



Course guide

270719 - URL - Unsupervised and Reinforcement Learning

Last modified: 02/02/2024

Unit in charge: Barcelona School of Informatics
Teaching unit: 723 - CS - Department of Computer Science.
Degree: MASTER'S DEGREE IN ARTIFICIAL INTELLIGENCE (Syllabus 2017). (Optional subject).
Academic year: 2023 **ECTS Credits:** 4.5 **Languages:** English

LECTURER

Coordinating lecturer: JAVIER BÉJAR ALONSO
Others: Segon quadrimestre:
JAVIER BÉJAR ALONSO - 10

PRIOR SKILLS

Basic knowledge of clustering and neural networks

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CEA12. Capability to understand the advanced techniques of Knowledge Engineering, Machine Learning and Decision Support Systems, and to know how to design, implement and apply these techniques in the development of intelligent applications, services or systems.

CEA13. Capability to understand advanced techniques of Modeling , Reasoning and Problem Solving, and to know how to design, implement and apply these techniques in the development of intelligent applications, services or systems.

CEP1. Capability to solve the analysis of information needs from different organizations, identifying the uncertainty and variability sources.

General:

CG1. Capability to plan, design and implement products, processes, services and facilities in all areas of Artificial Intelligence.

CG3. Capacity for modeling, calculation, simulation, development and implementation in technology and company engineering centers, particularly in research, development and innovation in all areas related to Artificial Intelligence.

Transversal:

CT2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

Basic:

CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

TEACHING METHODOLOGY

Presentation classes and class laboratories



LEARNING OBJECTIVES OF THE SUBJECT

1.To known and use advanced unsupervised machine learning techniques for application on all the domains of engineering and science

STUDY LOAD

Type	Hours	Percentage
Hours large group	40,5	100.00

Total learning time: 40.5 h

CONTENTS

Data Mining, a global perspective

Description:

Brief introduction to what is Data Mining and Knowledge Discovery, the areas they are related to and the different techniques involved

Pre-processing and unsupervised data transformation

Description:

This topic will include different algorithms for unsupervised data preprocessing such as data normalization, discretization, outliers detection, dimensionality reduction and feature extraction (PCA, ICA, SVD, linear and non linear multidimensional scalling and non negative matrix factorization)

Unsupervised Machine Learning

Description:

This topic will include classical and current algorithms for unsupervised learning from machine learning and statistics including hierarchical and parititional algorithms (K-means,Fuzzy C-means, Gaussian EM, graph partitioning, density based algorithms, grid based algorithms, unsupervised ANN, affinity propagation, ...)

Unsupervised methodologies in Knowledge Discovery and Data Mining

Description:

This topic will include current trends on knowledge discovery for data mining and big data, (scalability, any time clustering, one pass algorithms, approximation algorithms, distributed clustering, ..)

Advanced topics in unsupervised learning

Description:

This topic will include and introduction to different advanced topics in unsupervised learning such as consensus clustering, subspace clustering, biclustering and semisupervised clustering



Unsupervised learning for sequential and structured data

Description:

This topic will include algorithms for unsupervised learning with sequential data and structured data, such as sequences, strings, time series and data streams, graphs and social networks

Unsupervised Deep Learning: Autoregressive and Flow models

Description:

We will see algorithms able to estimate probability distribution models from unsupervised data that can be sampled to generate new data assuming autoregressive dependencies and flow transference models

Unsupervised Deep Learning: Latent Variable models, Autoencoders and Variational Autoencoders

Description:

This topic will introduce to latent variable models for learning of probabilistic models of data and latent representations for sampling and generating data for applications in image and text generation

Unsupervised Deep Learning: Implicit models, Generative Adversarial Networks

Description:

This topic will introduce to models that represent implicitly probability distribution models using adversarial learning. Different models based on Generative Adversarial Networks will be explained following its evolution since their original formulation. Different applications to image generation will be explained.

Unsupervised Deep Learning: Self-supervised and Contrastive learning

Description:

This topic will introduce to models for learning representations to be used for other tasks using self-supervised methodologies and contrastive learning. Different approaches for defining the unsupervised task used to learn a representation will be explained in the context of applications for image and text.



ACTIVITIES

Unsupervised learning

Description:

This activity develops the topics of the unsupervised learning part of the course

Specific objectives:

1

Related competencies :

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CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

Full-or-part-time: 56h

Theory classes: 20h

Self study: 36h



Unsupervised Deep Learning

Description:

This activity develops the syllabus of the Unsupervised Deep learning part of the course

Specific objectives:

1

Related competencies :

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Full-or-part-time: 56h 30m

Theory classes: 20h 30m

Self study: 36h

GRADING SYSTEM

The evaluation will be based on final test exam about the topics of the course (20%), the implementation of an unsupervised learning algorithm from a paper (40%) and a review and video presentation of a deep unsupervised learning paper (40%)

BIBLIOGRAPHY

Basic:

- Aggarwal, C. C., & Reddy, C. K. Data clustering : algorithms and applications. Boca Raton: CRC Press, 2014. ISBN 9781466558212.
- Zaki, M.J.; Meira, W. Data mining and machine learning: fundamental concepts and algorithms. 2nd ed. Cambridge, UK: Cambridge University Press, 2020. ISBN 9781108473989.
- Goodfellow, I., Bengio, Y., Courville, A., & Bengio, Y. Deep learning [on line]. Cambridge, Massachusetts: MIT press, [2016] [Consultation: 07/03/2024]. Available on: <https://www.deeplearningbook.org/>. ISBN 9780262035613.

RESOURCES

Hyperlink:

- <https://sites.google.com/upc.edu/mai-url>