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	100.

2. Data about the subject

2.1	Subject name			Mathematical Models for Machine Learning			
2.2	Subject area			Mathematics			
2.2	Course responsible/lecturer			Prof. Dr Ioan Radu Peter			
2.3	Teachers in charge of seminars			Prof. Dr Ioan Radu Peter			
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: DD–**d**eepening, SD–**s**pecialty, CD–**c**omplementary						DD
	Optionality: MD-**m**andatory, ED-**e**lective, OD-**o**ptional						OD

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	
(b) Supplementary study in the library, online and in the field	
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	
(d) Tutoring	
(e) Exams and tests	
(f) Other activities	

3.8 Total hours of individual study (summ (3.7(a)…3.7(f)))	33
3.9 Total hours per semester (3.4+3.8)	75
3.10 Number of credit points	3

4. Pre-requisites (where appropriate)

4.1	Curriculum	Master of PhD student
4.2	Competence	

5. Requirements (where appropriate)

5.1	For the course	Computer, projector
5.2	For the applications	70% presence for entrance to the final exam

6. Specific competences

6.1 Professional competences	Understanding mathematical models in machine learning, deep learning, as part of Artificial Intelligence and Computer Vision.
6.2 Cross competences	The ability to apply mathematics for understanding major algorithms, the ability to choose algorithms in problems.

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

7.1 General objective	Understanding mathematical models in machine learning, deep learning, as part of Artificial Intelligence and Computer Vision.
7.2 Specific objectives	The ability to apply mathematics for understanding major algorithms, the ability to choose algorithms in problems.

8. Contents

8.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
Introduction.	2		
Norms. Vector normalizations, meaning.	2		
Generalized Inverse I	2		
Generalized Inverse II	2		
Factorizations (QR, LD etc)	2		
Singular Value Decomposition.	2		
Sparse systems.	2		
Eigenvalues, eigenvectors. Gram Matrices.	2		
Rayleigh quotients. Applications in Machine Learning.	2		
Optimization methods related to Machine Learning.	2		
Classical algorithms using matrix optimization. Principal directions, PCA.	2		
Constrained optimization. Karush-Kuhn-Tucker methods.	2		
Final discussion. Approach methods.	2		
Bibliography Papers related to topics, which have online access. Papers in journals, tutorials, Lecture notes.			
8.2. Seminars /Laboratory/Project	Number of hours	Teaching methods	Notes
Vector normalization. Generalized inverse I.	2		
Generalized inverse II, factorizations.	2		
Eigenvectors, eigenvalues.	2		
Rayleigh quotients. Applications in Machine Learning.	4		
Constrained optimization. Karush-Kuhn-Tucker methods.	2		
Final discussion. Approach methods.	2		
Bibliography Papers in journals, tutorials, Lecture notes.			

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

Understanding mathematical models in Machine Learning, Deep learning is a cornerstone for efficient design of algorithms.

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	Understanding the teorethical notions, their relations with algorithms.	Written exam.	75%
10.5 Seminars	Understanding "hidden" mathematical models in different algorithms.	Seminar grade.	25%
10.6 Minimum standard of performance			
Ability to model/present topics and working with them.			

Date of filling in:		**Title Surname Name**	**Signature**
08.02.2024	Lecturer	Prof. dr. Ioan Radu Peter	
	Teachers in charge of application	Prof. dr. Ioan Radu Peter	

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