1. BASIC INFORMATION

Course	DATA VISUALIZATION
Degree program	BACHELOR'S DEGREE IN DATA SCIENCE
School	SCHOOL OF SCIENCES, ENGINEERING AND DESIGN
Year	3º
ECTS	6 ETCS
Credit type	MANDATORY
Language(s)	ENGLISH
Delivery mode	IN PERSON
Semester	6

2. INTRODUCTION

The increasing access we have to information is the force that has driven the development of Machine Learning and Artificial Intelligence, but all the data in the world is useless if it cannot be understood, which is why data visualization is of vital importance in the field of Data Science, since it will allow us to obtain information more effectively. So, if a picture is worth a thousand words, a data visualization is worth at least a million.

Data visualization is a general term that describes any effort to help people understand the importance of data by placing it in a visual context. Patterns, trends, and correlations that can sometimes go unnoticed in data can be more easily exposed and recognized with data visualization libraries.

The current data visualization tools go beyond the graphs and squares that we were used to making in Excel spreadsheets, now the data is displayed in a more sophisticated way as infographics, geographic maps, heat maps, among others. Images may include interactive capabilities, allowing users to manipulate them and drill down into the information displayed there. These same data visualization tools have been very important in democratizing data analysis.

Data visualization is a way of displaying complex data in a way that is graphical and easy to understand. This can be especially useful when one is trying to explore data and become familiar with it.
Plots and charts can be very effective in conveying a clear description of data, especially when disseminating results to an audience or sharing data with other data scientists.

Additionally, they can be invaluable when it comes to backing up any recommendations you make to client managers or other decision-makers in your field.

3. SKILLS AND LEARNING OUTCOMES

Specific competencies

- CE10. Ability to apply Big Data methodologies, architectures, and techniques for effective data management.
- CE11. Ability to apply computational learning techniques to design and implement applications and systems that use them, including those dedicated to the automatic extraction of information and knowledge from large volumes of data.
- CE12. Ability to describe systems interoperability techniques and data integration and aggregation.
- CE13. Ability to design efficient interfaces in the context of Big Data that guarantee accessibility and usability, using graphic and analytical representation techniques.

Core competencies

- CB1: That the students have demonstrated that they possess and understand knowledge in an area of study that starts from the base of general secondary education, and is usually at a level that, although it is supported by advanced textbooks, also includes some aspects that involve insights from the cutting edge of your field of study.
- CB2: That students know how to apply their knowledge to their work or vocation in a professional way and have the skills that are usually demonstrated through the development and defence of arguments and problem solving within their area of study.
- CB3: That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include reflection on relevant issues of a social, scientific or ethical nature.

Cross-curricular competencies

- CT3 - Teamwork: Ability to actively integrate and collaborate with other people, areas and/or organizations to achieve common goals.
- CT5 - Problem analysis and resolution: Being able to critically evaluate information, break down complex situations into their constituent parts, recognize patterns, and consider other alternatives, approaches, and perspectives to find optimal solutions and efficient negotiations.
- CT8. Entrepreneurial spirit: Ability to assume and carry out activities that generate new opportunities, anticipate problems, or imply improvements.

Learning outcomes

- LO1. Use the methodologies, architectures and techniques for the storage and management of large volume databases to solve practical cases.
- LO2. Interpret and apply models and standards in the field of large volume data systems to practical cases.
- LO3. Describe machine learning techniques, select the most appropriate and design a solution to a given problem that uses them.
- LO4. Collect information to analyse trends in the field of Big Data connecting them with real cases and discuss their evolution and future applications.
- LO5. Design, develop and evaluate graphical interfaces for data visualization using specific languages and environments. Propose alternative solutions and decide the most appropriate, prioritizing usability and user experience.
- LO6. Implement computer applications that make use of large-volume databases, including the application of machine learning techniques to obtain models, their visualization, and their interpretation...

Learning outcomes	Competencies
LO1	C10, C11, C13.
LO2	CT5, CB3
LO3	C12
LO4	C10, C11, C12, C13, CT3
LO5	CT3, CB1, CB2, CB3.
LO6	C13

4. CONTENTS

BLOCK 0: INTRODUCTION

BLOCK 1: DATA STORYTELLING

FOCUS 1.1 Data Fundamentals

Basic Principles of Visualization

Types of Data Visualizations

Common Visualization Tools and Software

FOCUS 1.2: Usability and Cognition in Data Visualization

Human Perception and Cognition in Data Visualization

Cognitive Load and Information Processing

Designing User-Friendly Visualizations

Usability Testing and Evaluation

Laws and Standards of UX in Data Visualization

FOCUS 1.3: Web Audits for Enhanced User Experience

Techniques for Web Audits

Integrating UX Principles in Web Development

Accessibility in Web Design

Addressing Common UX Challenges

Case Studies on Successful Web Audits

BLOCK 2: WEB DEVELOPMENT

FOCUS 2.1: HTML and Web Development

Introduction to HTML (Hypertext Markup Language)

HTML Elements, Tags, and Document Structure

Integrating HTML with Data Visualization

Basics of Web Development

Building Interactive Web Applications with HTML

FOCUS 2.2: XML, CSS, JS, Vue.js Integration for Enhanced Visualizations

Introduction to XML (eXtensible Markup Language)

Styling with CSS (Cascading Style Sheets)

Interactive Data Visualization with JavaScript

Integrating XML, CSS, JS, and Vue.js for Enhanced Visualizations

Project Work and Application of Web Technologies

FOCUS 2.3: Introduction to Front-End Frameworks (Vue.js)

Overview of Front-End Frameworks

Introduction to Vue.js

Integrating Vue.js in Data Visualization

Building Interactive Web Applications with Vue.js

Hands-on Exercises with Vue.js

BLOCK 3: TOOLS AND LIBRARIES FOR DATA VISUALIZATION

FOCUS 3.1: Interactive Python Libraries

Bokeh

Plotly & Plotly Dash

FOCUS 3.2: Geolocation Systems and Python Libraries

Basics of Geospatial Data & Introduction to Geolocation Systems

Python Libraries for Geospatial Data Analysis (e.g., GeoPandas, Folium)

FOCUS 3.3: Tools for Generating Scorecards and Business Decision Support Systems

Understanding Scorecards and Decision Support Systems

Tool for Creating Scorecards (Power BI)

Integration of Data Visualization in Business Decision Making

Ethical Considerations in Decision Support Systems

BLOCK 4: User Experience in Mobile and Web Environments

Principles of User Experience (UX) Design

Mobile and Web Interface Design

Responsive Design for Visualizations

User Interaction and Engagement

Evaluating and Improving UX in Data Visualizations

5. TEACHING-LEARNING METHODOLOGIES

Cooperative learning: students learn to collaborate with other people (colleagues and teachers) to solve in a creative, inclusive, and constructive way the questions and problems identified from the cases raised, using the knowledge and material resources available.

Problem-based learning: Problems will be raised with the objective that students solve them working as a team or individually.

Master Class: presentations made by the teacher with the necessary technological tools for the maximum understanding of the concepts taught.

Directed academic activities: more autonomous, individual and group work, with search for information, written synthesis and debates and public defence of works.

6. LEARNING ACTIVITIES

Below, the types of training activities that will be carried out and the student's dedication in hours to each of them are identified:

IN-PERSON MODALITY

Learning activity	Number of hours
Master classes	20 h
Problem solving / case study	12 h
Seminars, debates, dialogues	12 h
Laboratory practices	40 h
Apprenticeship contract	2 h
Autonomous work	68 h
Personal tutorials	6 h
TOTAL	**150h**

7. ASSESSMENT

The assessment systems are listed below, as well as their weight on the total grade of the subject:

Assessment	Weight
Face-to-face to assess theorical/practical content objectives (objective multiple-choice test, written presentations, oral presentations, case studies /problem solving, debates, simulation tests)	60%
Non-contact tests to evaluate theorical/practical content objectives (case study/problem solving)	25%
Tests to assess attitudes (attitudinal assessment)	10%
Self-assessment and co-assessment tests (learning contract, learning objetctives)	5%

In the Virtual Campus, when you access the subject, you will be able to consult in detail the evaluation activities that you must carry out, as well as the delivery dates and the evaluation procedures for each one of them.

7.1. First exam period

To pass the course in ordinary call you must obtain a grade greater than or equal to 5.0 out of 10.0 in the final grade (weighted average) of the course.

In any case, it will be necessary for you to obtain a grade greater than or equal to 5.0 in the final test, so that it can be averaged with the rest of the activities.

7.2. Second exam period

To pass the course in extraordinary call you must obtain a grade greater than or equal to 5.0 out of 10.0 in the final grade (weighted average) of the course.

In any case, it will be necessary for you to obtain a grade greater than or equal to 5.0 in the final test, so that it can be averaged with the rest of the activities.

The activities not passed in ordinary call must be delivered, after having received the corrections corresponding to them by the teacher, or those that were not delivered.

8. BIBLIOGRAPHY

- Data visualization a successful design process; a structured design approach to equip you with the knowledge of how to successfully accomplish any data visualization challenge efficiently and effectively. Andy Kirk. (2012). Birmingham, UK : Packt Pub

- Data visualization: a guide to visual storytelling for libraries. Lauren Magnuson. (2016). Rowman & Littlefield.

- Data visualization: a practical introduction. Kieran Healy. (2019). Princeton University Press.
- Data visualization for dummies. Mico Yuk and Stephanie Diamond. (2014). John Wiley & Sons Incorporation.
- Hands-on data visualization with bokeh: interactive web plotting for python using bokeh. Kevin Jolly. (2018). Pack Pub.
- Python data visualization cookbook. Igor Milovanović. (2013). Pack Pub.