VNIVERSITAT DE VALÈNCIA

Course Guide
45010 Deep learning

COURSE DATA

Data Subject	
Code	45010
Name	Deep learning
Cycle	Master's degree
ECTS Credits	6.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
2221 - M.U. en Ciencia de Datos	School of Engineering	1	Second term

Subject-matter

Degree	Subject-matter	Character
2221 - M.U. en Ciencia de Datos	17 - Deep learning	Obligatory

Coordination

Name	Department
FERRI RABASA, FRANCESC JOSEP	240 - Computer Science
MARTIN GUERRERO, JOSE DAVID	242 - Electronic Engineering
SORIA OLIVAS, EMILIO	242 - Electronic Engineering

SUMMARY

In this course, the most advanced machine learning models are taught; it is therefore a continuation of the machine learning modules (I) and (II). The course focuses on models that currently have a large number of parameters such as deep convolutional models, recurrent models and MLPs used as autoencoders. Finally, the paradigm of reinforcement learning using these models is discussed.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

No enrolment restrictions with other subjects in the curriculum have been specified.

OUTCOMES

2221 - M.U. en Ciencia de Datos

- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Be able to assess the need to complete their technical, scientific, language, computer, literary, ethical, social and human education, and to organise their own learning with a high degree of autonomy.
- Ability to access and manage information in different formats for subsequent analysis in order to obtain knowledge from data.
- Capacidad para trabajar en equipo para llegar a soluciones de problemas interdisciplinarios usando técnicas de análisis de datos.
- Ser capaces de acceder a herramientas de información (bibliográficas y de empleo) y utilizarlas apropiadamente.
- Ser capaces de asumir la responsabilidad de su propio desarrollo profesional y de su especialización en uno o más campos de estudio, aplicando los conocimientos adquiridos en la identificación de salidas profesionales y yacimientos de empleo.
- Extraer conocimiento de conjuntos de datos en diferentes formatos.
- Entender la utilidad de la ciencia de datos y sus elementos asociados, así como su aplicación en la resolución de problemas, eligiendo las técnicas más adecuadas a cada problema, aplicando de forma correcta las técnicas de evaluación y, finalmente,
  interpretando los modelos y resultados.
- Ability to solve classification, modelling, segmentation and prediction problems from a set of data.
- Modelar la dependencia entre una variable respuesta y varias variables explicativas, en conjuntos de datos complejos, mediante técnicas de aprendizaje máquina, interpretando los resultados obtenidos.

LEARNING OUTCOMES

To learn the main deep neural architectures.

To learn about the architecture and elements of convolutional networks.

To learn about LSTM/GRU neurons and their use in recurrent networks.

To learn about the paradigm of reinforced learning and its deep versions.

DESCRIPTION OF CONTENTS

1. Autoencoders.

Basic autoencoders: relationship with PCA. Deep autoencoders. Variational versions.

2. Convolutional Neural Networks (CNN)

MLP problems with images. Architecture of a CNN. Learning algorithm. Classical structures. Transfer learning.

3. Recurrent neural networks

Recurrent networks: early architectures (Elman / Jordan / IIR networks). Current models: LSTM and GRU. Attention Models.

4. Generative Adversarial Networks

GAN: basic architecture. Cost function. Learning algorithm. Variations

5. Reinforcement learning. Deep models.

Reinforcement learning. Elements. Bellman's equation. Q-Learning. Deep models.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theoretical and practical classes	60,00	100
Development of individual work	20,00	0
Study and independent work	12,00	0
Readings supplementary material	3,00	0
Preparation of evaluation activities	12,00	0
Preparing lectures	20,00	0
Preparation of practical classes and problem	13,00	0
Resolution of case studies	10,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Theoretical activities. Expository development of the subject with the participation of the student in the resolution of specific questions. Individual evaluation questionnaires.
Practical activities. Learning by solving problems, exercises and case studies through which competences on the different aspects of the subject are acquired.
Laboratory and/or computer classroom work. Learning through activities carried out individually or in small groups and carried out in computer classrooms.

EVALUATION

The assessment of the learning of the knowledge and competences achieved by the students will be carried out continuously throughout the course, and will consist of the following assessment blocks:
1. Exercises and assignments handed in during the course and/or partial exams: 70% of the final mark.
2. Final exam: 30% of the final mark.

The marks obtained in section 1 will be retained in the two exam sessions of the academic year in which they have been taken, given that their evaluation is only possible during the teaching period.

REFERENCES

Basic

- Francois Chollet (2017). Deep Learning with Python. Manning Publications. 2017.
- Ian GoodFellow, Yoshua Bengio (2016). Deep Learning. MIT Press, 2016
- Nikhil Buduma, Nicholas Locascio (2017). Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms 1st Edition. OReilly
- Maxim Lapan (2020). Deep Reinforcement Learning Hands-On: Apply modern RL methods to practical problems of chatbots, robotics, discrete optimization, web automation, and more, 2nd Edition. Packt
- Kevin Murphy (2021). Probabilistic Machine Learning: a Probabilistic Perspective. MIT Press. Disponible en https://probml.github.io/pml-book/book1.html

Additional

- Mohamed Elgendy (2020) Deep Learning for Vision Systems, Manning

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

In the event of a hybrid mode of teaching (combining face-to-face and non-face-to-face) or a closure of the facilities for health reasons that totally or partially affect the classes of the subject, these will preferably be replaced by synchronous non-face-to-face sessions following the established timetables.
If the closure affects any on-site assessment test of the subject, this will be replaced by a test of a similar nature that will be carried out in virtual mode through the computer tools supported by the Universitat de València.
The percentages of each assessment test will remain unchanged, according to what is established in this guide.