200630 - FBIO - Fundations of Bioinformatics

Coordinating unit: 200 - FME - School of Mathematics and Statistics
Teaching unit: 1004 - UB - (ENG)Universitat de Barcelona
Academic year: 2017
Degree: MASTER'S DEGREE IN STATISTICS AND OPERATIONS RESEARCH (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5
Teaching languages: Spanish

Teaching staff
Coordinator: ESTEBAN VEGAS LOZANO
Others: Primer quadrimestre:
ESTEBAN VEGAS LOZANO - A

Requirements
Knowledge of statistical software R.
References:

Degree competences to which the subject contributes

Specific:
5. CE-1. Ability to design and manage the collection of information and coding, handling, storing and processing it.
6. CE-2. Ability to master the proper terminology in a field that is necessary to apply statistical or operations research models and methods to solve real problems.
7. CE-3. Ability to formulate, analyze and validate models applicable to practical problems. Ability to select the method and / or statistical or operations research technique more appropriate to apply this model to the situation or problem.
8. CE-5. Ability to formulate and solve real problems of decision-making in different application areas being able to choose the statistical method and the optimization algorithm more suitable in every occasion.
9. CE-6. Ability to use appropriate software to perform the necessary calculations in solving a problem.
10. CE-9. Ability to implement statistical and operations research algorithms.

Transversal:
1. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding how companies are organised and the principles that govern their activity, and being able to understand employment regulations and the relationships between planning, industrial and commercial strategies, quality and profit.
2. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data.
and information in the chosen area of specialisation and critically assessing the results obtained.

**Teaching methodology**

Theory sessions:
In the theory sessions, the professor will present the problems that are tackled in each topic and will provide a summary of the principle concepts and problematic points of each topic.
The student should complete the professor's explanations by consulting the reference texts and complementary materials.

Practical Sessions:
The practical sessions will be conducted in the computer lab, where instruction will take place regarding the use of bioinformatics tools pertinent to each topic and the problems that are posed.

**Learning objectives of the subject**

Upon completing the course, the student must be able to:

* Identify the bioinformatics domain of study.
* Know the large group of problems that bioinformatics poses.
* Be familiar with the most typical methods and models in bioinformatics.

* Be familiar with the basic components of organisms.
* Understand the coding and transmission mechanisms of biological information.
* Know the processes of gene expression and its regulation.

* Know the existence and availability of diverse information resources, both basic (nucleic acids, proteins, etc.) and more complex (patterns, genomes, etc.).
* Know the principle tools for recovering information such as SRS or Entrez.
* Know how to access these resources and make queries for obtaining information.

* Understand and differentiate distinct types of problems related to the alignment of sequences: in pairs, multiples and data search.
* Know the algorithms for aligning two sequences in optimum form.
* Know how to perform and interpret the alignment of two sequences.
* Understand the problem of Multiple Sequence Alignment (MSA).
* Know how to perform and interpret an MSA.
* Know how to conduct a sequence search in a database and how to interpret the results.

* Know the principle methods for representing an MSA and understand the relationships (hierarchical) between them.
* Understand the basic components of Markov models and their application toward sequence analysis.
* Know the basic components of a hidden Markov model and understand its advantages and uses for biological problems.

* Understand the problem of gene prediction and the difficulties (alternative splicing, non-coding genes, etc.) that are involved in their complete resolution.
* Know the principle methods for gene prediction.
* Know how to use gene prediction tools and their basic limitations.
* Be familiar with and know how to use genome browsers.

* Know the approach to systems biology as a comparison to traditional approaches.
* Know the study process based on microarrays.
* Conduct a microarray analysis in simple situations.
200630 - FBIO - Fundations of Bioinformatics

*Know the different types of biological networks.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>30h</th>
<th>24.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time: 125h</td>
<td>Hours medium group:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>15h</td>
<td>12.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>80h</td>
<td>64.00%</td>
</tr>
</tbody>
</table>
Content

1. Introduction to Bioinformatics
   Degree competences to which the content contributes:

2. Basic Concepts of Molecular Biology
   Degree competences to which the content contributes:

3. Biological Databases: Concepts, Types and Applications
   Degree competences to which the content contributes:

4. Sequence Alignment.
   Degree competences to which the content contributes:

5. Probabilistic models of biological sequences.
   Degree competences to which the content contributes:

   Degree competences to which the content contributes:

7. Functional and systems genomics.
   Degree competences to which the content contributes:

<table>
<thead>
<tr>
<th>Qualification system</th>
</tr>
</thead>
</table>
The evaluation will be based on four components:

* Completion of short test exercises (2) during class hours (25%)
* Class participation and completion of assigned exercises during practice sessions (25%)
* Presentation of assigned work throughout the course (50%)
Bibliography

Basic:


Complementary:


Others resources:

Bioinformatics notes, available on the intranet or supplied by the professor in pdf.

Hyperlink

Curs d'introducció a la Bioinformàtica
http://www.ub.edu/stat/docencia/Biologia/introbioinformatica/

Documents electrònics

Complete Online Bioinformatics Courses/Tutorials
http://www.med.nyu.edu/rcr/rcr/btr/complete.html

Enciclopèdies i diccionaris

Bioinformàtica en la Wikipedia
http://es.wikipedia.org/wiki/Bioinform%C3%A0tica

Llibres Electrònics

Online lectures in Bioinformatics
http://lectures.molgen.mpg.de/online_lectures.html

The NCBI Bookshelf

Organismes i Institucions

The European Bioinformatics Institute
http://www.ebi.ac.uk/
Portals temàtics

The National Center for Biotechnology Information

Instituto Nacional de Bioinformática
http://www.inab.org/

Portals temàtics

BIOINFORMATICS.CA
http://bioinformatics.ca/

123Genomics
http://www.123genomics.com/

Revistes

Bioinformatics
http://bioinformatics.oxfordjournals.org/

Briefings in Bioinformatics
http://bib.oxfordjournals.org/

BMC Bioinformatics
http://www.biomedcentral.com/bmcbioinformatics/

Webs

International Society for Computational Biology (ISCB)
http://www.iscb.org/

The Gene Discovery Page
http://www.biowriters.com/bioinformatics/gdp.html