



Teaching Guide

| Identifying Data | | | | | 2023/24 |
|----------------------------|--|---------------|--|----------------|---------|
| Subject (*) | Analysis Technics and Data Modelling for Efficiency | | Code | 730547020d | |
| Study programme | Máster Universitario en Eficiencia Enerxética e Sustentabilidade (a distancia) | | | | |
| Descriptors | | | | | |
| Cycle | Period | Year | Type | Credits | |
| Official Master's Degree | 2nd four-month period | First | Optional | 3 | |
| Language | SpanishGalician | | | | |
| Teaching method | Non-attendance | | | | |
| Prerequisites | | | | | |
| Department | Ciencias da Computación e Tecnoloxías da InformaciónComputaciónMatemáticas | | | | |
| Coordinador | Fontenla Romero, Oscar | E-mail | oscar.fontenla@udc.es | | |
| Lecturers | Fontenla Romero, Oscar Gómez Rodríguez, Marcos | E-mail | oscar.fontenla@udc.es marcos.gomez.rodriguez@udc.es | | |
| Web | campusvirtual.udc.gal | | | | |
| General description | The main objective of this course is that students learn the fundamental concepts and the main models of data mining, both from a standpoint of machine learning and statistical, and their application in the field of energy efficiency. | | | | |

Study programme competences

| Code | Study programme competences |
|------|---|
| A4 | CE4 - Apply data analysis methods for the creation of efficient energy systems |
| B1 | CB6 - Possess and understand knowledge that provides a foundation or opportunity to be original in the development and/or application of ideas, often in a research context |
| B6 | CG1 - Search and select alternatives considering the best possible solutions |
| B14 | CG9 - Apply knowledge of advanced sciences and technologies to professional or research practice of efficiency |
| C3 | CT3 - Use the basic tools of information and communication technologies (ICT) necessary for the exercise of their profession and for learning throughout their lives |

Learning outcomes

| Learning outcomes | Study programme competences | | |
|---|-----------------------------|------|-----|
| Demonstrate detailed understanding of the main methods of data mining. | AC4 | | |
| Recognize problems that are amenable to energy optimization by using data mining techniques. | | BC14 | |
| Application of classification and regression techniques to data obtained by monitoring critical variables on energy efficiency | AC4 | BC6 | |
| Propose solutions for improving energy efficiency in systems that have operating data provided by different data acquisition systems. | | BC1 | CC3 |
| Knowing tools for dimension reduction | AC4 | | |

Contents

| Topic | Sub-topic |
|--|---|
| 1. Introduction to machine learning and data mining | 1.1. Preliminary concepts 1.2. Exploratory data analysis 1.3. Types of problems: classification, regression, clustering, anomaly detection, etc. 1.4. Types of learning: supervised, unsupervised, reinforcement, etc. |
| 2. Models for supervised and unsupervised classification of data | 2.1. Preliminary concepts 2.2. Main models: k-nearest neighbors, SVMs, clustering, etc. |
| 3. Regression/system identification models for estimation and prediction | 3.1. Preliminary concepts 3.2. Main models |



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| 4. Data processing techniques | 4.1. Data preparation and standardization 4.2. Dimension reduction |
| 5. Experimental methodology and analysis of results | 5.1. Metrics for evaluating the models and techniques for unbiased estimate of the error 5.2. Model selection and analysis of results |
| 6. Statistical Quality Control | 6.1. Control graphs 6.2. Process capacity analysis |
| 7. Applications in Energy Efficiency | 7.1. Examples in forecasting 7.2. Examples for anomaly detection |

| Planning | | | | |
|--------------------------------|--------------|----------------------|-------------------------------|-------------|
| Methodologies / tests | Competencies | Ordinary class hours | Student?s personal work hours | Total hours |
| Guest lecture / keynote speech | B1 B6 | 10 | 20 | 30 |
| Laboratory practice | A4 | 11 | 0 | 11 |
| Supervised projects | A4 B14 C3 | 0 | 30 | 30 |
| Objective test | A4 B1 | 3 | 0 | 3 |
| Personalized attention | | 1 | 0 | 1 |

(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

| Methodologies | |
|--------------------------------|--|
| Methodologies | Description |
| Guest lecture / keynote speech | Classroom activity used to establish the fundamental concepts of matter. It consists of the oral presentation complemented by the use of audiovisual/multimedia media and performing some questions to students in order to transmit knowledge and facilitate learning. |
| Laboratory practice | Development of practices in the computer lab. This will consist of case studies and examples. Besides the students will solve exercises posed by teachers. |
| Supervised projects | Performing work related to any of the topics on the agenda of the subject. Students will deliver them in electronic format, including a memory and a presentation that will have to expose the teacher. These works require the assistance of at least one personal tutoring for each group. |
| Objective test | Evaluation test to be held at the end of course in the corresponding official announcements. It will consist of a written test that will be necessary to respond to different theoretical and practical issues. |

| Personalized attention | |
|------------------------|--|
| Methodologies | Description |
| Supervised projects | The personalized attention will be needed to show the progress of the proposed work and to provide appropriate guidance and ensure quality. It will also be used for solving conceptual questions and monitoring the execution of the work. These tutorials be made in person at the teacher's office. |

| Assessment | | | |
|---------------------|--------------|--|---------------|
| Methodologies | Competencies | Description | Qualification |
| Supervised projects | A4 B14 C3 | Autonomous individual or small group work. It will be necessary to deliver the materials (memory and presentation) in a timely manner as described in the statement. In addition, it will require oral presentation by all members of the working group, using for that presentation delivered. It is taken into account for the evaluation of this activity the memory, the presentation and also the answers to the teacher's questions during compulsory presentation. Omission of the presentation will be a grade of zero in this activity. | 40 |



| | | | |
|----------------|-------|---|----|
| Objective test | A4 B1 | Final test of matter consisting of conducting individual examination. This test will have questions and related theoretical concepts studied in lectures, laboratory practices or content of such practices tutored projects. | 60 |
|----------------|-------|---|----|

Assessment comments

In order to pass the course the student must meet the following requirements (score between 0 and 10 in all activities):-Achieving a grade greater or equal than 3.5 in the objective test conducted at the end of the semester.-Achieving a grade greater or equal than 5 adding of all the grades of the assessment tests.

Notes on activities:

- All activities will have a single opportunity to be submitted during the academic year, except for the final objective test, which will have two official exam opportunities.

The evaluation criteria for the second opportunity will be the same as those for the first opportunity.

Evaluation in the case of the early call:

If student requests and presents himself to the early call, 60% of his grade will be the final exam and the other 40% the supervised work. The tutored work must be delivered as a deadline one week before the date of the official exam in the early call. In order to pass the subject, the student must meet the requirements mentioned above.

Sources of information

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| Basic | - Basilio Sierra Araujo (2006). Aprendizaje Automático: conceptos básicos y avanzados. Pearson Prentice Hall - Douglas Montgomery (2005). Introduction to Statistical Quality Control. John Wiley & Sons - T. Agami Reddy (2011). Applied Data Analysis and Modeling for Energy Engineers and Scientists. Springer |
| Complementary | |

Recommendations

Subjects that it is recommended to have taken before

Subjects that are recommended to be taken simultaneously

Subjects that continue the syllabus

Other comments

To help achieve a sustainable environment and meet the objectives of the "Green Campus Ferrol Action Plan" the delivery of documentary work carried out in this subject:1. It will be requested in virtual format and/or computer support.2. It will be done through Moodle, in digital format without the need to print them.3. If done on paper:- Plastics will not be used.- Double-sided prints will be made.- Recycled paper will be used.- The printing of drafts will be avoidedThe full integration of students who, for physical, sensory, psychological or sociocultural reasons, experience difficulties for an adequate, equal and profitable access to university life will be facilitated.Situations of discrimination based on gender must be detected and actions and measures to correct them will be proposed.

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.