VNIVERSITAT DE VALÈNCIA

Course Guide
42589 Computational systems biology

COURSE DATA

Data Subject	
Code	42589
Name	Computational systems biology
Cycle	Master's degree
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
2116 - M.U. en Bioinformática 12-V.1	School of Engineering	2	First term

Subject-matter

Degree	Subject-matter	Character
2116 - M.U. en Bioinformática 12-V.1	7 - Computational systems biology	Obligatory

Coordination

Name	Department
ARNAU LLOMBART, VICENTE	240 - Computer Science
MARIN NAVARRO, JULIA VICTORIA	30 - Biochemistry and Molecular Biology
PERETO MAGRANER, JULI	30 - Biochemistry and Molecular Biology

SUMMARY

It is important for the bioinformatician to be familiar with the concepts of Systems Biology and to understand the cell as a set of elements that interact with each other in different ways to carry out functions. Systems Biology combines the processing of massive amounts of data, network thinking and modeling of dynamic systems. This course is an introduction to the computational handling of data to obtain biologically relevant information.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Graph theory. Basic concepts in biochemistry (metabolism, intra- and intercellular signaling), molecular biology (macromolecule structure and interactions) and molecular genetics

OUTCOMES

2116 - M.U. en Bioinformática 12-V.1

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Be able to access the information required (databases, scientific articles, etc.) and to interpret and use it sensibly.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Be able to access to information tools in other areas of knowledge and use them properly.
- To be able to assess the need to complete the scientific, historical, language, informatics, literature, ethics, social and human background in general, attending conferences, courses or doing complementary activities, self-assessing the contribution of these activities towards a comprehensive development.
- Desarrollar la iniciativa personal y ser capaces de realizar una toma rápida y eficaz de decisiones en su labor profesional y/o investigadora.
- Trabajar en equipo con eficiencia en su labor profesional y/o investigadora y con personas de diferente procedencia.
- Manejar conceptos de biología de sistemas y entender la célula como un conjunto de elementos que interactúan para llevar a cabo funciones.
- Adquirir los conocimientos para manejar datos en forma de red e integrar datos ómicos en redes así como modelar tanto redes conocidas (p. ej. pathways) como redes nuevas descritas en estándares como SMBL.

LEARNING OUTCOMES

1) Basic concepts of Systems Biology to understand living beings as a set of elements that interact to carry out functions.

2) Modeling of simple dynamic systems.

3) Data management, especially metabolic, in the form of a network.

DESCRIPTION OF CONTENTS

1. Introduction to Systems Biology.

Basic concepts and critical analysis of the main ways of studying complex biological systems. Networks and dynamic models. Robustness and fragility of biological systems

2. Modeling of dynamic systems.

Concept and classes of models. Models in temporal differential equations. Steady states and stability. Examples of functional circuit models: homeostatics, reversible and irreversible switches, oscillatory responses.

3. Biological networks.

Introduction to network and graph theory. Introduction to stoichiometric analysis of simple metabolic pathways. Flux balance analysis (FBA). Applications and case studies

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	21,00	100
Laboratory practices	9,00	100
Attendance at events and external activities	10,00	0
Development of group work	10,00	0
Development of individual work	20,00	0
Study and independent work	20,00	0
Readings supplementary material	20,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	25,00	0
Preparation of practical classes and problem	20,00	0
Resolution of case studies	10,00	0

TOTAL	**180,00**

TEACHING METHODOLOGY

MD1 - Task training of the teaching-learning environment interaction in the classroom through expository sessions. Previous assignments include preparation (information search, reading texts supplied by teachers), teaching sessions themselves and the later work of deepening.

MD2 - Learning through problem solving and case studies, through which it is acquiring skills on different aspects of materials and subjects.

MD3 - Activities labs. Include preparation, implementation of the monitoring practices and teacher support, online freelance work and reporting practices.

MD4 - Cross-disciplinary skills. Include attendance at courses, conferences or round tables organized by the CEC of the Master and / or conduct of a bibliographic work on issues that contribute to the integral. It produces a report of activities.

EVALUATION

The different contents of the course will be evaluated through the presentation of assignments proposed by the professor. Each assignment will have the corresponding due date for the first and second call.

The final grade will be calculated as the average of the grades of all the assignments. In the case of practical sessions and seminars, attendance will be recorded. Assignments associated to practical sessions or seminars cannot be submitted if 75% of the sessions corresponding to the assignment have not been attended. It is understood that if the assignment is associated to a single session, it must have been attended.

REFERENCES

Basic

- Davies JA (2028) Synthetic Biology. A very short introduction. Oxford University Press.
- Sauro HM (2014) Systems Biology. Introduction to Pathway Modeling. Ambrosius Pub.
- Voit, E (2017) A First Course in Systems Biology. CRC Press.
- Voit, E (2020) Systems Biology. A very short introudction. Oxford University Press