Valid for academic year: 2019 - 2020

COURSE DESCRIPTION

1. Program details

University	"Lucian Blaga" University of Sibiu
Faculty	Engineering Faculty
Department	Department of Computer Science and Electrical and Electronics Engineering
Main field of study	Computer Engineering and Information Technology
Level of education	Master
Specialization	ADVANCED COMPUTING SYSTEMS

2. Course details

Course title	Neuroprocessing			
Course code	Type of course	Year of study	Semester	Number of credits
mACS.201.SO	compulsory	1	2	7
Evaluation type	Type of course (FD=fundamental discipline.; DD=domain discipline; SD=specialized discipline; CD=complementary discipline)			
E	SD			
Course instructor	Dr. ing. Ioan Z. MIHU			
Seminar/lab/project instructor	Dr. ing. Daniel MORARIU			

3. Estimated time

Course duration in the curriculum – number of hours per week				
Lecture	Seminar	Lab	Project	Total
2	-	1	1	**4**
Course duration in the curriculum - Total of hours curriculum				
Lecture	Seminar	Lab	Project	Total ($NOAD_{sem}$)
28		14	14	**56**

Distribution of hours for individual study	No. hours
Individual study using course handbooks, bibliography and notes	25
Additional documentation in library and on specialized electronic platforms	10
Preparing seminars / labs, homework, essays and portfolios	10
Tutoring	5
Exam preparation	6
Total hours for individual study ($NOSI_{sem}$)	56
Total hours per semester ($NOAD_{sem} + NOSI_{sem}$)	**112**

4. Prerequisites (if applicable)

Curriculum	Fundamentals in Artificial Intelligence
Competencies	High Level Programming Languages

5. Conditions (if applicable)

course materials	Study the recommended references and scientific papers; Video-projector, Whiteboard
sem/lab/project materials	Lab Room with computers having installed the necessary software tools (see the applications)

6. Specific competences acquired

Professional competence	• Understanding innovative/advanced information processing systems and related research methodologies. A unified/holistic vision of computer engineering, in terms of hardware-software co-design. • Advanced methods of learning in collaborative and multi-agent systems (swarm intelligence). Optimal mapping of concurrent applications on distributed heterogeneous systems.
Transversal competences	• Team working capacity development in order to achieve the objectives, based on the degree of social perception, persuasion, negotiation, coordination, training, adaptability and flexibility. • Creating a technical language, appropriate analyses and experimental developments in advanced computing systems.

7. Objectives (based on the specific grid for the accumulated competences)

General objective	Designing the Systems based on Neural Networks
Specific 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. Contents

Course		Time
1.	The biological paradigm of neural computation and Artificial Neural Systems. Preliminaries.	2 hours
2.	Threshold logic. Networks of functions. Synthesis of Boolean functions. Feedforward and recurrent networks.	2 hours
3.	Weighted networks - The Perceptron. Implementation of logical functions. Linearly separable functions. Perceptron learning.	2 hours
4.	Unsupervised learning and clustering algorithms. Competitive learning. Principal component analysis. Unsupervised reinforcement learning. Applications.	2 hours
5.	Multilayer Feedforward Networks. The Backpropagation Algorithm	2 hours
6.	Fast learning algorithms. Improvements to backpropagation	2 hours
7.	Multilayer Feedforward Networks Applications	2 hours
8.	Single-Layer Feedback Networks. The Hopfield Model	2 hours

9.	Feedback Networks Applications	2 hours
10.	Associative Networks	2 hours
11.	Stochastic Networks	2 hours
12.	Self-Organizing Networks	2 hours
13.	Self-Organizing Networks Applications	2 hours
14.	Neural Networks Implementation	2 hours
		28
Lab		Time
1.	Building intelligent systems using Artificial Neural Networks. Supervised and unsupervised learning.	2 hours
2.	Building classifiers using Artificial Neural Networks.	2 hours
3.	Features extraction. Principal Component Analysis (PCA).	2 hours
4	Pattern Recognition using Feedforward Neural Networks.	2 hours
5	Pattern Recognition using Feedback Neural Networks.	2 hours
6	Clustering using Self-Organizing Networks.	2 hours
7	Hierarchical Neural Systems for complex applications	2 hours
	Total lab hours:	14
Project: Neural System for Classification and Pattern Recognition		Time
1.	Multilayer Feedforward Networks and the Backpropagation Algorithm	2 hours
2.	Self-Organizing Networks.	2 hours
3.	The Hopfield Network.	2 hours
4.	The Associative Memories.	2 hours
5.	On-Line Shape Recognition with Incremental Training using a Neural Network with Binary Synaptic Weights (BSW)	2 hours
6	Hierarchical Neural System for Character Recognition and Fingerprint Classification	2 hours
7	Text mining - neural and non-neural techniques	2 hours
	Total project hours:	14

Teaching methods

Lectures, explanations, conversations, demonstrations, case studies, exercises, debates.	Language of instruction	English

References

Recommended reading	J. M. Zurada, *Introduction to Artificial Neural Systems*, West Publishing Company, 1992.
	S. Haykin, *Neural Networks. A Comprehensive Foundation*, Prentice Hall, 1999
	M Akay (editor), *Handbook of Neural Engineering*, IEEE Press, 2007
	T. M. Mitchell, *Machine Learning*, McGrow-Hill, 1997
	Lakhmi C. Jain, V. Rao Vemuri, Industrial Applications of Neural Networks, CRC Press, ISBN 0-8493-9802-9, 1999
More references	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
	I. Z. Mihu, *"NEUROPROCESOARE SISTOLICE. Analiză, Proiectare, Evaluare"*, Editura Universităţii "Lucian Blaga" din Sibiu, 2001

9. Linking course content with expectations of the epistemic community representatives, professional associations and employers' representatives in the field related to the program

Curricula are continuously updated based on the most prestigious international text-books and also based on the most relevant progresses in this field (as these developments are presented in top-level scientific reviews, research projects and international conferences).

10. Evaluation

Type	Evaluation criteria	Evaluation methods	Percentage in final grade	Obs.*
Course	Assessments	Writing Work	10%	CPE
	Exam	Writing Exam	30%	CEF
Lab	Developing the required applications	Presentation of the applications, explanations, answer to the questions	30%	nCPE
Project	Software Implementation of the Neural System		20%	nCPE
	Scientific Report	Presentation	10%	nCPE
Minimum standard of performance				
50% after summing column 4 values				

(*) REP – required for exam participation; nREP – not required for exam participation; RFE – required for final evaluation.

Date of completion: 12.09.2019

Date of approval in the Department:…….

	Position, title, first name, surname	Signature
Course instructor	Conf. dr. ing. Ioan Z. MIHU	
Head of department	Prof.dr. ing. Daniel VOLOVICI, PhD	