

<b>POLI</b> ESCOLA SUPERIOR TECNOLOGIA GESTÃO <b>TÉCNICO</b> <b>GUARDA</b>	<b>SUBJECT DESCRIPTION</b>	<b>MODELO</b> PED.013.03
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Course	Data science and artificial intelligence					
Subject	Artificial neural networks					
Academic year	2023/2024	Curricular year	2nd	Study period	2nd semester	
Type of subject	Compulsory	Student workload (H)	Total: 168	Contact: 60	ECTS	6
Professor(s)	Prof. Noel Lopes, PhD					
<input checked="" type="checkbox"/> Area/Group Coordinator <input type="checkbox"/> Head of Department	(select)		Prof. José Fonseca, PhD			

## PLANNED SUBJECT DESCRIPTION

### 1. LEARNING OBJECTIVES

1. Understand the architecture and functioning of neural networks (neurons, connections, activation functions, layers, etc.).
2. Know the main algorithms for training neural networks.
3. Choose the appropriate architecture and training algorithm for a given problem.
4. Use neural networks to create classification, prediction, and regression models to solve real and concrete problems.
5. Evaluate and compare neural network models.

### 2. PROGRAMME

1. Introduction to Neural Networks
2. Neural Network architectures
3. Backpropagation Algorithm (BP)
4. Multiple Backpropagation Algorithm (MBP)
5. Radial Basis Function Networks (RBF)
6. Self-Organizing Maps (SOM)
7. Real-World Applications of Neural Networks

### 3. COHERENCE BETWEEN PROGRAMME AND OBJECTIVES

- Objective 1 is fulfilled by contents 1 and 2.
- Objective 2 is fulfilled by contents 3, 4, 5, and 6.
- Objective 3 is fulfilled by content 7, as well as contents 3, 4, 5, and 6.
- Objectives 4 and 5 are fulfilled by content 7.

### 4. MAIN BIBLIOGRAPHY

- Noel Lopes, Apontamentos do docente
- Charu C. Aggarwal, 2018, "Neural Networks and Deep Learning: A Textbook", Springer. ISBN 978-3319944623 (colocar também na bibliografia da UC de Deep Learning)
- Noel Lopes, Bernardete Ribeiro, 2015, "Machine Learning for Adaptive Many-Core Machines - A Practical Approach", Studies in Big Data, vol. 7, Springer International Publishing. ISBN 978-3-319-06937-1
- Christopher M. Bishop. Pattern Recognition and Machine Learning. Springer. ISBN 2006. 978-0387310732

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- Noel Lopes, *Multiple Back-Propagation Software*, <http://mbp.sourceforge.net/>
- Noel Lopes et al., *GPUMLib*, <http://gpumlib.sourceforge.net/>

### 5. TEACHING METHODOLOGIES (INCLUDING EVALUATION)

*Theoretical-practical classes are oriented towards problem-solving through the development of assignments. To solve the assignments, datasets are chosen in which a portion of each dataset is provided to them, and the other portion is concealed to serve as a test set.*

*The assignments involve solving problems by creating computational learning models (neural networks), whose performance is evaluated using the concealed test sets. The evaluation of the assignments is synchronized with the performance of the models.*

**Assessment rules (100%):** *Development of assignments and writing of articles on one of the developed assignments.*

### 6. COHERENCE BETWEEN TEACHING METHODOLOGIES AND OBJECTIVES

*In the theoretical classes, the theoretical part of neural networks is taught, including architecture and training algorithms.*

*In the theoretical-practical classes, tools for training neural networks are taught, and data preprocessing, model training, and subsequent validation and evaluation are performed.*

### 7. ATTENDANCE

N/A.

### 8. CONTACTS AND OFFICE HOURS

Noel Lopes ([noel@ipg.pt](mailto:noel@ipg.pt)), office 27, Office hours: Monday 10:00 – 12:00; Friday 8:30 – 11:30

### DATE

19 de fevereiro de 2024

### SIGNATURES

Professor

\_\_\_\_\_  
(signature)

Area/Group Coordinator

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(signature)