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	Data Science / Master
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name	***Image Processing and Computer Vision***			Subject code	**11.00**
2.2 Course responsible / lecturer	Prof. dr. eng. Oniga Florin - Florin.Oniga@cs.utcluj.ro				
2.3 Teachers in charge of seminars / Laboratory / project	Lect. dr. eng. Muresan Mircea-Paul - Mircea.Muresan@cs.utcluj.ro				
2.4 Year of study	I	2.5 Semester	2	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	-	Laboratory	1	Project	-
3.2 Number of hours per semester		of which:	Course		Seminars		Laboratory		Project	
3.3 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:										-

3.4 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	-
4.2 Competence	Mathematical methods and models that can be applied in image processing

5. Requirements (where appropriate)

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

6. Specific competence

6.1 Professional competences	• analyse big data • create data models • perform data mining • perform scientific research • provide technical documentation • use data processing techniques • utilise machine learning
6.2 Cross competences	• develop an analytical approach • taking a proactive approach • developing strategies to solve problems

7. Expected Learning Outcomes

Knowledge	• computer science • data analytics • data models • digital data processing • unstructured data • statistics • computer programming • software components • software libraries
Skills	• create data sets • develop data processing applications • establish data processes • manage research data • perform dimensionality reduction • process data • use data processing techniques • create data models • interpret technical requirements • use software libraries • adapt to changes in technological development plans
Responsibilities and autonomy	• develop an analytical approach • take a proactive approach • develop strategies to solve problems

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

8.1 General objective	Development of skills and abilities for the design of image processing and computer vision systems in the context of data science
8.2 Specific objectives	Assimilation of knowledge and skills in the context of data science regarding: - Understanding and using concepts, paradigms, and models of image processing and computer vision. - Studying, designing, implementing, and evaluating modules of applications for image processing and computer vision. - Image processing and computer vision methods.

9. Contents

9.1 Lectures	Hours	Teaching methods	Notes
Introduction	2	Interactive	

Machine Learning Basics	2	presentation, student involvement in presentations and debates, ad-hoc quizzes.	
Deep Learning Basics	2		
Computer vision – Deep Learning	2		
Image Classification	2		
Object Detection 1	2		
Object Detection 2	2		
Semantic Segmentation	2		
Instance Segmentation	2		
Vision Transformer	2		
Image Generation	2		
Visualization & Understanding	2		
Student presentation – individual activities 1	2		
Student presentation – individual activities 2	2		

Bibliography:

1. CS231n: Convolutional Neural Networks for Visual Recognition, http://cs231n.stanford.edu/
2. CS 198-126: Modern Computer Vision Fall 2022 (UC Berkeley)
3. David Forsyth, Jean Ponce „Computer Vision A Modern Approach", Prentice Hall, USA, 2002
4. Gonzalez, R. C., & Woods, R. E. (2007). Digital Image Processing (3rd ed.). Pearson.
5. Szeliski, R. (2010). Computer Vision: Algorithms and Applications. Springer.
6. IEEE Transactions on Pattern Analyses and Machine Intelligence
7. IEEE Transactions on Image Processing
8. CVPR, ECCV and ICCV papers

9.2 Applications - Seminars/Laboratory/Project	Hours	Teaching methods	Notes
Advanced Image Preprocessing Techniques for Detection and Segmentation	2	Experiments and implementation using specific software tools (Python, Pytorch, Anaconda, Jupyter Notebook)	
Feature Extraction, Object Detection and Classification using Advanced Engineering Approaches	2		
Object Detection and Classification using Data Driven Approaches	2		
Semantic Segmentation Models	2		
Multi-Task Networks	2		
Image synthesis using Diffusion Models	2		
Image Annotation	2		

Bibliography:

1. Dey, S. (2017). Python Image Processing Cookbook. Packt Publishing.
2. Scientific papers IEEE Transactions on Pattern Analyses and Machine Intelligence, IEEE Transactions on Image Processing, CVPR, ECCV and ICCV papers etc.

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

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	Assessment criteria	Assessment methods	Weight in the final grade
Course	Exam	Written examination. Additional bonus points for activity during lectures and individual (optional) presentations	50%
Seminar	-	-	-
Laboratory	Testing the practical abilities of designing and implementing solutions	Lab assessment (continuous evaluation of activity, written	50%

	to specific problems. Attendance and activity.	and oral verification), optional individual activity assessment.	
Project	-	-	-
Minimum standard of performance: Final grade > 5			

Date of filling in:	**Responsible**	**Title First name Last name**	**Signature**
	Course	Prof.dr.eng. Florin ONIGA	
	Applications	Lecturer.dr.eng. Mircea Paul MURESAN	

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