in those cases will be described.)*

Starting from the analysis of students' learning characteristics and their specific needs, the teaching process will explore both expository methods (lecture, presentation) and conversational-interactive methods based on discovery learning models facilitated by direct and indirect exploration of reality (experimentation,demonstration, modeling), as well as action-based methods such as exercises, practical activities, and problem-solving.
In the teaching activities, lectures will be conducted using PowerPoint presentations or various video materials made available to students. Each class will begin with a recapitulation of previously covered chapters, with a focus on the concepts discussed in the last session.
Presentations will incorporate images and diagrams to ensure that the presented information is easily understood and assimilated. This discipline covers information and practical activities designed to support students in their learning efforts and in developing optimal collaborative and communication relationships in a conducive discovery learning environment.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	The need of image/video compression. Methods for evaluating the compression algorithms.	2
2	Basic JPEG Compression Algorithm. Progressive JPEG Compression Algorithm.Lossless Sequential JPEG Coding Algorithm. Hierarchical JPEG Compression Algorithm.	2
3	JPEG2000 Compression Algorithm.	2
4	Motion Estimation and Compensation Techniques.	2
5	Video Compression Standards MPEG1/2/4	4
6	Segmentation and Structuring of Video Documents for Indexing Applications	6
7	ANN (Artificial Neural Network) and CNN (Convolutional Neural Network)	4
8	CNN Networks. Practical Applications of Artificial Intelligence Systems.	6

	Total:	28
Bibliography:		

LABORATORY		
Crt. no.	**Content**	**No. hours**
1	JPEG and JPEG2000 lossy compression algorithms	2
2	Motion estimation and compensation using block-level matching techniques	2
3	Evaluation of Still/Motion Image Compression Algorithms Using VCDemo	2
4	Video indexing: shot boundary detection and keyframe extraction	2
5	Automatic detection and recognition of human faces in images/video streams	4
6	Laboratory colloquium	2
	Total:	14
Bibliography:		

11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	Understanding fundamental theoretical concepts.	Examination during the session held at a fixed date in accordance with students' preferences; the topics cover the entire subject, synthesizing theoretical content through a comparative approach and explicating application models through exercises and problems.	50%
	Understanding howto apply theory to specific problems.	Idem	
	Differentiated analysis of theoretical techniques and methods.	Idem	

11.5 Seminary/laboratory/project	Understanding the use of the Python programming language and the libraries Keras,TensorFlow, and OpenCV	Laboratory reports and final laboratory colloquium, comprising both a theoretical and a practical component.The theoretical aspect is assessed through multiple-choice tests, while the practical aspect is evaluated by examining the student's solution process (implementation, testing,functioning) of a practical problem.	20%
	Development of a functional system.	Presentation of the implemented system.	30%
11.6 Passing conditions			
• Achieving 50% of the total score. • Demonstrating knowledge of the fundamental elements of static image and video sequence compression systems, image and video stream indexing techniques, as well as machine learning systems using deep neural network architectures. • Demonstrating knowledge of the main neural network architectures used in practical applications, such as VGG, ResNet, Inception, Xception.			

12. Corroborate the content of the course with the expectations of representatives of employers and representative professional associations in the field of the program, as well as with the current state of knowledge in the scientific field approached and practices in higher education institutions in the European Higher Education Area (EHEA)

• Through the conducted activities, students develop skills to provide solutions to problems and propose ideas for improving the existing situation in the field of information technology with direct and immediate applications in robotics, IoT, or autonomous systems.
• In developing the content of the course, knowledge/aspects/phenomena described in the specialized literature/own published or presented research were taken into account.
• The course has content similar to courses offered by Stanford University in the USA.
• The activities carried out during the course/laboratory aim at developing the graduate's skills to manage practical situations that they may encounter in real life, with the purpose of increasing their contribution to improving the socio-economic environment.

Date	Course lecturer	Instructor(s) for practical activities
10.10.2024	Prof. Dr. Ruxandra-Georgiana TAPU	Prof. Dr. Ruxandra-Georgiana TAPU

Date of department approval Head of department

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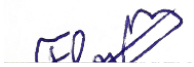
29.10.2024

Conf. Dr. Bogdan Cristian FLOREA



Date of approval in the Faculty Council

Dean

Prof. Dr. Mihnea Udrea