

Course guide

310764 - 310764 - Artificial Intelligence in Construction

Last modified: 30/06/2023

Unit in charge: Barcelona School of Building Construction
Teaching unit: 748 - FIS - Department of Physics.
753 - TA - Department of Architectural Technology.
749 - MAT - Department of Mathematics.

Degree: BACHELOR'S DEGREE IN ARCHITECTURAL TECHNOLOGY AND BUILDING CONSTRUCTION (Syllabus 2019).
(Optional subject).

Academic year: 2023 **ECTS Credits:** 3.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: Guillem Grabolosa, Antoni

Others: Martí Muñoz, Jordi

PRIOR SKILLS

No prior programming knowledge is required. At the beginning of the course, a review of specific questions of mathematical foundations is advised: matrix representation, linear systems, elementary derivatives (chain rule) and optimization of functions of one or more variables.

TEACHING METHODOLOGY

In each block of the course, there will be introductory sessions to the subject by the teachers, and practical exercises will be proposed as homework. The other sessions will focus on the analysis of selected publications: students will work in groups and teachers will have a role to support learning. Other sessions will be dedicated to oral presentations by the students.

LEARNING OBJECTIVES OF THE SUBJECT

- Get the knowledge about the main applications of artificial intelligence in the field of building construction.
- Use existing tools to automate or facilitate usual processes of companies in the construction sector.
- Learn to locate and manage the resources needed for the application of artificial intelligence methods, and incorporate them into the execution processes in building construction.
- Understand the basic knowledge of artificial intelligence, as well as the main ideas that govern machine learning algorithms.

STUDY LOAD

Type	Hours	Percentage
Self study	45,0	60.00
Hours large group	30,0	40.00

Total learning time: 75 h

CONTENTS

Artificial intelligence: examples of applications to building construction.

Description:

General view of the subject, with examples of diagnosis of pathologies, valuation of properties, energy efficiency, estimation of construction costs,... which will be discussed along the course.

Specific objectives:

Introduce, through examples, applications of artificial intelligence in the field of construction.

Related activities:

Introductory lectures. Reading of specialized articles.

Full-or-part-time: 4h 30m

Theory classes: 2h

Self study : 2h 30m

Generative artificial intelligence

Description:

Know and use different tools for the generation of texts, images, plans...

Specific objectives:

Know how to write prompts for the generation of quality texts and images.

Understand the benefits of different tools available in the field of generation with artificial intelligence.

Related activities:

We will define different processes of activities in the construction sector and use tools to automate or streamline these processes.

Full-or-part-time: 19h

Theory classes: 3h

Practical classes: 4h 30m

Self study : 11h 30m

Predictive artificial intelligence

Description:

Understand the importance of data collection in any business area and process and automate the interpretation of this data.

Specific objectives:

Learn about the possibilities offered by different tools to develop data collection applications.

Use artificial intelligence to train models and make predictions from a set of data.

Related activities:

Develop a data collection application and use artificial intelligence to analyze that data and make predictions.

Full-or-part-time: 18h 30m

Theory classes: 4h 30m

Practical classes: 3h

Self study : 11h

Idees bàsiques d'aprenentatge automàtic: regressió, xarxes neuronals artificials i altres algorismes.

Description:

Introduction of an overview of supervised learning versus unsupervised learning, and of classification problems versus regression problems.

Study of supervised learning problems using regression methods, both linear and multilinear.

Basic structure of an artificial neural network.

Elementary examples of artificial neural networks.

Analysis of network components in an application to building construction.

Other methods of artificial intelligence: genetic algorithms; unsupervised learning.

Specific objectives:

Distinguish between supervised and unsupervised learning.

Distinguish between classification and regression problems.

Understand the concepts and procedures needed to perform a (multi)linear regression from experimental data: regression model, cost functions, gradient descent method.

State the possibility of other type of regressions.

Understand the basic knowledge of artificial intelligence, as well as the main ideas that govern machine learning algorithms.

Know some relevant algorithms: neural networks, genetic algorithms, simulated annealing, transformers,...

Learn to locate and manage the resources needed for the application of artificial intelligence methods, and incorporate them into the execution processes in building construction.

Related activities:

Exercises to assimilate concepts, reading articles and modifying programming code. The block culminates with a practical application of using software to solve a classification or regression problem, based on data from construction-related problems.

Full-or-part-time: 33h

Theory classes: 5h

Practical classes: 8h

Self study : 20h

GRADING SYSTEM

At the end of the topics "Generative artificial intelligence" and "Predictive artificial intelligence" a deliverable task will be proposed; each of them will be assessed with 25% of the grade of the course. The expected delivery dates are Oct. 23rd and Nov. 20th, respectively.

The evaluation of the block "Basic ideas of automatic learning..." will be done continuously, with (a) the delivery of the resolution of 3 exercises to validate the knowledge acquired, with an assessment, which will count for 7.5%, 7.5% and 10% of the course's grade, respectively; (b) the completion of a mini-project applying artificial intelligence tools to a constructive problem, of which a short report and an oral presentation will be made, which will count for 25% of the mark of the course. The delivery of the 3 validation exercises is planned for Nov. 27th, Dec. 4th and Dec. 18th. The mini-project will be presented in January, on the date set by the center's calendar.

This course does not have a final exam or re-evaluation exam. In the event that a student does not pass the subject once the scheduled assignments have been evaluated, and their grade is between a 3 and a 5 over 10, a new deliverable mini-project will be proposed.

BIBLIOGRAPHY

Basic:

- Núñez Tabales, J. M.; Rey Carmona, F. J.; Caridad y Ocerin, J. M.. "Redes neuronales (RN) aplicadas a la valoración de locales comerciales". Informes de la Construcción [on line]. Available on: <http://dx.doi.org/10.3989/ic.15.053%20>.- Coloma, J. F.; Valverde, L.F.; García, M.. "Estimación de los costes de construcción de viviendas rústicas mediante Redes Neuronales Artificiales". Informes de la Construcción [on line]. Available on: <https://doi.org/10.3989/ic.62206>.- Chávez-Hernández, J. A. ; Recarey, C. A. ; García-Lorenzo, M. M. ; López-Jiménez, O. "Utilización de la Inteligencia Artificial en el diagnóstico patológico de edificaciones de valor patrimonial". Informes de la Construcción [on line]. Available on: <https://doi.org/10.3989/ic.11.036>.- Mehmood, M. U.; Chun, Daye ; Zeeshan, Han, Hyunjoo; Jeon, Gyuyeob; Chen, Kuan. "A review of the applications of artificial intelligence and big data to buildings for energy-efficiency and a comfortable indoor living environment". Energy & Buildings [on line]. Available on: <https://doi.org/10.1016/j.enbuild.2019.109383>.- Pampliega, Carlos J.. "Inteligencia artificial en el sector de la construcción". Building & Management [on line]. [Consultation: 26/07/2023]. Available on: <https://doi.org/10.20868/bma.2019.2.3917>.- Pedro Ponce Cruz. Inteligencia artificial con aplicaciones a la ingeniería [on line]. Alfaomega Grupo Editorial, 2015Available on: http://libroweb.alfaomega.com.mx/book/inteligencia_artificial_con_aplicaciones_a_la_ingenieria. ISBN 978-607-7854-83-8.

RESOURCES

Computer material:

- Matlab. Programming platform.

Hyperlink:

- AI with Matlab. <https://it.mathworks.com/campaigns/offers/ai-with-matlab.html>