

## Course guide

### 270219 - VI - Information Visualization

Last modified: 11/07/2024

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

**Degree:** BACHELOR'S DEGREE IN DATA SCIENCE AND ENGINEERING (Syllabus 2017). (Compulsory subject).

**Academic year:** 2024    **ECTS Credits:** 6.0    **Languages:** English

#### LECTURER

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**Coordinating lecturer:** PERE PAU VÁZQUEZ ALCOCER

**Others:** Primer quadrimestre:  
OSCAR ARGUDO MEDRANO - 11, 13  
IMANOL MUÑOZ PANDIELLA - 11, 12  
PERE PAU VÁZQUEZ ALCOCER - 11, 12, 13

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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##### Specific:

CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.

CE10. Visualization of information to facilitate the exploration and analysis of data, including the choice of adequate representation of these and the use of dimensionality reduction techniques.

CE4. Use current computer systems, including high performance systems, for the process of large volumes of data from the knowledge of its structure, operation and particularities.

CE5. Design and apply techniques of signal processing, choosing between different technological tools, including those of Artificial vision, speech recognition and multimedia data processing.

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

##### Generical:

CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.

##### Transversal:

CT3. Efficient oral and written communication. Communicate in an oral and written way with other people about the results of learning, thinking and decision making; Participate in debates on topics of the specialty itself.

CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.

CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

##### Basic:

CB3. That students have the ability to gather and interpret relevant data (usually within their area of ??study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.

## TEACHING METHODOLOGY

Classes will be given with the support of slides and articles.  
During the classes, exercises will be proposed and resolved.

For the laboratory part, directed practices will be developed in the laboratory hours.

There will be a partial delivery of laboratory and a final project.

## LEARNING OBJECTIVES OF THE SUBJECT

- 1.Introduction to Information Visualization
- 2.Introducción a la percepción visual
- 3.Exploratory data analysis
- 4.Design of information visualization systems
- 5.Focus and context
- 6.Interaction and animation
- 7.Visualization of multi-dimensional data
- 8.Multiple views and coordinated views
- 9.Item and attributes reduction
- 10.Validation of visualization systems
- 11.Implementation of visualization applications
- 12.Advanced visualization tècniques

## STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours small group	30,0	20.00
Self study	90,0	60.00

**Total learning time:** 150 h

## CONTENTS

### Introduction to visualization

#### Description:

In this topic we will discuss the need for visualization of data and the objectives of the visualization tools.

### Perception and color

#### Description:

Visual perception is a very important factor when creating visualizations, since the visual system is the one that receives the greatest amount of information that we perceive. In this topic we will talk about the visual system, and some theories of the perception of color and forms.

### Visual representations of the data

#### Description:

There are a large number of methods of data representation: tables, graphs, trees, etc. In this topic we will visit them and we will end up giving some guides to select the most appropriate representation for each problem.

### Visualization of multiple data

**Description:**

In many cases, the information that we want to represent will be highly complex and we will often find ourselves in the situation of having to represent multiple variables. Here we will discuss different possibilities that will be detailed in later issues.

### Animation and interaction

**Description:**

To explore the data, you must be able to work on visual representations. This topic will see data changes in different dimensions: time, point of view ...

### View manipulation

**Description:**

To explore the data, you must be able to work on visual representations. In this section you will see changes of data in different dimensions: time, point of view ...

### Advanced data representation systems

**Description:**

Advanced data representation systems

- Maps
- Time display
- Visualization of 3D data
- Other scientific data

### Implementation of information visualization applications

**Description:**

There are many tools and technologies developed recently that make creating views easier, such as Tableau, Vega, Lyra or using programming languages and libraries such as D3 for JavaScript or Bokeh for Python. The objective of this subject is that students are able to perform visualization applications using some of the most modern tools.

## ACTIVITIES

### Introduction to data visualization systems

**Description:**

Development of the theme: Introduction to visualization

**Specific objectives:**

1, 4

**Related competencies :**

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CT3. Efficient oral and written communication. Communicate in an oral and written way with other people about the results of learning, thinking and decision making; Participate in debates on topics of the specialty itself.

**Full-or-part-time: 5h**

Self study: 1h

Theory classes: 1h 30m

Practical classes: 0h 30m

Laboratory classes: 2h

## Color and perception

### Description:

Development of the subject: perception and color

Ranking of Mackinlay

Pre-attentive care

Type of dimensions

Principles of perception

Brands and channels

Color

### Specific objectives:

2, 3, 4

### Related competencies :

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

Self study: 2h

Theory classes: 3h

Practical classes: 1h

## Design of information visualization systems

### Description:

Development of topic 3: Design of information visualization systems

### Specific objectives:

3, 4, 7

### Related competencies :

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CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.

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CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.

CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

### Full-or-part-time: 7h

Self study: 3h

Theory classes: 2h 30m

Practical classes: 1h 30m

## Exploratory data analysis

### Description:

Development of the subject: Exploratory data analysis

### Specific objectives:

4, 6, 7

### Related competencies :

CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

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CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

**Full-or-part-time:** 3h 30m

Self study: 2h

Theory classes: 1h

Practical classes: 0h 30m

## Exploratory data analysis

### Description:

Development of the theme: Multi-dimensional view

Multiple brands and channels

Complex diagrams: Trellis, SPLOM, PCP

Views

### Specific objectives:

2, 3, 4, 6, 7

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CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

### Full-or-part-time: 4h

Self study: 2h

Theory classes: 1h 30m

Practical classes: 0h 30m

### Design of views in a commercial tool such as QlikView

**Description:**

Design of views in a commercial tool such as QlikView

**Specific objectives:**

3, 7, 11

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CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

**Full-or-part-time:** 14h

Self study: 6h

Guided activities: 2h

Laboratory classes: 6h

## Interaction and animation

### Description:

Development of the theme: Interaction and animation

### Specific objectives:

3, 4, 5, 8

### Related competencies :

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

Self study: 2h

Theory classes: 3h

Practical classes: 1h

## View manipulation

### Description:

Development of the theme: View manipulation

### Specific objectives:

5, 6, 7, 8

### Related competencies :

CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

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CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

### Full-or-part-time: 4h

Self study: 2h

Theory classes: 1h 30m

Practical classes: 0h 30m

## Focus + context

### Description:

Techniques of focus and context of the data:

- Delete information
- Superimposition of information
- Distortion

### Specific objectives:

2, 4, 5, 8

### Related competencies :

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### Full-or-part-time: 4h

Self study: 2h

Theory classes: 1h 30m

Practical classes: 0h 30m

## Data reduction

### Description:

Development of the subject: Data reduction

### Specific objectives:

4, 5, 7, 9, 10

### Related competencies :

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CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

### Full-or-part-time: 3h

Self study: 2h

Theory classes: 1h

## Advanced data representation systems

### Description:

Advanced data representation systems

- Maps
- Time display
- Visualization of 3D data
- Other scientific data

### Specific objectives:

3, 4, 7, 12

### Related competencies :

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### Full-or-part-time: 7h

Self study: 3h

Theory classes: 3h

Practical classes: 1h

## Validation of information visualization systems

### Description:

Evaluation and validation of data visualization systems

### Specific objectives:

3, 4, 10

### Related competencies :

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### Full-or-part-time: 3h

Self study: 1h

Theory classes: 1h 30m

Practical classes: 0h 30m

## Partial exam

### Description:

Partial exam

### Specific objectives:

2, 3, 4, 6, 7, 8

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CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

**Full-or-part-time:** 5h 30m

Self study: 4h

Guided activities: 1h 30m

## Lab project

### Description:

Lab project

### Specific objectives:

3, 4, 11

### Related competencies :

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

Self study: 4h

Guided activities: 2h

### Implementation of information visualization applications

**Description:**

Implementation of information visualization applications

**Specific objectives:**

3, 4, 7, 11

**Related competencies :**

CB3. That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.

CE10. Visualization of information to facilitate the exploration and analysis of data, including the choice of adequate representation of these and the use of dimensionality reduction techniques.

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.

CE4. Use current computer systems, including high performance systems, for the process of large volumes of data from the knowledge of its structure, operation and particularities.

CE5. Design and apply techniques of signal processing, choosing between different technological tools, including those of Artificial vision, speech recognition and multimedia data processing.

CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.

CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

CT3. Efficient oral and written communication. Communicate in an oral and written way with other people about the results of learning, thinking and decision making; Participate in debates on topics of the specialty itself.

CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.

CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

**Full-or-part-time:** 44h

Self study: 20h

Guided activities: 2h

Laboratory classes: 22h

## Final exam

### Description:

Final exam

### Specific objectives:

2, 3, 4, 5, 6, 7, 8, 9, 10

### Related competencies :

CB3. That students have the ability to gather and interpret relevant data (usually within their area of ??study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.

CE10. Visualization of information to facilitate the exploration and analysis of data, including the choice of adequate representation of these and the use of dimensionality reduction techniques.

CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.

CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.

CE4. Use current computer systems, including high performance systems, for the process of large volumes of data from the knowledge of its structure, operation and particularities.

CE5. Design and apply techniques of signal processing, choosing between different technological tools, including those of Artificial vision, speech recognition and multimedia data processing.

CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.

CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

CT3. Efficient oral and written communication. Communicate in an oral and written way with other people about the results of learning, thinking and decision making; Participate in debates on topics of the specialty itself.

CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.

CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

### Full-or-part-time: 4h

Self study: 4h

## GRADING SYSTEM

During the course there will be two laboratory practices (Labo1 and Labo2). In addition, there will be a partial exam (Partial) and a final exam (Final).

The final grade is calculated as:

Final Note = 0.15 Labo1 + 0.3 Labo2 + max(0.15 Partial + .4 Final, 0.55 Final)

The re-evaluation exam substitutes the theoretical contents, not the lab part.

## BIBLIOGRAPHY

### Basic:

- Munzner, Tamara. Visualization analysis and design [on line]. Boca Raton: CRC Press, Taylor & Francis Group, 2015 [Consultation: 05/03/2025]. Available on:

<https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=1664615>. ISBN 9781466508934.

- Few, S. Show me the numbers: designing tables and graphs to enlighten. 2nd ed. Burlingame, Calif: Analytics Press, 2012. ISBN 9780970601971.