COURSE PROGRAMME

1. Information about the programme

1.1 University	**University "Alexandru Ioan Cuza" of Iasi**
1.2 Faculty	**Faculty of Mathematics**
1.3 Department	**Department of Mathematics**
1.4 Domain	**Mathematics**
1.5 Cycle	**Masters**
1.6 Programme / Qualification	**Applied Mathematics**

2. Information about the course

2.1 Course Name			Artificial Intelligence Special Chapters				
2.2 Course taught by			Assoc. Prof. PhD. LIVIU VIRGIL CIORTUZ				
2.3 Seminary / laboratory taught by			Lecturer PhD. MARIUS OVIDIU APETRII				
2.4 Year	I	**2.5** Semester	I	**2.6** Type of evaluation*	E	**2.7** Course type**	Op

E – Exam / C – Colloquium / V – Verification
***OB – Obligatory / OP – Optionally / F – Facultative*

3. Total hours (estimated per semester and activities)

3.1 Number of hours per week	4	**3.2** course	2	**3.3** seminary/ laboratory	2
3.4 Total number of hours	56	**3.5** course	28	**3.6** seminary/ laboratory	28

Distribution	hours
Individual study using textbooks, course notes, bibliography items, etc.	30
Supplimentary study (library, on-line platforms, etc.)	30
Individual study for seminary/laboratory, homeworks, projects, etc.	45
Tutoring	10
Examination	4
Other activities	0
3.7 Total hours of individual activity*	119
3.8 Total hours per semester	175
3.9 Credit points	7

4. Pre-requisites - Curriculum (if necessary)

5. Conditions (if necessary)

5.1 Course	
5.2 Seminary / Laboratory	

6. Objectives

7. Specific competencies/Learning outcomes

• develops open-source software • performs data analysis • applies statistical analysis techniques • thinks abstractly • finds solutions to problems

8. Contents

8.1 Course	**Teaching methods**	**Remarks** (number oh hours, references)
Revision of basic notions in probabilities and statistics: random events, probability function / distribution, the independence of random events; random variabiles (discrete vs continuous ones), the independence of random variabiles. Expectation and variance. Common probabilistic distributions. Some basic [theoretical] properties.	Lecture	2 hours
Introductory notions of Machine Learning. Main types of Machine Learning algorithms: classification, clusterization, regression, ranking, feature selection, recommendation systems.	Lecture	2 hours
Decision trees. The ID3 algorithm. Evaluation measures for classification algorithms: accuracy, training error, [cross-]validation erorr, precision, recall etc.	Lecture	2 hours
Variants / extensions to the ID3 algorithm. Overfitting. Pruning strategies for decision trees.	Lecture	2 hours
Types / classes of hypotheses in Machine Learning: Maximum Likelihood (ML) hypotheses and Maximum A posteriory Probability (MAP) hypotheses. Bayesian classification. The Naive Bayes and Joint/Optimal Bayes algorithms.	Lecture	2 hours
Computing the mean error rate for Bayesian classifiers. The nature of the decision boundary in Bayesian classification.	Lecture	2 hours
Parameter estimation for [uni-variate] probabilistic distributions: the MLE și MAP methods. The case of Bernoulli [and gaussian univariate] distributions.	Lecture	2 hours
Revision.	Partial exam	2 hours
Logistic Regression. The relationship between Bayesian classification and logistic regression.	Lecture	2 hours
Instance-based learning. The k-nearest neighbour (k-NN) algoritm. The relationship between the asymptotic error rate of the 1-NN algorithm and the error rate of the Joint Bayes algorithm.	Lecture	2 hours
Ensemble methods based on decision trees: the AdaBoost algorithm.	Lecture	2 hours
Supervised learning (classification) vs unsupervised learning (clusterization). Main types of clustering algorithms. Hierarchical clustering: aglomerative (bottom-up) vs divisive (top-down). Types of similarity functions (single-link, complete-link, average-linkage, Ward's metric).		2 hours

8.1 Course	Teaching methods	Remarks (number oh hours, references)
Partitional clustering (i.e. non-hierarchical clustering using ”hard” assignment of instances to clusters): the K-means algorithm.	Lecture	2 hours
The monotonicity of the „distorsion” (J) criterion at the application of the K-means algorithm.	Lecture	2 hours

Bibliography
[1] Tom Mitchell. Machine Learning. McGraw Hill. 1997. [2] Liviu Ciortuz, Alina Munteanu, Elena Bădărău. Exerciții de învățare automată. Ediția a III-a revizuită (online), Iași, varianta 2025f (https://edu.info.uaic.ro/invatare-automata/ML.ex-book/editia-2025f/ML.ex-book.25sept2025.pdf)

8.2 Seminary / Laboratory	Teaching methods	Remarks (number oh hours, references)
Revision of basic notions of probabilities and statistics: exercises.	Solving exercises at the blackboard, individual work, interactive methods, quizzes.	2 hours
Machine learning systems/programs: several case studies.	Demos	2 hours
The ID3 algorithm using discrete attributes: exercises. Computing the training / test / validation / leave-one-out errors.	Machine learning systems/programs: several case studies.	2 hours
The ID3 algorithm using continuous attributes: exercises. Applying different pruning strategies on decision trees: exercises.	Machine learning systems/programs: several case studies.	2 hours
Applying the Naive Bayes and Joint Bayes algorithms: exercises.	Machine learning systems/programs: several case studies.	2 hours
Computing the mean error rate în Bayesian classification: exercises.	Machine learning systems/programs: several case studies.	2 hours
Maximum Likelihood Estimation (MLE) estimation: exercises.	Machine learning systems/programs: several case studies.	2 hours
Partial exam	Partial exam 1.	2 hours
Applying logistic regression: exercises.	Solving exercises at the blackboard, individual work, interactive methods, quizzes.	2 hours
Applying the k-NN algorithm: exercises.	Solving exercises at the blackboard, individual work, interactive methods, quizzes.	2 hours
Applying the AdaBoost algorithm: exercises.	Solving exercises at the blackboard, individual work, interactive methods, quizzes.	2 hours
Hierarchical clustering: the bottom-up and top-down approaches: exercises.	Solving exercises at the blackboard, individual work, interactive methods, quizzes.	2 hours
Applying the k-means algorithm: exercises.	Solving exercises at the blackboard, individual work, interactive methods, quizzes.	2 hours
Properties of the k-means algorithm: exercises.	Solving exercises at the blackboard, individual work, interactive methods, quizzes.	2 hours

Bibliography

[1] Tom Mitchell. Machine Learning. McGraw Hill. 1997.

[2] Liviu Ciortuz, Alina Munteanu, Elena Bădărău. Exerciții de învățare automată. Ediția a III-a revizuită (online), Iași, varianta 2025f (https://edu.info.uaic.ro/invatare-automata/ML.ex-book/editia-2025f/ML.ex-book.25sept2025.pdf)

[3] Christopher Manning, Heinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 2000.

9. Coordination of the contents with the expectations of the community representatives, professional associations and relevant employers in the corresponding domain

The content of the course is designed to address the necessities of the employers from the IT industry.

10. Assessment and examination

10.1 Continuous assessment		Percentage (min. 30%)		75
Course	Assessment type			Written assessment
	Percentage			34
	Failure to pass the continuous assessment results in failure to pass the final assessment			No
	Assessment methods	Details	Percentage	with reexamination
		Continuous written assessment	100	Yes
Seminary / Laboratory	Assessment type			Mixed assessment
	Percentage			66
	Failure to pass the continuous assessment results in failure to pass the final assessment			Yes
	Assessment methods	Details	Percentage	with reexamination
		Portfolio	75	No
		Test	25	No

10.2 Final assessment	Percentage (max. 70%)	25
	Assessment type	Final mixed assessment

10.3 Special notes (special situations is assessment)	

10.4 Minimum performance standard	
Minimum 2.5 (out of 10) points at partial exams Final mark (see the formula below): minimum 4.5.	

Date, **Course coordinator,**
Assoc. Prof. PhD. LIVIU VIRGIL CIORTUZ

Seminary coordinator,
Lecturer PhD. MARIUS OVIDIU APETRII

Aproval date in the department,

Head of the departament,
Prof. PhD. IONEL DUMITREL GHIBA