COURSE DATA

Data Subject	
Code	44752
Name	Predictive analytics in health
Cycle	Master's degree
ECTS Credits	8.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
2231 - Master's Degree in Biomedical Engineering	Faculty of Medicine and Odontology	1	First term

Subject-matter

Degree	Subject-matter	Character
2231 - Master's Degree in Biomedical Engineering	2 - Design and analysis of experiments	Obligatory

Coordination

Name	Department
MARTIN GUERRERO, JOSE DAVID	242 - Electronic Engineering
SERRANO LOPEZ, ANTONIO JOSE	242 - Electronic Engineering

SUMMARY

The subject deals with techniques to extract relevant information for clinical decision making, based on clinical data. In particular, methods related to data analysis, machine learning, and decision support tools for classification and prediction are taken into account.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

None special knowledge is required.

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

2231 - Master's Degree in Biomedical Engineering

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Ser capaz de analizar, proponer y construir soluciones a problemas complejos en entornos emergentes y multidisciplinares asociados a la ingeniería biomédica, con una visión global.
- Ser capaz de diseñar y llevar a cabo investigaciones basadas en el análisis, la modelización y la experimentación.
- Ser capaz de aportar ideas y soluciones de amplia originalidad, prácticas y aplicables, flexibles y complejas, que afecten tanto a las personas como a los procesos.
- Ser capaz de aplicar procesos innovadores a la resolución de problemas que conduzcan a la obtención de mejores resultados.
- Ser capaz de elaborar, dirigir y ejecutar proyectos en contextos poco estructurados que satisfagan las exigencias técnicas, de seguridad y medioambientales, ejerciendo liderazgo sobre el proyecto.
- Tener compromiso ético, medioambiental, profesional y social en el desarrollo de soluciones ingenieriles compatibles, sostenibles y en continua sintonía con la realidad del entorno humano y natural.
- Ser capaz de planificar las actividades a desarrollar en un proyecto complejo, definiendo los objetivos y prioridades a alcanzar por los diferentes miembros del equipo de trabajo.
- Saber emplear de forma efectiva la instrumentación y los métodos de observación del área biomédica para el estudio y análisis de los sistemas complejos del área.
- Ser capaz de diseñar, implementar y gestionar experimentos adecuados, analizar sus resultados y sacar conclusiones en el ámbito de la ingeniería biomédica.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

The student will understand the relevant of expert systems in the routine activity of Healthcare. He will know the different kinds of expert systems for each particular environment, as well as their pros/cons when being used in a specific application. The students will know how to develop an expert system that is adequate for the faced problem; they will also get the practical knowledge for that development and an ulterior objective assessment.

DESCRIPTION OF CONTENTS

1. 1-Introduction

1.1 Data in clinical problems
1.2 Big data in clinical problems
1.3 Predictive analytics in clinical problems

2. 2-Bases of predictive analytics

2.1 Kinds of data
2.2 Problems to solve
2.3 Stages in a problem of predictive analytics
2.4 Performance measures
2.5 Model validation
2.6 Freeware tools

3. 3-Exploratory Data Analysis

3.1.Missing data
3.2.Outliers
3.3.Feature selection
3.4.Feature extraction
3.5.Problem characterization: visualization and statistical parameters

4. 4-Clustering

4.1.Definition. Distances
4.2.Basic algorithms: K-Means and Fuzzy C-Means
4.3.Adaptive Resonance Theory
4.4.Self-Organizing Maps
4.5.Hierarchical clustering
4.6.Spectral clustering

5. 5.Classification, modeling and prediction

5.1.Generalized linear models
5.2.Multilayer Perceptron
5.3.Decision trees
5.4.Ensemble methods
5.5.Other problems and techniques

5.6.Current trends

6. Practical exercices

Session 1. Exploratory data analysis in clinical problems
Session 2. Clustering
Session 3. Linear modeling
Session 4. Non-linear modeling

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	60,00	100
Laboratory practices	20,00	100
Development of group work	20,00	0
Study and independent work	10,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	5,00	0
Resolution of case studies	15,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Theoretical classes will be taught mostly on the basis of master lectures. Different audiovisual resources will be available, thus making use of slide presentations and multimedia documents, depending on the topic. Students will have access to all the material before the class. Theoretical classes will also include working on solving practical exercises, fostering an independent student work.

In the practical lessons, students will work either individually, or in couples, on a real clinical problem. Each team will work on a different problem (data set) that will be chosen in the first lab session

Theoretical classes will be taught mostly on the basis of master lectures. Different audiovisual resources will be available, thus making use of slide presentations and multimedia documents, depending on the topic. Students will have access to all the material before the class. Theoretical classes will also include working on solving practical exercises, fostering an independent student work.

In the practical lessons, students will work either individually, or in couples, on a real clinical problem. Each team will work on a different problem (data set) that will be chosen in the first lab session

EVALUATION

- Exam consisting of short questions about theory and simple practical problems (55%)

- Preliminary presentation of the work done on the real medical data set (15%)

- Technical report providing detailed information about the data set, the used methodology, the achieved results and the drawn conclusions. In the case of teams formed by two students, the tasks carried out by each member of the team should clearly be stated (30%).

REFERENCES

Basic

-

Referencia : Introduction to Machine Learning (Ethem Alpaydin;MIT Press, 2014)

Referencia : Practical Predictive Analytics and Decisioning Systems for Medicine: Informatics Accuracy and Cost-Effectiveness for Healthcare Administration and Delivery Including Medical Research (Linda Miner;Academic Press, 2014 1st Edition)

Referencia : Análisis de datos experimentales (E. Soria, J. D. Martín, A. J. Serrano, D. Aguado; UPV, 2007)

Referencia : Pattern Recognition (S. Theodoridis, K. Koutroumbas; Academic Press, 2008)

ADDENDUM COVID-19

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

English version is not available