

Current Topics in Bioinformatics

Code: 105065
ECTS Credits: 3

Degree	Type	Year	Semester
2500890 Genetics	OT	4	0

Contact

Name: Antoni Barbadilla Prados
Email: Antonio.Barbadilla@uab.cat

Use of Languages

Principal working language: spanish (spa)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Other comments on languages

45%

Teachers

Marta Coronado Zamora
Jesus Murga Moreno

Prerequisites

- It is recommended to have passed the subject of Bioinformatics (3rd course of Genetics), Genomics, Proteomics and Interactomics (3rd course of Genetics) and the module of databases and programming fundamentals within the subject Instrumental Techniques (2nd year of Genetics).
- It is essential to know at a basic level some programming language (preferably Perl or Python) and be familiar with the Linux environment in order to follow the practical sessions and complete the activities of continuous evaluation.
- A level B1.2 of English or equivalent is recommended.

Objectives and Contextualisation

The purpose of this subject is to cover basic topics of bioinformatics in the form of practical lessons, workshops and lectures given by experts. It is not a cumulative subject but a transversal one, whose purpose is to provide students with the wide range of concepts and approaches that bioinformatics encompasses.

The main objective is to provide students with the knowledge and skills necessary to apply bioinformatics in different areas of genomic research and, by extension, other omics. The subject taught and the activities carried out during this course provide an global insight into the potential of bioinformatics field in both basic and applied research.

Competences

- Be able to analyse and synthesise.
- Be able to communicate effectively, orally and in writing.
- Describe and identify the structural and functional characteristics of nucleic acids and proteins including their different organisational levels.
- Describe the organisation, evolution, inter-individual variation and expression of the human genome.
- Develop self-directed learning.
- Know and apply the omic tools of genomics, transcriptomics and proteomics.
- Measure and interpret the genetic variation in and between populations from a clinical, conservational and evolutionary perspective, and from that of the genetic improvement of animals and plants.
- Perceive the strategic, industrial and economic importance of genetics and genomics to life sciences, health and society.
- Reason critically.
- Use and interpret data sources on the genomes and macromolecules of any species and understand the basics of bioinformatics analysis to establish the corresponding relations between structure, function and evolution.
- Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.

Learning Outcomes

1. Be able to analyse and synthesise.
2. Be able to communicate effectively, orally and in writing.
3. Defend the relevance of progress in the generation and interpretation of data on a genomic scale for our understanding and technological manipulation of organisms.
4. Develop self-directed learning.
5. Explain and apply the methods for the analysis and annotation of genomes.
6. Explain how knowledge of human genetic variation is applied to personalised medicine, pharmacogenomics and nutrigenomics.
7. List and explain the content of bioinformatics databases and perform searches for information.
8. Reason critically.
9. Use and interpret the results of bioinformatics applications in the molecular analysis of sequences.
10. Use and manage bibliographic information or computer or Internet resources in the field of study, in ones own languages and in English.
11. Use bioinformatics techniques and tools to describe and analyse the human genome.
12. Use the techniques, tools and methodologies used to describe, analyse and interpret the enormous amounts of data produced by high performance technologies.

Content

The subject will be composed of theoretical-practical sessions, lectures and workshops given by recognized specialists in the different subjects and fields.

Theoretical-practical sessions (~ 13h)

They will take place in the computer room. Students will work both individually and as a group (3 students) promoting active learning that will allow them to develop the capacity for analysis and synthesis, critical reasoning and the capacity to solve problems.

Title	Description
Introduction	Introduction of <i>workflows</i> , analysis, methodology and grading of the subject

Data management and processing Types of biological data: sequences, annotation, expression data, alignments... Familiarizing oneself with the properties and structure of each type of data and the tools to analyze them is key in bioinformatics. Processing of raw data.

Data exploration and visualization A través de esta práctica aprenderán a representar datos biológicos en un mensaje claro y a extraer información de los mismos.

Mentoring*

Genome-Wide Association studies Perform a complete genome association study.

Transcriptomic analyses Perform a complete expression analysis, distributed in the following steps:
- Data quality control
- Alignment of RNA-seq
- Differential expression analysis
- Visualization of the results

Mentoring* *Two extra sessions of two hours will be implemented to be set according to the needs of the students and the difficulty of the cases.

Invited conferences (10h)

Attendance to at least four conferences (2h / conference) of invited experts in the field of bioinformatics that will be taught in English.

Workshops (5h)

Title	Speaker	Aprox. date
Bioinformatics Opportunities in Europe	Margarita Navia Head of Strategic Projects Barcelona Institute of Science and Technology (BIST)	3r week Febraury 2020
Entrepreneurship and Bioinformatics		3r week March 2020

Methodology

In-person learning activities and autonomous learning.

A cooperative learning experience will be implemented, specifically the Puzzle methodology will be followed: data sets and procedures are provided in a distributed manner to small groups. Each group must manage and solve practical cases autonomously.

Each module will work in parallel on similar concepts through real practical cases, so that once finished the students will exchange information about the chosen methodology, its development and the results obtained, trying to achieve an effective cooperation among the students. The members of each group will know in depth the information they manage. Each group will make a lecture and/or writing of a portfolio through which the other groups understand the characteristics and foundations of each analysis. The four practical sessions will be linked, since the results of one practice will serve as data input for the next practice.

The active participation, the management of the work, as well as the discussion of the acquired knowledge will form a vital part in the role played by each student.

Conferences and workshops

A total of 5 lectures will be given by experts in their respective fields of research or work that will offer a real vision on how bioinformatics plays a key role in the resolution of basic and applied biological research questions. Emphasis will be placed on the importance of data processing in the current era of big data.

The two workshops will consist of two sessions that will deal with two aspects of practical interest, how to obtain funding at the European level to carry out research in bioinformatics and how to create technology-based companies.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	11	0.44	3, 6, 5, 7
Theoretical-practical sessions	13	0.52	3, 4, 6, 5, 7, 8, 2, 1, 10, 9, 11, 12
Workshops	5	0.2	4, 5, 8, 2
Type: Supervised			
Portfolio	20	0.8	3, 4, 6, 5, 7, 8, 2, 1, 10, 9, 11, 12
Type: Autonomous			
Study/Problem solving	25	1	4, 7, 8, 9, 11, 12

Assessment

The grading will be carried out through the delivery of four portfolios and the lecturing of one of the four cases to be treated.

Portfolio (70%). In each portfolio the basic fundamentals of the analyzed data will be exposed, the tools used, the development of the methodology, as well as a discussion on the final result of the delivery. Each portfolio will have the same weight in the final evaluation.

Exhibition (20%). Each group will make a 10-minute oral presentation.

Assistance and participation (10%).

The subject is passed when the average score of the assessment activities is equal to or greater than 5. The continuous and transversal nature of this evaluation means that the subject can not be evaluated if the minimum participation of the students is less than 80% of the students. proposed sessions.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Lecture	20%	1	0.04	3, 6, 5, 8, 2, 9
Portfolio	70%	0	0	3, 4, 6, 5, 7, 8, 2, 1, 10, 9, 11, 12
Soft skills	10%	0	0	3, 4, 6, 5, 8, 2, 1, 10

Bibliography

- Pevzner, P. and R. Shamir. 2011. Bioinformatics for Biologists. Cambridge University Press
- Samuelsson, T. 2012. Genomics and Bioinformatics: An Introduction to Programming Tools for Life Scientists

Web Master Bioinformatics UAB <https://mscbioinformatics.uab.cat/base/base3.asp?sitio=msbioinformaticsen>