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	Masters
1.6 Program of study / Qualification	Artificial Intelligence and Vision / Masters
1.7 Form of education	Full time

2. Data about the subject

2.1 Subject name	***Generative Artificial Intelligence***			Subject code	**11**
2.2 Course responsible / lecturer	Șl. dr. ing. Petrovai Andra - Andra.Petrovai@cs.utcluj.ro				
2.3 Teachers in charge of seminars / Laboratory / project	Șl. dr. ing. Petrovai Andra - Andra.Petrovai@cs.utcluj.ro				
2.4 Year of study	I	2.5 Semester	2	2.6 Type of assessment (E - exam, C - colloquium, V – verification)	C
2.7 Subject category	Formative category: DF – fundamental, DS – speciality, DC – complementary				DS
	Optionality: DOB – mandatory, DOP – optional (alternative), DFA – optional (free choice)				DOB

3. Estimated total time

3.1 Number of hours per week	2	of which:	Course	1	Seminars	1	Laboratory	-	Project	-
3.2 Number of hours per semester	28	of which:	Course	14	Seminars	14	Laboratory	-	Project	-
3.3 Individual study:										
(a) Manual, lecture material and notes, bibliography										15
(b) Supplementary study in the library, online and in the field										25
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										25
(d) Tutoring										-
(e) Exams and tests										7
(f) Other activities:										-

3.4 Total hours of individual study (suma (3.3(a)…3.3(f)))	72
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, Pattern Recognition Systems
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	• analyse business requirements • analyse big data • apply ICT systems theory • create data sets • define technical requirements • design process • develop creative ideas • develop statistical software • deliver visual presentation of data • creatively use digital technologies • use data processing techniques • acquire system component • align software with system architectures • create data models • manage system testing • assess ICT knowledge • manage database • implement ICT security policies • integrate system components • design enterprise architecture • design information system • use an application-specific interface • use markup languages • build predictive models • build recommender systems • utilise machine learning • conduct scholarly research • develop computer vision system • apply statistical analysis techniques • manage data collection systems
6.2 Cross competences	The graduate: • develop an analytical approach • taking a proactive approach • developing strategies to solve problems • being open minded • coordinate engineering teams

7. Expected Learning Outcomes

Knowledge	The student has knowledge of: • algorithms • artificial neural networks • computer programming (Python) • data models • computer vision • deep learning • image recognition • model-based systems engineering • task algorithmisation

Skills	The student is able to: • create data sets • creatively use digital technologies • deliver visual presentations of data • develop creative ideas • use data processing techniques • utilise machine learning • create data models
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 deep generative models
8.2 Specific objectives	Assimilation of knowledge and skills regarding: - understanding and using deep generative learning concepts, paradigms and models - the nuanced understanding and use of deep generative models - studying, designing, implementing and evaluating deep generative models

9. Contents

9.1 Lectures	Hours	Teaching methods	Notes
Introduction	2	Systematic exposure, student involvement in presentations and debates.	N/A
Autoregressive models	2		
Variational Autoencoders (VAEs), Normalizing Flows	2		
Generative Adversarial Networks (GANs)	2		
Energy-based models, Score based models	2		
Diffusion models for image generation	2		
Generative AI for Large Language Models	2		

Bibliography

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
2. Kevin Murphy, "Probabilistic Machine Learning Advanced Topics", MIT Press, 2023
3. IEEE Transactions on Pattern Analysis 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
Modeling Image Prior	2	Case study, Presentation, Debate.	N/A
Autoregressive models	2		
Variational Autoencoders (VAEs)	2		
Generative Adversarial Networks (GANs)	2		
Diffusion Models	2		
Applications - Videos	2		
Applications – 3D and Geometry	2		

Bibliography

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
2. Kevin Murphy, "Probabilistic Machine Learning Advanced Topics", MIT Press, 2023
3. IEEE Transactions on Pattern Analysis 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.

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	50%
Seminar	Individual presentation of a subject in the field	Oral examination	50%
Laboratory	-	-	-
Project	-	-	-
Minimum standard of performance:			

Date of filling in: 29.04.2026	**Responsible**	**Title First name Last name**	**Signature**
	Course	Șl.dr.ing. Andra PETROVAI	
	Applications	Șl.dr.ing. Andra PETROVAI	

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