SYLLABUS
Academic year 2024-2025

Dean,
Prof. Dr. Eng. Vasile-Ion Manta

1. Program data

1.1 Higher education institution	"Gheorghe Asachi" Technical University of Iași
1.2 Faculty	Automatic Control and Computer Engineering
1.3 Department	Computers
1.4 Field of studies	Computers and Information Technology
1.5 The cycle of studies[1]	Master
1.6 Study program	Artificial Intelligence

2. Subject data

2.1 Name of the subject / Code		**Data Analytics** (*Analiza datelor*) / **AI.112**					
2.2 Course coordinator		Assoc. Prof. Dr. Eng. Lavinia Ferariu					
2.3 Application instructor		Assoc. Prof. Dr. Eng. Lavinia Ferariu					
2.4 Year of study[2]	1	2.5 Semester[3]	1	2.6 Type of assessment[4]	*Colloquium*	2.7 Type of subject[5]	DS

3. Estimated total time of daily activities (hours per semester)

3.1 Number of hours per week	2	3.2 lectures	1	3.3a sem.		3.3b laboratory	1	3.3c project	
3.4 Total hours in curriculum[6]	28	3.5 lectures	14	3.6a sem.		3.6b laboratory	14	3.6c project	

Distribution of the time fund[7]	No. hours
Study by textbook, course support, bibliography and notes	20
Additional documentation in the library, on specialist electronic platforms and in the field	28
Preparation of seminars/labs/projects, assignments, reports and portfolios	20
Tutorial[8]	
Examinations[9]	4
Other activities:	

3.7 Total hours of individual study[10]	72
3.8 Total hours per semester[11]	100
3.9 Number of credits	4

4. Prerequisites (where applicable)

4.1 curriculum[12]	
4.2 competences	

5. Conditions (where applicable)

5.1 conducting the lectures[13]	• Blackboard, video projector
5.2 conducting the seminar / laboratory / project[14]	• Laboratory room with computers and Internet access • Python (free license)

6. Specific competences accumulated[15]

[1] *Bachelor / Master*
[2] *1-4 for Bachelor's, 1-2 for Master's*
[3] *1-8 for Bachelors, 1-3 for Masters*
[4] *Exam, colloquium or VP A/R – from the curriculum*
[5] *DF - fundamental subject, DID - subject in the field, DS - specialized subject or DC - complementary subject - from the education plan*
[6] *It is equal to 14 weeksx number of hours from point 3.1 (similar for 3.5, 3.6abc)*
[7] *The lines below refer to the individual study; the total is completed at point 3.7.*
[8] *Between 7 and 14 hours*
[9] *Between 2 and 6 hours*
[10] *The sum of the values on the previous lines, which refer to the individual study.*
[11] *The sum of the number of hours of direct teaching activity (3.4) and the number of hours of individual study (3.7); must be equal to the number of credits allocated to the subject (point 3.9)x 24 hours per credit.*
[12] *Mention the subjects that must be passed previously or equivalent*
[13] *Blackboard, video projector, flipchart, specific teaching materials, etc.*
[14] *Computing technique, software packages, experimental stands, etc.*

		Number of credits assigned to the subject[16]:	**4**	Distribution of credits per competences[17]
Professional competences	CP1	Knowledge of advanced concepts of computer science and information technology and the ability to work with these concepts.		0.7
	CP2	Scientific and practical research in the field of data analytics.		0.8
	CP3	Problem solving using methods and techniques specific to data analytics.		0.8
	CP4	Design and development of algorithms.		0.8
	CP5	Utilization of tools and technologies.		0.4
	CP6			
	CPS1			
	CPS2			
Transversal competences	CT1	Legislation compliant application of the intellectual property rights and of the principles, norms and values of the professional ethics code within their own strategies for rigorous, effective and responsible work.		0.1
	CT2	Application of communication techniques and effective group work; developing empathic interpersonal communication skills and assuming leadership roles/functions in a multi-specialized team.		0.2
	CT3	Creating opportunities for continuous training and the effective utilization of learning resources and techniques for personal development.		0.2
	CTS			

7. Objectives of the subject (resulting from the grid of specific competences accumulated)

7.1 General objective of the subject	Understand the concepts and techniques specific to data analytics.
7.2 Specific objectives	• Understand the categories of problems approached by data analytics and the main steps to be taken in design. • Learning to develop data analytics applications in Python.

8. Contents

8.1 Course[18]	Teaching methods[19]	Remarks
1. Introduction to Data Analytics (2 h) Scope of data analytics. Data analytics vs. data analysis. Types of analytics: descriptive, predictive, prescriptive, diagnostic. Main steps of data analytics: data collection, data preprocessing and data warehouse design, data mining and validation. Examples of applications. Perspectives in data analytics. ***2. Data Exploration and Preprocessing (2 h)*** Types of data. Conversions. Exploratory data analysis. Data cleaning – errors, missing values, outliers. Data transformation and selection. Data warehouses – common architectures. ***3. Statistical Tests (4 h)*** Hypothesis testing. Parametric and non-parametric comparison tests. Correlation tests. ***4. Data Mining - Association Rules (2 h)*** Quality metrics for association rules. Market basket problem. Frequent item set. Apriori algorithm.	The presentation of course-related materials using video-projected PowerPoint slides. Drawing connections with concepts from adjacent disciplines from both undergraduate and graduate programs of study, and verifying how the novel elements introduced are assimilated. Discussing the presented methods using numerous case studies and relevant examples.	Annual revisions of course materials All materials are available on the course website

[15] *Competencies from the G1 and G1bis Grids of the study program, adapted to the specifics of the subject, for which credits are allocated (www.rncis.ro or the faculty website)*

[16] *From the education plan*

[17] *The credits allocated to the subject are distributed on professional and transversal competences according to the specifics of the subject*

[18] *Chapter and paragraph headings*

[19] *Exposition, lecture, blackboard presentation of the studied issue, use of video projector, discussions with students (for each chapter, if applicable)*

5. ***Data Mining - Time Series (2 h)*** Stationary and nonstationary time series. Time series components. Preprocessing techniques. ARMA and ARIMA models. Motif discovery. 6. ***Anomaly Detection (2 h)*** Statistical approaches. Distance-based approaches. Density-based approaches. Cluster-based approaches. Reconstruction-based approaches. **TOTAL: 14 hours**		

Course references:

1. P. Bruce, A. Bruce, P. Gedeck, Practical Statistics for Data Science, 2020, O'Reilly Media, USA.
2. J. Han, M. Kamber, J. Pei, Data Mining Concepts and Techniques, 2012, Morgan Kaufmann, USA.
3. L. Igual, S. Segui, Introduction to Data Science, 2015, Springer, UK.
4. K. Jamsa, Introduction to Data Mining and Analytics, 2021, Jones & Barlett Learning, USA.
5. H. Jones, Data Analytics: The Ultimate Guide to Big Data Analytics for Business, Data Mining Techniques, Data Collection, and Business Intelligence Concepts, 2020, Bravex Publications, USA.
6. D.T. Larose, C.D. Larose, Data Mining and Predictive Analytics, 2015, John Wiley & Sons, Canada.
7. A. Maheshwari, Dana Analytics Made Accessible, 2023, Mc Graw Hill/Kindle.
8. G. Mount, Advancing into Analytics, 2021, O'Reilly Media, USA.

8.2a Seminar	Teaching methods[20]	Remarks

8.2b Laboratory	Teaching methods[21]	Remarks
1. The main in developing data analytics applications. (2h) 2. Data preprocessing. (2h) 3. Statistic tests. (4h) 4. Discovering association rules from data. (2h) 5. Discovering patterns in time series. (2h) 6. Anomaly detection. (2h) **TOTAL: 14 hours**	General and individual explanations, individual computer work	Annual revisions of materials

8.2c Project	Teaching methods[22]	Remarks

Applications references:

1. P. Bruce, A. Bruce, P. Gedeck, Practical Statistics for Data Science, 2020, O'Reilly Media, USA.
2. J. Han, M. Kamber, J. Pei, Data Mining Concepts and Techniques, 2012, Morgan Kaufmann, USA.
3. L. Igual, S. Segui, Introduction to Data Science, 2015, Springer, UK.
4. K. Jamsa, Introduction to Data Mining and Analytics, 2021, Jones & Barlett Learning, USA.
5. H. Jones, Data Analytics: The Ultimate Guide to Big Data Analytics for Business, Data Mining Techniques, Data Collection, and Business Intelligence Concepts, 2020, Bravex Publications, USA.
6. D.T. Larose, C.D. Larose, Data Mining and Predictive Analytics, 2015, John Wiley & Sons, Canada.
7. A. Maheshwari, Dana Analytics Made Accessible, 2023, McGraw Hill/Kindle.
8. G. Mount, Advancing into Analytics, 2021, O'Reilly Media, USA.

9. Corroboration of the contents of the subject with the expectations of representatives of the epistemic community, professional associations and representative employers in the field related to the program[23]

- The course content was created in accordance with the syllabuses of related courses from prestigious international universities.
- The course content aims to prepare the students for research-advanced design projects and was drafted to be up to

[20] *Discussions, debates, presentation and/or analysis of papers, solving exercises and problems*

[21] *Practical demonstration, exercise, experiment*

[22] *Case study, demonstration, exercise, error analysis, etc.*

[23] *The connection with other subjects, the usefulness of the subject on the labor market*

date with the relevant open problems in recent research. • The course content illustrates the utility of data analytics in several complex applications.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods		10.3 Weight in the final grade
10.4a Colloquium	Acquired theoretical and practical knowledge (quantity, correctness, accuracy)	Periodic tests[24]:		70% (minimum 5)
		Homework:		
		Other activities[25]:		
		Final evaluation: Written test, with problems and questions related to some study cases	100%	
10.4b Seminar				
10.4c Laboratory	Knowledge of equipment, how to use specific tools; evaluation of tools or achievements, processing and interpretation of results	• Written questionnaire • Oral presentation • Laboratory reports • Practical demonstration		30% (minimum 5)
10.4d Project				
10.5 Minimum performance standard[26]: grade 5 in the colloquium and applications.				

Date of completion,
10 January 2024

Signature of course coordinator,
Assoc. Prof. Dr. Eng. Lavinia Ferariu

Signature of application instructor,
Assoc. Prof. Dr. Eng. Lavinia Ferariu

Date of approval in the department,

Director of Department,
Assoc. Prof. Dr. Eng. Andrei Stan

[24] *The number of tests and the weeks in which they will be held will be specified.*

[25] *Scientific circles, professional competitions, etc.*

[26] *The minimum performance standard from the competences grid of the study program is customized to the specifics of the subject, if applicable.*