Data Modelling

Academic Year: (2023 / 2024) **Review date: 16-12-2023**

Department assigned to the subject: Signal and Communications Theory Department

Coordinating teacher: ARTES RODRIGUEZ, ANTONIO

Type: Electives ECTS Credits : 6.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Linear algebra.
Multivariable calculus.
Statistics.
Introduction to Machine Learning (or similar)

OBJECTIVES

The course provides an introduction to the basics of machine learning from a probabilistic perspective. The aim is to allow the student to develop the ability to design inference and learning models and methods in a Bayesian framework. The course begins with a review of probability, mathematics, and optimisation, followed by a discussion of the most common probabilistic models for discrete and continuous data and then models and methods for sequences. The main techniques of exact and approximate inference using a representation based on graphical models are presented below, including, among others, MCMC and variational inference methods. The course ends with the application of the above to deep generative models.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to probabilistic machine learning.
2. Models for discrete and continuous data.
3. Markovian and state-space models.
4. Graphical models. Exact and approximate inference in graphical models.
5. Deep generative models.

LEARNING ACTIVITIES AND METHODOLOGY

LEARNING ACTIVITIES

AF3 Theoretical, practical classes
AF4 Laboratory practices
AF5 Tutorials
AF6 Teamwork
AF7 Student individual work
AF8 Partial and final exams

METHODOLOGY

MD1: Lectures in a class by the teacher supported by computer and audiovisual media, in which the main concepts of the subject are developed, and a bibliography is provided to complement the student's learning.
MD2: Critical reading of texts recommended by the subject teacher
MD3: Resolution of practical cases, problems, etc., posed by the teacher individually or in groups
MD4: Presentation and discussion in class, under the teacher's moderation, of topics related to the content of the subject, as well as practical cases

MD5: Preparation of work and reports individually or in groups

TUTORING REGIME
There will be 2 hours a week of tutorials for students, and the teacher will be available in his office.

ASSESSMENT SYSTEM

% end-of-term-examination:	0
% of continuous assessment (assigments, laboratory, practicals…):	100

ORDINARY ASSESSMENT
The evaluation of the students will be carried out through continuous evaluation based on the resolution and delivery of brief tasks and individual works or in teams of development of methods of modelling and probabilistic learning, from the approach of the model and the inference to the coding in a language programming and analysis of a set.

SE2 Individual or group work or exams taken during the course: 100%

EXTRAORDINARY ASSESSMENT
The evaluation of the student will be carried out through a final oral evaluation.

SE3 Individual partial and/or final exams

BASIC BIBLIOGRAPHY

- Andrew Gelman et al. Bayesian Data Analysis, CRC Press, 2013

- Christopher M Bishop Patter Recognition and Machine Learning, Springer, 2006

- David JC Mackay Information Theory, Inference and Learning Algorithms, Cambridge University Press, 2006

- Kevin P Murphy Machine Learning. A Probabilistic Perspective, MIT Press, 2003

- Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong Mathematics for Machine Learning, Cambridge University Press, 2019