Course guide
270219 - VI - Information Visualization

Last modified: 10/07/2025

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

LECTURER

Coordinating lecturer: PERE PAU VÁZQUEZ ALCOCER

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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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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.
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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.

Full-or-part-time: 5h
Theory classes: 1h 30m
Practical classes: 0h 30m
Laboratory classes: 2h
Self study: 1h

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 :
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.
CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.
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Full-or-part-time: 6h
Theory classes: 3h
Practical classes: 1h
Self study: 2h

Design of information visualization systems

Description:
Development of topic 3: Design of information visualization systems

Specific objectives:
3, 4, 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.
CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.
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.
CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.
CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.
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.
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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
Theory classes: 2h 30m
Practical classes: 1h 30m
Self study: 3h

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.
CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.
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.
CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.
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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
Theory classes: 1h
Practical classes: 0h 30m
Self study: 2h

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

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.
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.
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: 4h
Theory classes: 1h 30m
Practical classes: 0h 30m
Self study: 2h

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

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.
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.
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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
Laboratory classes: 6h
Guided activities: 2h
Self study: 6h

Interaction and animation

Description:
Development of the theme: Interaction and animation

Specific objectives:
3, 4, 5, 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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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.

Full-or-part-time: 6h
Theory classes: 3h
Practical classes: 1h
Self study: 2h

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.
CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.
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.
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: 4h
Theory classes: 1h 30m
Practical classes: 0h 30m
Self study: 2h

Focus + context

Description:
Techniques of focus and context of the data:
- Delete information
- Superimposition of information
- Distortion

Specific objectives:
2, 4, 5, 8

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Full-or-part-time: 4h
Theory classes: 1h 30m
Practical classes: 0h 30m
Self study: 2h

Data reduction

Description:
Development of the subject: Data reduction

Specific objectives:
4, 5, 7, 9, 10

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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
Theory classes: 1h
Self study: 2h

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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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
Theory classes: 3h
Practical classes: 1h
Self study: 3h

Validation of information visualization systems

Description:
Evaluation and validation of data visualization systems

Specific objectives:
3, 4, 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.
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Full-or-part-time: 3h
Theory classes: 1h 30m
Practical classes: 0h 30m
Self study: 1h

Partial exam

Description:
Partial exam

Specific objectives:
2, 3, 4, 6, 7, 8

Related competencies :
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CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.
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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
Guided activities: 1h 30m
Self study: 4h

Lab project

Description:
Lab project

Specific objectives:
3, 4, 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.
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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: 6h
Guided activities: 2h
Self study: 4h

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.
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.
CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.
CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.
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.
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
Laboratory classes: 22h
Guided activities: 2h
Self study: 20h

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.
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.
CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.
CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.
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.
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.
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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.
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. Boca Raton: CRC Press, Taylor & Francis Group, 2015. ISBN 9781466508934.
- Few, S. Show me the numbers: designing tables and graphs to enlighten. 2nd ed. Burlingame, Calif: Analytics Press, 2012. ISBN 9780970601971.