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270219 - VI - Information Visualization

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 723 - CS - Department of Computer Science
Academic year: 2019
Degree: BACHELOR'S DEGREE IN DATA SCIENCE AND ENGINEERING (Syllabus 2017). (Teaching unit Compulsory)
ECTS credits: 6 Teaching languages: Catalan, English

Degree competences to which the subject contributes

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.

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

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

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

Study load

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours small group:	30h	20.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

Introduction to visualization

Degree competences to which the content contributes:

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

Perception and color

Degree competences to which the content contributes:

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

Degree competences to which the content contributes:

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

Degree competences to which the content contributes:

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

Degree competences to which the content contributes:

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

Degree competences to which the content contributes:

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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

Degree competences to which the content contributes:

Description:
Advanced data representation systems

- Maps

- Time display

- Visualization of 3D data

- Other scientific data

Implementation of information visualization applications

Degree competences to which the content contributes:

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.

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Planning of activities

Introduction to data visualization systems	Hours: 5h Theory classes: 1h 30m Practical classes: 0h 30m Laboratory classes: 2h Guided activities: 0h Self study: 1h

Description:
Development of the theme: Introduction to visualization

Specific objectives:
1, 3

Color and perception	Hours: 6h Theory classes: 3h Practical classes: 1h Laboratory classes: 0h Guided activities: 0h Self study: 2h

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

Design of information visualization systems	Hours: 7h Theory classes: 2h 30m Practical classes: 1h 30m Laboratory classes: 0h Guided activities: 0h Self study: 3h

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

Specific objectives:
3, 4, 5

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Exploratory data analysis	Hours: 3h 30m Theory classes: 1h Practical classes: 0h 30m Laboratory classes: 0h Guided activities: 0h Self study: 2h

Description:
Development of the subject: Exploratory data analysis

Specific objectives:
3, 5, 6

Exploratory data analysis	Hours: 4h Theory classes: 1h 30m Practical classes: 0h 30m Laboratory classes: 0h Guided activities: 0h Self study: 2h

Description:
Development of the theme: Multi-dimensional view
Multiple brands and channels
Complex diagrams: Trellis, SPLOM, PCP
Views

Specific objectives:
2, 3, 4, 5, 6

Design of views in a commercial tool such as QlikView	Hours: 14h Theory classes: 0h Practical classes: 0h Laboratory classes: 6h Guided activities: 2h Self study: 6h

Description:
Design of views in a commercial tool such as QlikView

Specific objectives:
4, 5, 11

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Interaction and animation	Hours: 6h Theory classes: 3h Practical classes: 1h Laboratory classes: 0h Guided activities: 0h Self study: 2h

Description:
Development of the theme: Interaction and animation

Specific objectives:
3, 4, 7, 8

View manipulation	Hours: 4h Theory classes: 1h 30m Practical classes: 0h 30m Laboratory classes: 0h Guided activities: 0h Self study: 2h

Description:
Development of the theme: View manipulation

Specific objectives:
5, 6, 7, 8

Focus + context	Hours: 4h Theory classes: 1h 30m Practical classes: 0h 30m Laboratory classes: 0h Guided activities: 0h Self study: 2h

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

Specific objectives:
2, 3, 7, 8

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Data reduction	Hours: 3h Theory classes: 1h Practical classes: 0h Laboratory classes: 0h Guided activities: 0h Self study: 2h

Description:
Development of the subject: Data reduction

Specific objectives:
3, 5, 8, 9, 10

Advanced data representation systems	Hours: 7h Theory classes: 3h Practical classes: 1h Laboratory classes: 0h Guided activities: 0h Self study: 3h

Description:
Advanced data representation systems

- Maps

- Time display

- Visualization of 3D data

- Other scientific data

Specific objectives:
3, 4, 5, 12

Validation of information visualization systems	Hours: 3h Theory classes: 1h 30m Practical classes: 0h 30m Laboratory classes: 0h Guided activities: 0h Self study: 1h

Description:
Evaluation and validation of data visualization systems

Specific objectives:
3, 4, 10

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Partial exam	Hours: 5h 30m Guided activities: 1h 30m Self study: 4h
Description: Partial exam Specific objectives: 2, 3, 4, 5, 6, 7	

Lab project	Hours: 6h Guided activities: 2h Self study: 4h
Description: Lab project Specific objectives: 3, 4, 11	

Implementation of information visualization applications	Hours: 44h Theory classes: 0h Practical classes: 0h Laboratory classes: 22h Guided activities: 2h Self study: 20h
Description: Implementation of information visualization applications Specific objectives: 3, 4, 5, 11	

Final exam	Hours: 4h Guided activities: 0h Self study: 4h
Description: Final exam Specific objectives: 2, 3, 4, 5, 6, 7, 8, 9, 10	

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Qualification 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 0.15 + max(0.15 Partial + .4 Final, 0.55 Final)

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

Bibliography

Basic:

Munzner, T. Visualization analysis and design [on line]. Boca Raton: CRC Press, Taylor & Francis Group, 2015 [Consultation: 04/09/2019]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=1664615>. ISBN 9781466508934.

Few, S. Show me the numbers: designing tables and graphs to enlighten. 2nd ed. Burlingame, Calif: Analytics Press, 2012. ISBN 0970601972.