COURSE SYLLABUS

Academic year 2024-2025

1. Programme Information

1.1. Higher education institution	**Lucian Blaga University of Sibiu**
1.2. Faculty	Faculty of Engineering
1.3. Department	Department of Computer Science and Electrical and Electronics Engineering
1.4. Field of study	Computer Science and Information Technology
1.5. Level of study[1]	Master
1.6. Programme of study/qualification	ADVANCED COMPUTING SYSTEMS

2. Course Information

2.1. Name of course	Neuroprocessing			Code	ACS.204.ZA
2.2. Course coordinator	Assoc. Prof. Ionel Daniel MORARIU, PhD				
2.3. Seminar/laboratory coordinator	Associate professor eng. Daniel MORARIU, PhD				
2.4. Year of study[2]	1	2.5. Semester[3]	2	2.6. Evaluation form[4]	E
2.7. Course type[5]	A	2.8. The formative category of the course[6]			Z

3. Estimated Total Time

3.1. Course Extension within the Curriculum – Number of Hours per Week					
3.1.a. Lecture	3.1.b. Seminar	3.1.c. Laboratory	3.1.d. Project	3.1.e. Other	Total
2	0	1	1	0	**4**
3.2. Course Extension within the Curriculum – Total Number of Hours within the Curriculum					
3.2.a. Lecture	3.2.b. Seminar	3.2.c. Laboratory	3.2.d. Project	3.2.e. Other	Total[7]
28	0	14	14	0	**56**

Time Distribution for Individual Study[8]	**Hours**
Learning by using course materials, references and personal notes	20
Additional learning by using library facilities, electronic databases and on-site information	10
Preparing seminars / laboratories, homework, portfolios and essays	56
Tutorial activities[9]	4
Exams[10]	4
3.3. Total Individual Study Hours[11] *(NOSI$_{sem}$)*	**94**
3.4. Total Hours in the Curriculum *(NOAD$_{sem}$)*	**56**
3.5. Total Hours per Semester[12] *(NOAD$_{sem}$ + NOSI$_{sem}$)*	**150**
3.6. No. of Hours / ECTS	**25**
3.7. Number of credits[13]	**6**

4. Prerequisites (if needed)

4.1. Courses that must be successfully completed first (from the curriculum)[14]	Fundamentals in Artificial Intelligence
4.2. Competencies	High Level Programming Languages

5. Conditions (where applicable)

5.1. For course/lectures[15]	For students: Study the recommended references and scientific papers; For course room: Videoprojector, Whiteboard
5.2. For practical activities (lab/sem/pr/app) [16]	Lab Room with computers having installed the necessary software tools (see the applications)

6. Specific competencies acquired[17]

Number of credits assigned to the discipline[18]			6	Credits distribution by competencies[19]
6.1. Professional competencies	PC2	analyses test data		1
	PC11	develop data processing applications		1
	PC13	develop open source software		1
	PC17	uses dedicated software for data analysis		1
	PC21	interpret current data		1
	PC23	present analysis results		1
6.2. Transversal competencies				

7. Course objectives (resulted from developed competencies)

7.1. Main course objective	Designing the Systems based on Neural Networks
7.2. Specific course objectives	Understanding the Artificial Neural Network (ANN) Architectures, Algorithms and Applications Understanding Learning and Optimization Strategies applied in ANN's. Understanding the Functionality of a Complex System based on **ANN's**

8. Content

8.1 Lectures[20]		**Teaching methods**[21]	**Hours**
Lecture 1	The biological paradigm of neural computation and Artificial Neural Systems. Preliminaries.	presentation using the video projector, discussions with students	2
Lecture 2	Fundamental concepts and modes of articifial neural systems	presentation using the video projector, discussions with students	2
Lecture 3	Weighted networks - The Perceptron. Implementation of logical functions. Linearly separable functions. Perceptron learning.	presentation using the video projector, discussions with students	2
Lecture 4	Multicategory single-layer Perceptron Network	presentation using the video projector, discussions with students	2
Lecture 5	Multilayer Feedforward Networks. The Backpropagation Algorithm	presentation using the video projector, discussions with students	2

Lecture 6	Single-Layer Feedback Networks. The Hopfield Model	presentation using the video projector, discussions with students	2
Lecture 7	Multilayer Feedforward Networks Applications	presentation using the video projector, discussions with students	2
Lecture 8	Feedback Networks Applications	presentation using the video projector, discussions with students	2
Lecture 9	Associative Networks	presentation using the video projector, discussions with students	2
Lecture 10	Stochastic Networks	presentation using the video projector, discussions with students	2
Lecture 11	Self-Organizing Networks	presentation using the video projector, discussions with students	2
Lecture 12	Self-Organizing Networks Applications	presentation using the video projector, discussions with students	2
Lecture 13	Hardware for neural networks	presentation using the video projector, discussions with students	2
Lecture 14	Neural Networks Implementation	presentation using the video projector, discussions with students	2
		Total lecture hours:	**28**

8.2 Practical activities

8.2.b. Laboratory		**Teaching methods**[22]	**Hours**
Laboratory 1	Single-layer Perceptron Network	software implementation of neural algorithms	2
Laboratory 2	Building classifiers using Artificial Neural Networks.Unsupervised network	software implementation of neural algorithms	2
Laboratory 3	Building classifiers using Artificial Neural Networks.Supervised network	software implementation of neural algorithms	2
Laboratory 4	Pattern Recognition using Feedforward Neural Networks.	software implementation of neural algorithms	2
Laboratory 5	The Hopfield Network.	software implementation of neural algorithms	2
Laboratory 6	Clustering using Self-Organizing Networks.	software implementation of neural algorithms	2
Laboratory 7	Hierarchical Neural Systems for complex applications	software implementation of neural algorithms	2
		Total laboratory hours:	14

8.2.c. Project:	**Neural System for Classification and Pattern Recognition**	**Teaching methods**[23]	**Hours**
Project 1	Multilayer Feedforward Networks and the Backpropagation Algorithm	study, software implementation, results, performance analysis.	2
Project 2	Self-Organizing Networks for document clustering	study, software implementation, results, performance analysis.	2

Project 3	The Hopfield Network.for characther recognition.	study, software implementation, results, performance analysis.	2
Project 4	On-Line Shape Recognition with Incremental Training using a Neural Network with Binary Synaptic Weights (BSW)	study, software implementation, results, performance analysis.	2
Project 5	On-Line Shape Recognition with Incremental Training using a Neural Network with Binary Synaptic Weights (BSW)	study, software implementation, results, performance analysis.	2
Project 6	Hierarchical Neural System for Character Recognition and Fingerprint Classification	study, software implementation, results, performance analysis.	2
Project 7	Text mining - neural and non-neural techniques	study, software implementation, results, performance analysis.	
		Total project hours:	

9. Bibliography

9.1. Recommended Bibliography	M Akay (editor), *Handbook of Neural Engineering*, IEEE Press, 2007
	J. M. Zurada, *Introduction to Artificial Neural Systems*, West Publishing Company, 1992.
	S. Haykin, *Neural Networks. A Comprehensive Foundation*, Prentice Hall, 1999
	Lakhmi C. Jain, V. Rao Vemuri, *Industrial Applications of Neural Networks*, CRC Press, ISBN 0-8493-9802-9, 1999
9.2. Additional Bibliography	Ioan Z. MIHU, *"NEUROPROCESOARE SISTOLICE. Analiză, Proiectare, Evaluare"*, Editura Universităţii "Lucian Blaga" din Sibiu, 2001, ISBN 973-651-293-2 (in roumanian language).
	T. M. Mitchell, *Machine Learning*, McGrow-Hill, 1997
	R. Rojas, *Neural Networks. A systematic Introduction*, Springer, 1996
	A. R. Omondi, J. C. Rajapakse, *FPGA Implementations of Neural Networks*, Springer, 2006
	J. R. Rabunal, J. Dorado, Artificial Neural Networks in Real-Life Applications, Idea Group Publishing, 2006

10. Conjunction of the discipline's content with the expectations of the epistemic community, professional associations and significant employers of the specific study program[24]

By periodical (formal and informal) discutions with representatives of IT companies

11. Evaluation

Activity Type	11.1 Evaluation Criteria	11.2 Evaluation Methods		11.3 Percentage in the Final Grade	Obs.[25]
11.4a Exam / Colloquy	• Theoretical and practical knowledge acquired (quantity, correctness, accuracy)	Tests during the semester[26]:	0%	40%	
		Homework:	30%		
		Other activities[27]:	30%		
		Final evaluation:	40%		
11.4b Seminar	• Frequency/relevance of participation or responses	Evidence of participation, portfolio of papers (reports, scientific summaries)		0%	
11.4c Laboratory	• Knowledge of the equipment, how to use specific tools; evaluation of tools, processing and	• Written questionnaire • Oral response • Laboratory notebook, experimental works, reports, etc.		30%	

	interpretation of results	• Practical demonstration		
11.4d Project	• The quality of the project, the correctness of the project documentation, the appropriate justification of the chosen solutions	• Self-evaluation, project presentation • Critical evaluation of a project	30%	
11.5 Minimum performance standard:[28]	Attending to minimum 50% of tasks in each component: course, laboratory and project.			

The Course Syllabus will encompass components adapted to persons with special educational needs (SEN – people with disabilities and people with high potential), depending on their type and degree, at the level of all curricular elements (skills, objectives, contents, teaching methods, alternative assessment), in order to ensure fair opportunities in the academic training of all students, paying close attention to individual learning needs.

Filling Date: 10.09.2024

Department Acceptance Date: 16.09.2024

	Academic Rank, Title, First Name, Last Name	Signature
Course Teacher	Assoc. Prof. Ionel Daniel MORARIU, PhD	
Study Program Coordinator	Prof. Adrian FLOREA, PhD	
Head of Department	Assoc. Prof. Radu George CREȚULESCU, PhD	
Dean	Prof. Maria VINȚAN, PhD	

[1] *Bachelor / Master*
[2] *1-4 for bachelor, 1-2 for master*
[3] *1-8 for bachelor, 1-3 for master*
[4] *Exam, colloquium or VP A/R - from the curriculum*
[5] *Course type: R = Compulsory course; E = Elective course; O = Optional course*
[6] *Formative category: S = Specialty; F = Fundamental; C = Complementary; I = Fully assisted; P = Partially assisted; N = Unassisted*
[7] *Equal to 14 weeks x number of hours from point 3.1 (similar to 3.2.a.b.c.)*
[8] *The following lines refer to individual study; the total is completed at point 3.37.*
[9] *Between 7 and 14 hours*
[10] *Between 2 and 6 hours*
[11] *The sum of the values from the previous lines, which refer to individual study.*
[12] *The sum (3.5.) between the number of hours of direct teaching activity (NOAD) and the number of hours of individual study (NOSI) must be equal to the number of credits assigned to the discipline (point 3.7) x no. hours per credit (3.6.)*
[13] *The credit number is computed according to the following formula, being rounded to whole neighbouring values (either by subtraction or addition*

$$No.\ credits = \frac{NOCpSpD \times C_C + NOApSpD \times C_A}{TOCpSdP \times C_C + TOApSdP \times C_A} \times 30\ credits$$

Where:

- NOCpSpD = Number of lecture hours / week / discipline for which the credits are calculated
- NOApSpD = Number of application hours (sem./lab./pro.) / week / discipline for which the credits are calculated
- TOCpSdP = Total number of course hours / week in the Curriculum
- TOApSdP = Total number of application hours (sem./lab./pro.) / week in the Curriculum
- C_C/C_A = Course coefficients / applications calculated according to the table

Coefficients	Course	Applications (S/L/P)
Bachelor	2	1
Master	2,5	1,5
Bachelor - foreign language	2,5	1,25

[14] *The courses that should have been previously completed or equivalent will be mentioned*
[15] *Board, video projector, flipchart, specific teaching materials, online platforms, etc.*
[16] *Computing technology, software packages, experimental stands, online platforms, etc.*
[17] *Competences from the Grids related to the description of the study program, adapted to the specifics of the discipline*
[18] *From the curriculum*
[19] *The credits allocated to the course are distributed across professional and transversal competences according to the specifics of the discipline*
[20] *Chapter and paragraph titles*
[21] *Exposition, lecture, board presentation of the studied topic, use of video projector, discussions with students (for each chapter, if applicable)*
[22] *Practical demonstration, exercise, experiment*
[23] *Case study, demonstration, exercise, error analysis, etc.*
[24] *The relationship with other disciplines, the usefulness of the discipline on the labour market*
[25] *CPE – Conditions Exam Participation; nCPE – Does Not Condition Exam Participation; CEF - Conditions Final Evaluation; N/A – not applicable*
[26] *The number of tests and the weeks in which they will be taken will be specified*
[27] *Scientific circles, professional competitions, etc.*
[28] *The minimum performance standard in the competence grid of the study program is customized to the specifics of the discipline, if applicable*