BASIC DETAILS:

Subject:	ANÁLISIS DE IMAGEN		
Id.:	33377		
Programme:	DOBLE GRADO EN FARMACIA Y BIOINFORMÁTICA. PLAN 2018		
Module:	BIOINFORMÁTICA		
Subject type:	OBLIGATORIA		
Year:	3	**Teaching period:**	Segundo Cuatrimestre
Credits:	6	**Total hours:**	150
Classroom activities:	68	**Individual study:**	82
Main teaching language:	Inglés	**Secondary teaching language:**	Castellano
Lecturer:	ALCAINE OTIN, ALEJANDRO (T)	**Email:**	lalcaine@usj.es

PRESENTATION:

This course has the objective of describe the principles and techniques of digital image processing from a bottom-up perspective. The student will be firstly introduced to the mathematical framework of signal processing as a fundamental basis to understand the characteristics of image processing and analysis. Finally, the student will learn the basis and necessary tools to use reconstruction and enhancement images techniques as well as biomedical image analysis techniques performed during clinical practice and research.

PROFESSIONAL COMPETENCES ACQUIRED IN THE SUBJECT:

General programme competences	G01	Use learning strategies autonomously for their application in the continuous improvement of professional practice.
	G02	Perform the analysis and synthesis of problems of their professional activity and apply them in similar environments.
	G03	Cooperate to achieve common results through teamwork in a context of integration, collaboration and empowerment of critical discussion.
	G04	Reason critically based on information, data and lines of action and their application on relevant issues of a social, scientific or ethical nature.
	G05	Communicate professional topics in Spanish and / or English both orally and in writing.
	G06	Solve complex or unforeseen problems that arise during the professional activity within any type of organisation and adapt to the needs and demands of their professional environment.
	G07	Choose between different complex models of knowledge to solve problems.
	G09	Apply information and communication technologies in the professional field.
	G10	Apply creativity, independence of thought, self-criticism and autonomy in the professional practice.
Specific programme competences	E02	Develop the use and programming of computers, databases and computer programs and their application in bioinformatics.
	E03	Apply the fundamental concepts of mathematics, logic, algorithmics and computational complexity to solve problems specific to bioinformatics.
	E04	Program applications in a robust, correct, and efficient way, choosing the paradigm and the most appropriate programming languages, applying knowledge about basic algorithmic procedures and using the most appropriate types and data structures.
	E05	Implement well-founded applications, previously designed and analysed, in the characteristics of the databases.
	E06	Apply the fundamental principles and basic techniques of intelligent systems and their practical application in the field of bioinformatics.
	E07	Apply the principles, methodologies and life cycles of software engineering to the development of a project in the field of bioinformatics.
	E12	Apply the principles and techniques of protein computational modelling to predict their biological function, their activity or new therapeutic targets (Structural Bioinformatics, Computational Toxicology).
	E13	Apply omics technologies for the extraction of statistically significant information and for the creation of relational databases of biodata that can be updated and publicly accessible to the scientific community.
	E14	Use programming languages, most commonly used in the field of Life Sciences, to develop and evaluate techniques and/ or computational tools.

	E15	Infer the evolutionary history of genes and proteins through the creation and interpretation of phylogenetic trees.
	E16	Plan linkage and association studies for medical and environmental purposes.
	E17	Induce complex relationships between samples by applying statistical and classification techniques.
	E18	Apply statistical and computational methods to solve problems in the fields of molecular biology, genomics, medical research and population genetics.
	E21	Apply computational and data processing techniques for the integration of physical, chemical and biological concepts and data for the description and/ or prediction of the activity of a substance in a given context.

PRE-REQUISITES:

The course will be delivered in English language. Academic reading and writing skills are expected from the students. Theory lectures will be completed with programming examples and practices/ projects will require programing in Python, so students should have general programming knowledge. Basic knowledge of mathematics and statistics are also required.

SUBJECT PROGRAMME:

Subject contents:

1 - Introduction
1.1 - Concept and types of signals
1.2 - Biomedical signals, origin and examples.
1.3 - Biomedical images, origin and examples.
1.4 - Signal as a function.
1.5 - Digital signals: Discretization, decimation and reconstruction.
2 - Basic principles of signal processing
2.1 - Introduction to signal processing
2.2 - Basic signals and operations
2.3 - Temporal Characterization of linear systems
2.4 - Frequential Characterization of signals and linear systems
2.5 - Z transform and digital filters
3 - Image processing and analysis
3.1 - Introduction to image properties and formats
3.2 - Neighborhood and spatial filters
3.3 - Fourier Analysis
3.4 - Image enhancement
3.5 - Morphological Operators
3.6 - Segmentation and detection theory

Subject planning could be modified due unforeseen circumstances (group performance, availability of resources, changes to academic calendar etc.) and should not, therefore, be considered to be definitive.

TEACHING AND LEARNING METHODOLOGIES AND ACTIVITIES:

Teaching and learning methodologies and activities applied:

Magistral lectures will be used to explain the different aspects of the subject and encouraged to be highly dynamic and interactive with visual examples and codes. Small exercises will be solved during class to consolidate the concepts. Moreover, in selected time moments, small **on-line tests** will be proposed to the students to assess their knowledge and follow-up of the subject.

Magistral lectures schedule will be altered with **webinars and workshop sessions** where the students will consolidate and practice the subject concepts mixing problem-based and project-based learning approaches. Additionally, an **individual coursework session** will be scheduled where the students will put in practice the concepts of the subject using a project-based learning approach.

The subject requires a high theoretical and practical effort from the student, and it is important to follow the concepts and exercises during the presential lectures. Additionally, the students will have via PDU many proposed exercises by the teacher with small tasks and challenges for autonomous learning. As a matter of that, the lecturer will be available to students during the tutorial schedule to help them in all matters concerning the course.

Student work load:

Teaching mode	Teaching methods	Estimated hours
Classroom activities	Master classes	27
	Practical exercises	14
	Workshops	10
	Laboratory practice	4
	Assessment activities	7
	Webinars, On-line sessions	6
Individual study	Tutorials	5
	Individual study	32
	Individual coursework preparation	40
	Collaborative tasks	5
	Total hours:	150

ASSESSMENT SCHEME:

Calculation of final mark:

Individual coursework:	25	%
Final exam:	40	%
On-line tests:	10	%
Practical Workshops:	25	%
TOTAL	100	%

*Las observaciones específicas sobre el sistema de evaluación serán comunicadas por escrito a los alumnos al inicio de la materia.

BIBLIOGRAPHY AND DOCUMENTATION:

Basic bibliography:

PROAKIS, John G. Digital Signal Processing. Prentice Hall, 1998.
DHAWAN, A. Medical image analysis. Wiley and Sons Inc, 2011.

Recommended bibliography:

SÖRNMO, Leif. Biomedical Signal Processing for Cardiac and Neurological Applications. Elsevier, Academic Press, 2005
OPPENHEIM, Alan V. Discrete-time signal processing (3rd ed.), Prentice-Hall, 2010
HAJNAL, J. Medical image registration. CRC Press, 2001.

Recommended websites: