Teaching guide

Subject identification

Subject	11017 - Information Theory
Credits	0.75 de presencials (18.75 hours) 2.25 de no presencials (56.25 hours) 3 de totals (75 hours).
Group	Group 1, 2S
Teaching period	Second semester
Teaching language	English

Professors

Lecturers	Horari d'atenció als alumnes					
	Starting time	Finishing time	Day	Start date	Finish date	Office
David Sánchez Martín david.sanchez@uib.es	14:00	15:00	Monday	12/09/2016	09/06/2017	Despatx 205 (IFISC)

Contextualisation

COURSE:

The science of information theory exceeds the realm of general communication and has multiple applications in physics, linguistics, ecology or psycology. This course will be divided in two broad areas. First, we will discuss the relation between information and probability in classical systems. Then, we will resort to quantum mechanics, which yields a probabilistic description of nature, and consider the fundamentals and latest developments in the field of quantum information.

PROFESSOR:

David Sánchez (PhD in Physics, 2002) is an Associate Professor at the UIB. He has published over 80 research papers and has taught different courses in quantum physics, nanostructures, mathematical methods and general physics.

Requirements

Skills

Specific

* E16, E18.

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Generic

* TG1, TG2, TG3.

Basic

* You may consult the basic competencies students will have to achieve by the end of the Master's degree at the following address: http://estudis.uib.cat/master/comp_basiques/

Content

Theme content

1. Conditional probabilities.
   Bayes theorem. Likelihood.
2. Entropy and information
   Shannon entropy. Relative entropy. Mutual information.
3. Entropy and physics
   Maxent method. Maxwell deamon. Physical limits of computation.
4. Communications theory
   Source coding theorem. Noisy-channel coding theorem.
5. Qubits and entangled states
   Density operator. Composite systems. Entanglement.
6. Measurements
   Projective measurements. Nonideal measurements. Bell inequality.
7. Quantum computation
   Quantum gates. Deutsch's algorithm. Grover's algorithm. Physical realizations.
8. Quantum information theory
   Von Neumann entropy. Quantum mutual information. Quantum communications theory.

Teaching methodology

In-class work activities

Modality	Name	Typ. Grp.	Description	Hours
Theory classes		Large group (G)	Lectures.	18.75

At the beginning of the semester a schedule of the subject will be made available to students through the UIBdigital platform. The schedule shall at least include the dates when the continuing assessment tests will be conducted and the hand-in dates for the assignments. In addition, the lecturer shall inform students as to whether the subject work plan will be carried out through the schedule or through another way included in the Campus Extens platform.

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Distance education work activities

Modality	Name	Description	Hours
Individual self-study	Homework assignments	Solve the proposed list of problems.	26.25
Individual self-study	Presentation	Discuss a relevant paper in the field of information theory.	30

Specific risks and protective measures

The learning activities of this course do not entail specific health or safety risks for the students and therefore no special protective measures are needed.

Student learning assessment

Homework assignments

Modality	Individual self-study
Technique	Objective tests **(retrievable)**
Description	Solve the proposed list of problems.
Assessment criteria	

Final grade percentage: 50%

Presentation

Modality	Individual self-study
Technique	Objective tests **(non-retrievable)**
Description	Discuss a relevant paper in the field of information theory.
Assessment criteria	

Final grade percentage: 50%

Resources, bibliography and additional documentation

Basic bibliography

Cover, M.T. and Thomas, J.A. Elements of information theory. Wiley, 2006.
Barnett, S.M. Quantum information. Oxford, 2009
Nielsen, M.A. and Chuang, I.L. Quantum computation and quantum information. Cambridge University Press, 2000

Other resources

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http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-441-information-theory-spring-2010/
http://ocw.mit.edu/courses/media-arts-and-sciences/mas-865j-quantum-information-science-spring-2006/

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