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 of Science
1.6	Program of study/Qualification	Artificial Intelligence and Vision
1.7	Form of education	Full time
1.8	Subject code	4

2. Data about the subject

2.1	Subject name			***Deep Learning Based Computer Vision***			
2.2	Subject area			Artificial Intelligence			
2.2	Course responsible/lecturer			Prof. dr. eng. Sergiu Nedevschi, Sergiu.Nedevschi@cs.utcluj.ro			
2.3	Teachers in charge of seminars			Prof. dr. eng. Sergiu Nedevschi, Sergiu.Nedevschi@cs.utcluj.ro			
2.4 Year of study	1	2.5 Semester	1	2.6 Assessment	E–**e**xam, C–**c**olloq., V-**v**erif.		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	3.2 Course	2	3.3 Seminar	1	3.3 Laborator	-	3.3 Proiect	-
3.4 Total hours in the curriculum	42	of which	3.5 Course	28	3.6 Seminar	14	3.6 Laborator	-	3.6 Proiect	-

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	23
(b) Supplementary study in the library, online and in the field	23
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	10
(d) Tutoring	-
(e) Exams and tests	2
(f) Other activities	-

3.8 Total hours of individual study (summ (3.7(a)…3.7(f)))	58
3.9 Total hours per semester (3.4+3.8)	100
3.10 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 seminar / laboratory / project	Computers, equipment and specific software

6. Specific competences

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	NA

7. Discipline objectives (as results from the *key competences gained*)

7.1	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
7.2	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

8. Contents

8.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
Introduction	2	Systematic exposure, student involvement in presentations and debates	
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

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

8.2. Seminars /Laboratory/Project	Number of hours	Teaching methods	Notes
Machine Learning Topics-1	2	Case study, Presentation, Debate	
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

9. 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

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	Exam	Written examination	50%
10.5 Applications (**Seminars** /Laboratory/Project)	Individual presentation of a subject in the field	Oral examination	50%
10.6 Minimum standard of performance: Both, Written examination and Oral examination, marks are bigger or equal with 5			

Date of filling in:		**Title Surname Name**	**Signature**
	Lecturer	Prof. dr. eng. Sergiu Nedevschi	
	Teachers in charge of application	Prof. dr. eng. Sergiu Nedevschi	

Date of approval in the department 20.02.2024	Head of department Prof.dr.ing. Rodica Potolea
Date of approval in the faculty council 22.02.2024	Dean Prof.dr.ing. Mihaela Dinsoreanu