Name of the Subject

Emphasis

NAME OF THE SUBJECT: APPLIED COMPUTATIONAL INTELLIGENCE

- Obligatory ( ): Basic ( ) Complementary ( )
- Elective (X): Intrinsic ( ) Extrinsic ( )

NUMBER OF ACADEMIC CREDITS: Four (4).

COURSE TYPE: THEORETICAL: ___ PRACTICAL: ___ THEORETICAL-PRACTICAL: _X_
Methodological alternatives:
Master Class (X), Seminar ( ), Seminar - Workshop (X), Workshop ( ), Practice (X), Tutored projects (X), Other: _____

Justification

Computational Intelligence focuses on the theory, design, application and development of computational paradigms motivated and inspired by biology and linguistics with emphasis on neural networks, connectionist systems, genetic algorithms, evolutionary programming, fuzzy systems and hybrid intelligent systems in which these paradigms are combined.

Computational Intelligence is closely related to other areas of science and branches of computing such as: artificial intelligence (AI), classification, cognitive computing, connectionism, data mining, graphical methods, intelligent agents and intelligent systems, and knowledge discovery in data (KDD), machine learning, natural computing, parallel distributed processing, pattern recognition, probabilistic methods, x SoftComputing, multi-varied statistics, and optimization. These topics have been highly researched and are the subject of intense scientific debate, but no consensus is in sight.

Computational intelligence has become a trend that means different things to different people. The branches of science are not defined, but they are slowly developing in the process of sharing and grouping common interests. In this context, Computational

Intelligence and especially its applications to various areas have a general and collective interest, and most focus on solving highly complex problems that only humans and animals can solve and that require intelligence. Specific interests also focus on methods and tools that are applicable to this type of problem. In this way, Computational Intelligence has permeated other areas such as tele-informatics and its related problems have begun to be part of the current body of scientific research.

PREREQUISITE: Basic knowledge of programming and experience in Matlab and Python

Content

General description xxxx.

GENERAL OBJECTIVE

The main objective is the introduction to the basic concepts and techniques of Computer SoftComputing, such as Fuzzy Logic, Neural Networks and Evolutionary Computing. The course will also present the latest developments and applications of SoftComputing.

SPECIFIC OBJECTIVES

- Introduction of concepts, models, algorithms and tools for the development of intelligent systems: fuzzy logic, artificial neural networks, genetic algorithms, fuzzy systems, swarm intelligence, ant colony optimization, artificial life, and hybrids of the

previous techniques. This domain is called Computational Intelligence, and is a numerical interpretation of biological intelligence.

- Understanding the need for Computational Intelligence (SoftComputing).
- To understand the different uses of SoftComputing in various areas.
- To understand the steps involved in the development of Computational Intelligence paradigms and their application.
- To acquire a practical knowledge of some popular SoftComputing and Computational Intelligence tools. Design, implement and verify the computer systems using appropriate techniques and tools.

SYNTHETIC PROGRAM:

Introduction

Imitating Nature in Problem Solving: The Basics
Introduction to Neuro-Diffusion Systems and SoftComputing

1. Fuzzy Systems

Fuzzy Sets
Fuzzy Logic
Fuzzy Relations
Diffuse Inference
Fuzzy Logic Operations
Adaptation of Diffuse Systems
Disjunctive Reasoning vs. Conjunctive
Fuzzy Models (Mamdami - Sugeno - Tsukamoto)
Application of Fuzzy Systems

2. Neural Networks

Single-layer and multi-layer neural networks
Perceptrons
Neural Networks for Supervised Learning
Unsupervised Learning Neural Networks
Competitive Learning Networks
Self-organization - Kohonen
Radial Base Functions in Neural Networks
Learning Vector Quantifier (LVQ)
Hebbian Learning

Application of Neural Networks

3. Evolutionary Computing
Genetic Algorithms
Evolutionary Multi-Objective Algorithms
Bio-Inspired Systems
Bayesian Networks
Particle Swarm Search
Application of Evolutionary Computing

4. Neuro-Diffusion and Hybrid Systems
Adaptive Neuro-Diffusion Inference Systems
ANFIS/RBFN Learning Methods
Architecture and Hybrid Learning Algorithms
Application of Intelligent Hybrid Systems

5. Computer Intelligence Applications
The complexity and computational power of Computational Intelligence models

Strategies

METHODOLOGY:

Magisterial chair: It will be conducted for each topic, showing definitions, its state of the art and its relevance in the formation of the Master's student.

Design, Implementation and Simulation Workshops: They will consist of the development of exercises, whose purpose is to put the theoretical concepts into practice. At least one workshop may be given by a national or international invited expert.

Directed readings: Readings will be developed on the relevant topics of each unit.

Conferences: Specialists in the subject will be invited to give talks and conferences during the semester.

Final Project: Students will carry out the development of a final project, where they will apply the concepts seen in class. The student will carry out a support of the project made to receive the respective feedback.

Shared Web Site: The virtual space of the virtual classrooms of the School of Engineering

will be used for the management of bibliographic material, delivery of papers and discussions of different topics through the network.

	Hours			Teacher hours / week	Student hours / week	Total Hours Student / semester	Academic credits
Type of course	DW	CW	AW	(DW + CW)	(DW + CW +AW)	X 16 weeks	
	2	2	8	4	12	192	4

Direct Presential Work (DW): classroom work in plenary session with all students.

Mediated-Cooperative Work (CW): Teacher tutoring work to small groups or individually to students.

Autonomous Work (AW): Student work without the presence of the teacher, which can be done in different instances: in work groups or individually, at home or in a library, laboratory, etc.)

Resources

PHYSICAL RESOURCES REQUIRED:

It will be conducted for each topic, showing definitions, its state of the art and its relevance in the formation of the Master's student. We will also use the Google Colab tool to execute code in Python.

Virtual classrooms: Google Meet and Classroom will be used for the development of the class and the monitoring and communication channel.

Institutional mail: Additionally, there will be permanent communication through the mail cesar.perdomo@correo.udistrital.edu.co

BIBLIOGRAPHY:

- Krohn, J., Beyleveld, G., & Bassens, A. (2019). Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence. Addison-Wesley Professional.
- Sumathi, S., & Paneerselvam, S. (2010). Computational intelligence paradigms: theory & applications using MATLAB. CRC Press.
- Alpaydin, E. (2020). Introduction to machine learning. MIT press.
- Bishop, C. M. (2006). Pattern recognition and machine learning. springer.
- Raschka, S., & Mirjalili, V. (2019). Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2. Packt Publishing Ltd.
- Quarteroni, A., Saleri, F., & Gervasio, P. (2006). Scientific computing with MATLAB and Octave (Vol. 2). Berlin: Springer.
- Konar, A. (2006). Computational intelligence: principles, techniques and applications. Springer Science & Business Media.
- Rojas, R. (2013). Neural networks: a systematic introduction. Springer Science & Business Media.
- Friedman, J., Hastie, T., & Tibshirani, R. (2001). The elements of statistical learning (Vol. 1, No. 10). New York: Springer series in statistics.
- Hassoun, M. H. (1995). Fundamentals of artificial neural networks. MIT press.
- Zurada, J. M. (1992). Introduction to artificial neural systems (Vol. 8). St. Paul: West.

- Engelbrecht, A. P. (2007). Computational intelligence: an introduction. John Wiley & Sons.

BIBLIOGRAPHIC RESOURCES:

- IEEE Computational Intelligence Magazine
- IEEE Transactions on Neural Networks
- IEEE Transactions on Fuzzy Systems
- IEEE Transactions on Evolutionary Computation
- IEEE Transactions on Computational Intelligence and AI in Games
- IEEE Press Books - Computational Intelligence Series
- Computational Intelligence: An International Journal - Wiley
- Encyclopedia of Computational Intelligence
- Applied Soft Computing – Elsevier

https://www.aprendemachinelearning.com/guia-de-aprendizaje/

http://faculty.neu.edu.cn/yury/AAI/Textbook/Deep%20Learning%20with%20Python.pdf

http://faculty.neu.edu.cn/yury/AAI/Textbook/DeepLearningBook.pdf

https://datasetsearch.research.google.com/

https://www.kaggle.com/

https://scholar.google.es/schhp?hl=es

https://ieeexplore-ieee-org.bdigital.udistrital.edu.co/Xplore/home.jsp

https://link-springer-com.bdigital.udistrital.edu.co/

https://www-sciencedirect-com.bdigital.udistrital.edu.co/

Course Schedule

Week /Unid	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Introduction																
2. Fuzzy Systems																
3. Neural Networks																
4. Evolutionary Computing																
5. Neuro-Diffusion and Hybrid Systems																
6. Computer Intelligence Applications																

Evaluation

	ASPECTS TO EVALUATE	FECHA	PERCENTAGE
FIRST NOTE	Workshop I Workshop II Workshop III Article I	Week 8	5% 5% 10% 15%
SECOND NOTE	Workshop IV Workshop V Workshop VI Article II	Week 15	5% 5% 10% 15%
THIRD NOTE	Final Projects Presentations – (Application of Intelligence Paradigm Computer Science in a Problem in the Area of Interest)	Week 17	30%

TEACHER INFORMATION:

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