SYLLABUS

1. Data about the program of study

1.1 Institution	The Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Automation and Computer Science
1.3 Department	Computer Science
1.4 Field of study	Computer Science and Information Technology
1.5 Cycle of study	Master
1.6 Program of study / Qualification	Artificial Intelligence and Vision / Master
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name	***Deep Learning Based Computer Vision***			Subject code	**6.00**
2.2 Course responsible / lecturer	Prof. dr. eng. Sergiu Nedevschi - Sergiu.Nedevschi@cs.utcluj.ro				
2.3 Teachers in charge of seminars / Laboratory / project	Prof. dr. eng. Sergiu Nedevschi - Sergiu.Nedevschi@cs.utcluj.ro				
2.4 Year of study	I	2.5 Semester	1	2.6 Type of assessment (E - exam, C - colloquium, V – verification)	E
2.7 Subject category	Formative category: DA – advanced, DS – speciality, DC – complementary				DS
	Optionality: DI – imposed, DO – optional (alternative), DF – optional (free choice)				DI

3. Estimated total time

3.1 Number of hours per week	3	of which:	Course	2	Seminars	1	Laboratory	-	Project	-
3.2 Number of hours per semester	42	of which:	Course	28	Seminars	14	Laboratory	-	Project	-
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										-
(b) Supplementary study in the library, online and in the field										23
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										23
(d) Tutoring										10
(e) Exams and tests										-
(f) Other activities:										2

3.4 Total hours of individual study (suma (3.3(a)…3.3(f)))	58
3.5 Total hours per semester (3.2+3.4)	100
3.6 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 Curriculum	Image Processing
4.2 Competence	Operation with mathematical methods and models, techniques and technologies specific to the field of image processing.

5. Requirements (where appropriate)

5.1. For the course	Blackboard, video projector, screen, computer
5.2. For the applications	Computers, equipment and specific software

6. Specific competence

6.1 Professional competences	**C1** - Operation with mathematical methods and models, techniques and advanced specific engineering and IT technologies • **C1.1** - Demonstration of advanced theoretical and practical concepts and principles related to intelligent systems and artificial vision • **C1.2** - The use of specific theories and tools (algorithms, schemes, models, protocols, etc.) to explain the structure and mode of operation of the latest intelligent and artificial vision systems reported in the specialized scientific literature. • **C1.3** - The use of models for different components of complex intelligent and artificial vision systems under conditions of partial specification. • **C1.4** - Formal and comparative evaluation of the characteristics of complex intelligent and artificial vision systems. • **C1.5** - Theoretical substantiation of the characteristics of designed complex intelligent and artificial vision systems, based on modern theoretical and practical trends. **C2** - The use of computing techniques in the fields of artificial intelligence and vision and their applications. • **C2.1** - Identifying and describing the structure and mode of operation of intelligent and artificial vision components and systems. • **C2.2** - Explanation of the role, interactions and functional characteristics of the components of the latest intelligent and artificial vision systems reported in the specialized scientific literature. • **C2.3** - Building original components, hardware and software, of intelligent and artificial vision systems, using algorithms, design methods, protocols, programming languages, data structures, technologies. • **C2.4** - Evaluation of the functional and non-functional characteristics of intelligent and artificial vision systems, based on specific metrics. • **C2.5** - Implementation of intelligent and artificial vision systems. **C3** - Specification, analysis, modeling, design, verification, testing and validation of advanced artificial vision systems using field-specific tools. • **C3.1** - Advanced knowledge, understanding and use of artificial vision concepts, paradigms and models. • **C3.2** - Advanced knowledge, understanding and nuanced use of artificial vision algorithms. • **C3.3** - Development and implementation of original solutions for artificial vision applications. **C4** - Contextual integration and integrity of intelligent and artificial vision systems • **C4.1** - Demonstration of knowledge and understanding of the specific interoperability elements of intelligent systems and artificial vision • **C4.2** - Using interdisciplinary knowledge to adapt intelligent systems and artificial vision in relation to the dynamic requirements of the application field.

	• **C4.3** - The combined use of classical and original principles and methods to ensure the security, encryption, safety and ease of use of intelligent and artificial vision systems. • **C4.4** - Use of quality, safety and security standards in information processing. • **C4.5** - Carrying out interdisciplinary projects, including problem identification and analysis, development of design specifications, development, functional testing and evaluation of specific quality and performance criteria.
6.2 Cross competences	N/A

7. Expected Learning Outcomes

Knowledge	The student has knowledge of: • computer vision • image recognition • computer programming • deep learning • business intelligence • artificial neural networks
Skills	The student is able to: • analyse business requirements • use an application-specific interface • utilise machine learning • acquire system components
Responsibilities and autonomy	The student has the ability to work independently in order to: • develop an analytical approach • take a proactive approach • develop strategies to solve problems • be open-minded • coordinate engineering teams

8. Discipline objective (as results from the *key competences gained*)

8.1 General objective	The development of skills and abilities for the development of artificial vision systems in the field of intelligence and artificial vision, computers and information technology.
8.2 Specific objectives	Assimilation of knowledge and skills regarding: - understanding and using deep learning based artificial vision concepts, paradigms and models - the nuanced understanding and use of artificial vision algorithms - studying, designing, implementing and evaluating artificial vision application modules - image processing and pattern recognition methods -3d reconstruction and processing methods

9. Contents9.1 Lectures	Hours	Teaching methods	Notes
Introduction	2		
Machine Learning Basics	2		
Neural Networks: Compute Graphs, Backpropagation, MLP, Output and Loss, Activation, Pre-processing,	2		

Neural Networks: Optimization, Regularization, Training	2		
Convolutional Neural Networks and Architectures	2		
Recurrent Neural Networks	2		
Attention and Transformers	2		
Object Detection and Semantic Segmentation	2		
Transformers Based Solutions	2		
Elements of Projective Geometry	2		
3D Reconstruction	2		
Structure from Motion and Epipolar Geometry	2		
Similarity Measures and Point-feature Extraction	2		
Detection and Segmentation in the 3D Space	2		

Bibliography:

Convolutional Neural Networks for Visual Recognition, http://cs231n.stanford.edu/
2. David Forsyth, Jean Ponce „Computer Vision A Modern Approach", Prentice Hall, USA, 2002
3. IEEE Transactions on Pattern Analyses and Machine Intelligence
4. IEEE Transactions on Image Processing
5. IEEE Transactions on Intelligent Transportation Systems
6. CVPR, ECCV and ICCV papers

9.2 Applications - Seminars/Laboratory/Project	Hours	Teaching methods	Notes
Machine Learning Topics-1	2		
Machine Learning Topics-2	2		
Deep Learning Based Computer Vision	2		
Detection, classification, semantic segmentation from images and image sequences	2		
Stereovision and depth from monocular images	2		
Optical flow, motion flow	2		
Detection, classification, semantic segmentation of 3D Point Clouds	2		

Bibliography:

1. Convolutional Neural Networks for Visual Recognition, http://cs231n.stanford.edu/
2. David Forsyth, Jean Ponce „Computer Vision A Modern Approach", Prentice Hall, USA, 2002
3. IEEE Transactions on Pattern Analyses and Machine Intelligence
4. IEEE Transactions on Image Processing
5. IEEE Transactions on Intelligent Transportation Systems
6. CVPR, ECCV and ICCV papers

**Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica și etapele proiectului.*

10. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

It is carried out through periodic meetings with representatives of the economic environment.

11. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Exam	Written examination	50%
Seminar	Individual presentation of a subject in the field	Oral examination	50%
Laboratory	-	-	-
Project	-	-	-
Minimum standard of performance: Both, Written examination and Oral examination, marks are bigger or equal with 5			

Date of filling in: 01.09.2025	**Responsible**	**Title First name Last name**	**Signature**
	Course	Prof. dr. eng. Sergiu NEDEVSCHI	
	Applications	Prof. dr. eng. Sergiu NEDEVSCHI	

Date of approval in the department 17.09.2025	Head of department, Prof.dr.eng. Rodica Potolea
Date of approval in the Faculty Council 19.09.2025	Dean, Prof.dr.eng. Vlad Mureșan