



# Course guide

## 270969 - VD - Data Visualization

Last modified: 30/01/2026

**Unit in charge:** Barcelona School of Informatics  
**Teaching unit:** 723 - CS - Department of Computer Science.

**Degree:** MASTER'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2012). (Optional subject).  
MASTER'S DEGREE IN INNOVATION AND RESEARCH IN INFORMATICS (Syllabus 2012). (Optional subject).  
MASTER'S DEGREE IN DATA SCIENCE (Syllabus 2021). (Optional subject).

**Academic year:** 2025    **ECTS Credits:** 6.0    **Languages:** English

### LECTURER

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**Coordinating lecturer:**

**Others:**

### PRIOR SKILLS

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Students should have a basic knowledge of statistics and eventually computer graphics. They should also be able to program in some general programming language, preferably Python.

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

CE11. Analyze and extract knowledge from unstructured information using natural language processing techniques, text and image mining  
CE5. Model, design, and implement complex data systems, including data visualization

**Generical:**

CG2. Identify and apply methods of data analysis, knowledge extraction and visualization for data collected in disparate formats

**Transversal:**

CT4. INFORMATION LITERACY: Capacity for managing the acquisition, the structuring, analysis and visualization of data and information in the field of specialisation, and for critically assessing the results of this management.

**Basic:**

CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.  
CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.  
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

### TEACHING METHODOLOGY

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The subject will be taught with theoretical content and problems that will be raised during the development of the theoretical classes and more technical content taught in the laboratory classes. In the laboratories, you will start by solving simple visualization exercises and then you will move on to developing a project in two stages. In a first stage, a static multi-view visualization will be performed and in a second stage, interaction and more complex visualization elements will be added.



## LEARNING OBJECTIVES OF THE SUBJECT

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- 1.Introduction to Visualization
- 2.Perception
- 3.Basic data visualization techniques
- 4.Advanced visualization techniques
- 5.Geospatial visualization
- 6.Implementation of data visualization systems
- 7.Trees and graphs visualization
- 8.Time-oriented visualization
- 9.Text visualization
- 11.Multiple Views
- 12.Advanced visualization concepts

## STUDY LOAD

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Type	Hours	Percentage
Self study	96,0	64.00
Hours small group	27,0	18.00
Hours large group	27,0	18.00

**Total learning time:** 150 h

## CONTENTS

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### Visualization 101

**Description:**

This section will introduce the most important visualization concepts, some bad practices will be described. The history of the display will also be discussed.

### Data visualization idioms

**Description:**

This topic will show the most basic data visualization techniques and also present some more advanced techniques for visualizing complex data, such as multi-variable visualization or geospatial visualization.

### Perception

**Description:**

The basic operation of the visual perception system will be explained. Some important concepts such as attentional variables, the importance of color, and the most important principles of perception will also be described. It will also describe which visual variables are perceived more carefully than others.

### Multiple view design

**Description:**

To represent highly complex information, it is very common to need multiple variables and views. This section will cover how to design complex systems using multiple views: how to organize views, separate data, and how to create linked interactions.



### Implementation of data visualization applications

**Description:**

There are many tools and technologies developed that allow the programming of data visualization systems. There are tools that do not require any programming such as Tableau, Vega, Lyra or that provide more control over the result using programming languages and libraries such as Altair for Python, Matplotlib for R, or D3 for JavaScript. The aim of this topic is for students to be able to assess the needs of a project in order to be able to choose the right tool. In addition, it will also be essential for students to learn how to make interactive data visualization applications using a modern library, such as Altair or Vega.

### Visualization for specialized data

**Description:**

This section will deal with data that have a specific nature, such as geospatial data, temporal data, textual data, etc.

### Advanced concepts

**Description:**

In this section, we will deal with advanced visualization concepts, that may include areas such as the visualization of scientific data, dimensionality reduction algorithms, etc.

## ACTIVITIES

### Introduction to visualization and data visualization systems

**Description:**

Topic development: Introduction to visualization

**Specific objectives:**

1

**Related competencies :**

CG2. Identify and apply methods of data analysis, knowledge extraction and visualization for data collected in disparate formats

CE5. Model, design, and implement complex data systems, including data visualization

CE11. Analyze and extract knowledge from unstructured information using natural language processing techniques, text and image mining

CT4. INFORMATION LITERACY: Capacity for managing the acquisition, the structuring, analysis and visualization of data and information in the field of specialisation, and for critically assessing the results of this management.

CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.

CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

**Full-or-part-time:** 8h

Theory classes: 3h

Practical classes: 1h

Laboratory classes: 2h

Self study: 2h



## Visualization techniques

### Description:

Topic development: Visual representations of data. Basic visualization techniques. Advanced visualization techniques.

### Specific objectives:

3, 4

### Related competencies :

CG2. Identify and apply methods of data analysis, knowledge extraction and visualization for data collected in disparate formats

CE5. Model, design, and implement complex data systems, including data visualization

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### Full-or-part-time: 12h

Theory classes: 3h

Practical classes: 1h

Laboratory classes: 2h

Self study: 6h

## Perception

### Description:

Topic development: perception and color.

Ranking of visual variables.

Concepts of perception: preattentive variables.

Principles of perception.

Marks and channels.

Use of color and color palettes.

### Specific objectives:

2

### Related competencies :

CE5. Model, design, and implement complex data systems, including data visualization

CE11. Analyze and extract knowledge from unstructured information using natural language processing techniques, text and image mining

CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.

CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

### Full-or-part-time: 8h

Theory classes: 3h

Practical classes: 1h

Laboratory classes: 2h

Self study: 2h

### Techniques for specialized data visualization

**Description:**

This section will deal with the specific types of data: geospatial data, text, etc., which are particular because of the way the data is represented, and the techniques required for its visualization.

**Specific objectives:**

5, 7, 8, 9

**Related competencies :**

CG2. Identify and apply methods of data analysis, knowledge extraction and visualization for data collected in disparate formats

CE5. Model, design, and implement complex data systems, including data visualization

CE11. Analyze and extract knowledge from unstructured information using natural language processing techniques, text and image mining

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**Full-or-part-time:** 12h

Theory classes: 6h

Practical classes: 2h

Self study: 4h

### Multiple view design

**Description:**

Development of the topic: Design of multiple views. Organization of multiple views. Coordinated views. Interaction. Exploratory data analysis.

**Specific objectives:**

11

**Related competencies :**

CG2. Identify and apply methods of data analysis, knowledge extraction and visualization for data collected in disparate formats

CE5. Model, design, and implement complex data systems, including data visualization

CE11. Analyze and extract knowledge from unstructured information using natural language processing techniques, text and image mining

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**Full-or-part-time:** 12h

Theory classes: 1h 30m

Practical classes: 0h 30m

Self study: 10h



### Advanced visualization concepts

**Description:**

In this section, advanced concepts will be introduced, such as dimensionality reduction algorithms, visualization of scientific data, etc.

**Specific objectives:**

12

**Related competencies :**

CG2. Identify and apply methods of data analysis, knowledge extraction and visualization for data collected in disparate formats

CE5. Model, design, and implement complex data systems, including data visualization

CE11. Analyze and extract knowledge from unstructured information using natural language processing techniques, text and image mining

CT4. INFORMATION LITERACY: Capacity for managing the acquisition, the structuring, analysis and visualization of data and information in the field of specialisation, and for critically assessing the results of this management.

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**Full-or-part-time:** 2h

Theory classes: 1h 30m

Practical classes: 0h 30m

### Implementation of data visualization applications.

**Description:**

Learning a data visualization tool or library. Data visualization project.

**Specific objectives:**

1, 2, 3, 4, 5, 6, 8, 11

**Related competencies :**

CG2. Identify and apply methods of data analysis, knowledge extraction and visualization for data collected in disparate formats

CE5. Model, design, and implement complex data systems, including data visualization

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**Full-or-part-time:** 72h

Laboratory classes: 18h

Guided activities: 1h

Self study: 53h



### Lab1 delivery

**Description:**

Delivery of the first part of the project: Static visualization

**Specific objectives:**

1, 2, 3, 5, 6

**Related competencies :**

CG2. Identify and apply methods of data analysis, knowledge extraction and visualization for data collected in disparate formats

CE5. Model, design, and implement complex data systems, including data visualization

CE11. Analyze and extract knowledge from unstructured information using natural language processing techniques, text and image mining

CT4. INFORMATION LITERACY: Capacity for managing the acquisition, the structuring, analysis and visualization of data and information in the field of specialisation, and for critically assessing the results of this management.

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CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

**Full-or-part-time:** 6h

Self study: 6h

### Lab2 delivery

**Description:**

Delivery of the second part of the project: Lab2

**Specific objectives:**

1, 2, 3, 4, 5, 6, 7, 8, 9, 11

**Related competencies :**

CG2. Identify and apply methods of data analysis, knowledge extraction and visualization for data collected in disparate formats

CE5. Model, design, and implement complex data systems, including data visualization

CE11. Analyze and extract knowledge from unstructured information using natural language processing techniques, text and image mining

CT4. INFORMATION LITERACY: Capacity for managing the acquisition, the structuring, analysis and visualization of data and information in the field of specialisation, and for critically assessing the results of this management.

CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.

CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

**Full-or-part-time:** 6h

Self study: 6h



### Final exam

**Description:**

There will be a final test to demonstrate the knowledge acquired in the subject.

**Specific objectives:**

1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12

**Related competencies :**

CG2. Identify and apply methods of data analysis, knowledge extraction and visualization for data collected in disparate formats

CE5. Model, design, and implement complex data systems, including data visualization

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**Full-or-part-time:** 10h

Guided activities: 2h

Self study: 8h

### Mid term exam

**Description:**

Mid term exam

**Specific objectives:**

1, 2, 3, 4, 5, 6

**Related competencies :**

CG2. Identify and apply methods of data analysis, knowledge extraction and visualization for data collected in disparate formats

CE5. Model, design, and implement complex data systems, including data visualization

CE11. Analyze and extract knowledge from unstructured information using natural language processing techniques, text and image mining

CT4. INFORMATION LITERACY: Capacity for managing the acquisition, the structuring, analysis and visualization of data and information in the field of specialisation, and for critically assessing the results of this management.

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CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

**Full-or-part-time:** 6h

Guided activities: 2h

Self study: 4h



## GRADING SYSTEM

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The subject will be evaluated with a project that will have two deliveries, a midterm exam (MidTerm), and a final exam (FinalExam). The first installment will be a static display (Lab1) and the second will be an interactive display (Lab2). The final grade will be:  $NF = 0.15 * Lab1 + 0.25 * Lab2 + 0.2 * MidTerm + 0.4 * FinalExam$

## BIBLIOGRAPHY

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### Basic:

- Vázquez, P. P. Data visualization with Vega-Altair 5 [on line]. Primera edició. Barcelona: Iniciativa Digital Politècnica, Oficina de Publicacions Acadèmiques Digitals de la UPC, 2024 [Consultation: 17/02/2026]. Available on: <https://hdl.handle.net/2117/416815>. ISBN 9788410008892.
- Knaflic, Cole Nussbaumer. Storytelling with data : a data visualization guide for business professionals. Hoboken, New Jersey: John Wiley & Sons, Inc, 2015. ISBN 9781119002062.