

Guia docent

205262 - 205262 - Optimització Numèrica amb Aplicacions en Machine Learning i Enginyeria Aeronàutica

Última modificació: 02/04/2024

Unitat responsable: Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual de Terrassa

Unitat que imparteix: 748 - FIS - Departament de Física.

Titulació: GRAU EN ENGINYERIA EN TECNOLOGIES AEROESPACIALS (Pla 2010). (Assignatura optativa).
GRAU EN ENGINYERIA EN VEHICLES AEROESPACIALS (Pla 2010). (Assignatura optativa).

Curs: 2024

Crèdits ECTS: 3.0

Idiomes: Anglès

PROFESSORAT

Professorat responsable: Alex Ferrer Ferré

Altres:

METODOLOGIES DOCENTS

Each session consists in a theoretical part of 1 hour and a practical part of 1.5 hour. In the practical part, a set of small exercises will be solved and discussed in class to fix the main ideas and concepts of the session, and the take-home assignments will be discussed.

OBJECTIUS D'APRENTATGE DE L'ASSIGNATURA

This course is an introduction to Machine Learning. The main objective is to learn several numerical techniques used in this field. After learning some basics in optimization and statistics, the course will focus on understanding the numerical algorithms used for solving some of the most important problems in Machine Learning: linear regression, logistic regression, clustering, k-means, support vector machine, principal component analysis, EM, neuronal networks and others. Finally, the techniques learned during the course will be applied to some problems that appear in Aeronautical engineering.

HORES TOTS DE DEDICACIÓ DE L'ESTUDIANTAT

Tipus	Hores	Percentatge
Hores grup gran	30,0	40.00
Hores aprenentatge autònom	45,0	60.00

Dedicació total: 75 h

CONTINGUTS

Module 1: Introduction to Machine Learning

Descripció:

1. Introduction to Machine Learning. Basics in Optimization. Basics in Statistics.
2. Basics in Python and Jupyter.

Dedicació: 15h

Grup gran/Teoria: 8h

Aprenentatge autònom: 7h



Module 2: Supervised learning

Descripció:

Introduction. Linear regression. Classification and logistic regression. Naive Bayes. Neural networks. Support vector machine and kernel trick. K-nearest neighbors. Bayes learning: MAP and MLE.

Dedicació: 25h

Grup gran/Teoria: 10h

Aprenentatge autònom: 15h

Module 3: Unsupervised learning

Descripció:

Introduction. Clustering. K-means algorithm. Principal component analysis. EM algorithm. Kernel density estimation. Non-negative matrix factorization. Autoencoders.

Dedicació: 25h

Grup gran/Teoria: 10h

Aprenentatge autònom: 15h

Module 4: Application to Aeronautical Engineering

Descripció:

Aeronautical engineering problems solved by Machine learning algorithms

Dedicació: 10h

Grup gran/Teoria: 2h

Aprenentatge autònom: 8h

SISTEMA DE QUALIFICACIÓ

3 or 4 take-home assignments (50% of the final grade).

1 final project (50% of the final grade).

BIBLIOGRAFIA

Bàsica:

- Goodfellow, Ian, Bengio, Yoshua; Courville, Aaron. Deep learning : adaptive computation and machine learning series [en línia]. Cambridge, Massachusetts: The MIT Press, 2016 [Consulta: 21/10/2024]. Disponible a: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=6287197>. ISBN 9780262035613.
- Boyd, Stephen P; Vandenberghe, Lieven. Convex optimization. Cambridge: Cambridge University Press, 2004. ISBN 9780521833783.
- Nocedal, Jorge; Wright, Stephen J. Numerical optimization [en línia]. 2nd ed. Berlin: Springer, cop. 2006 [Consulta: 24/04/2024]. Disponible a: <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-0-387-40065-5>. ISBN 0387303030.
- Allaire, G. Shape optimization by the homogenization method. New York [etc.]: Springer, cop. 2002. ISBN 0387952985.