Computational biology

Academic Year: (2023 / 2024) **Review date: 12/02/2024 12:21:14**

Department assigned to the subject: Bioengineering Department

Coordinating teacher: QUILEZ LOPEZ, CRISTINA

Type: Electives ECTS Credits : 6.0

Year : Semester :

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

It is strongly advised to have knowledge in programming, fundamentals of molecular and cellular Biology and/or Biochemistry.

LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG2. Learn new methods and technologies from basic scientific and technical knowledge, and being able to adapt to new situations.
CG3. Solve problems with initiative, decision making, creativity, and communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the engineering activity. Capacity for leadership, innovation and entrepreneurial spirit.
CG4. Solve mathematical, physical, chemical, biological and technological problems that may arise within the framework of the applications of quantum technologies, nanotechnology, biology, micro- and nano-electronics and photonics in various fields of engineering.
CG5. Use the theoretical and practical knowledge acquired in the definition, approach and resolution of problems in the framework of the exercise of their profession.
CG6. Develop new products and services based on the use and exploitation of new technologies related to physical engineering.
CG7. Undertake further specialized studies, both in physics and in the various branches of engineering.
CE11. Analyze biological systems as complex systems, know the concepts of synthetic biology and apply the latest developments in biomaterials and biofabrication techniques, including bioprinting techniques.
CT1. Work in multidisciplinary and international teams as well as organize and plan work making the right decisions based on available information, gathering and interpreting relevant data to make judgments and critical thinking within the area of study.

RA1. To have acquired sufficient knowledge and proved a sufficiently deep comprehension of the basic principles, both theoretical and practical, and methodology of the more important fields in science and technology as to be able to work successfully in them.
RA2. To be able, using arguments, strategies and procedures developed by themselves, to apply their knowledge and abilities to the successful solution of complex technological problems that require creating and innovative thinking.
RA3. To be able to search for, collect and interpret relevant information and data to back up their conclusions including, whenever needed, the consideration of any social, scientific and ethical aspects

relevant in their field of study.
RA4. To be able to successfully manage themselves in the complex situations that might arise in their academic or professional fields of study and that might require the development of novel approaches or solutions.
RA6. To be aware of their own shortcomings and formative needs in their field of specialty, and to be able to plan and organize their own training with a high degree of independence.

OBJECTIVES

The student will acquire the ability to apply different computational techniques to solve complex problems typical of biology and medicine. Such problems are characterized by involving the analysis of large quantities of information (data base searching, comparative analysis of sequences of DNA, RNA, microRNA and protein, domain searching, evaluation of the pathogenicity of variants, evolutionary conservation, phylogeny ..), so that in practice only they are approachable through intensive computing techniques, in which the student is formed.

DESCRIPTION OF CONTENTS: PROGRAMME

Topics to be addressed include approaches and computational techniques for the search of the genetic structure, sequence alignment through the use of dynamic programming, prediction of the folding and structure of proteins, interactions of proteins and drugs. Different examples will be studied in the different areas and students will make use of computational biology tools for their analysis. As part of the subject, the relationship between computational biology and biotechnology will be studied.

Topics covered include:

1. Computational approaches and techniques for searching sequence, structural and expression databases and its relationship with disease databases.
2. Alignment and comparison of sequences by using dynamic programming.
3. Gene structure prediction
4. Obtaining the protein sequence encoded
5. Folding and protein structure prediction
6. Prediction of functional and protein-binding domains
7. Molecular evolution and phylogenetic sequences analysis.
8. Linkage analysis, physical maps and identification of the disease-causing gene.
9. Genome structure analysis, repetitive sequence searching and microRNAs.
10. Evaluation of the pathogenicity of disease variants.
11. Search for restriction sites and generation of recombinant vectors in silico

Different examples will be reviewed in different areas and students make use of computational biology tools for analysis.

LEARNING ACTIVITIES AND METHODOLOGY

The teaching will be on line through the platform Blackboard collaborate and it will include:
-On line lectures, which will present the skills that students should acquire and the bioinformatic tools to be used. To facilitate its development students will receive class notes and baseline texts that facilitates follow lessons and develop further work. Resolution of representative exercises will be included.
-On line practices in computer lab for the resolution of exercises by means of bioinformatic tools.
-In-person classes for doubts resolution, tutorials and carrying out of the continuos evaluation exams.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

The evaluation system includes continuous assessment of student work (class participation and 2 skills assessment tests and theoretical and practical knowledge), and final evaluation through a final (theoretical and practical exam) that comprehensively assess the knowledge and skills acquired throughout the course. There can be an additional research project proposed by the teachers to have an additional mark. The shares allocated are defined in the following terms.

% end-of-term-examination: 60 (minimum mark required is equal to 4)
% of continuous assessment (assigments, laboratory, practicals...): 40

BASIC BIBLIOGRAPHY

- - Lesk, A.M. Introduction to BioInformatics, Oxford University Press, Third Edition

- - Mount, DW Bioinformatics, Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, Second Edition