Universidad Zaragoza

Year : 2019/20

30260 - Bioinformatics

Syllabus Information

Academic Year: 2019/20
Subject: 30260 - Bioinformatics
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 439 - Bachelor's Degree in Informatics Engineering
ECTS: 6.0
Year: 4
Semester: Second semester
Subject Type: ---
Module: ---

1.General information

1.1.Aims of the course

The course and its expected results meet the following approaches and objectives:

In this course, students will learn the basics of molecular biology as well as the main challenges of bioinformatics, will enhance its ability to design and develop algorithms tailored to the specific context of bioinformatics and will know and apply other computer methodologies in this area.

1.2.Context and importance of this course in the degree

The Computer Science specialization covers a wide range of concepts, from the theoretical and algorithmic foundations to the forefront of developments in bioinformatics, robotics, computer vision, video games, and other interesting areas. Bioinformatics is one of the elective courses in this specialization that aims to give a global perspective of this discipline.

1.3.Recommendations to take this course

Interest and effort are required, in addition to the knowledge acquired in previous couses of mathematics, programming, data structures and algorithms, computer theory, basic algorithms, and algorithms for difficult problems.

2.Learning goals

2.1.Competences

After passing the course, students will be more competent to:

1. Combine general knowledge and specialized engineering to generate innovative and competitive proposals for professional activity.
2. Solve problems and make decisions with initiative, creativity and critical thinking.
3. Communicate and transmit knowledge, skills and abilities in Castilian and English.
4. Use the techniques, skills and tools necessary for engineering practice thereof
5. Learn continuously and develop independent learning strategies
6. Apply the information and communications technology in Engineering

7. Assess the computational complexity of a problem, knowing algorithmic strategies that can lead to resolution and recommend, develop and implement one that guarantees the best performance according to the requirements.
8. Know the fundamentals, paradigms and own techniques of intelligent systems and analyze, design and build systems, services and applications that use these techniques in any scope.

9. Know and develop computational learning techniques and design and implement applications and systems that use them, including those dedicated to automatic extraction of information and knowledge from large volumes of data.

2.2.Learning goals

The student, after passing this course, achieves the following results ...

1. He/she knows basic concepts of molecular biology together with the fundamental problems of bioinformatics.
2. He/she knows how to particularize general algorithmic schemes to solve problems.
3. He/she identifies the most relevant components of a problem and selects the most appropriate algorithmic technique for it, together with a reasoned argument of the choice.

4. He/she knows how to compare problems and use this comparison to solve a problem from an efficient solution of another one.
5. He/she knows how to reason about the correctness and efficiency of the advanced algorithms used.
6. He/she has the ability to work in a group, identify group goals, map out a work plan to achieve them, recognize the different roles within a team and is committed to the assigned tasks.
7. He/she can manage independent learning and development including management and organization time.
8. He/she appreciates the need for lifelong learning.

2.3.Importance of learning goals

Bioinformatics is an application domain of recent and rapid development. Computer and algorithmic techniques developed in the course are fundamental in the development of molecular biology and allow the student to join a new professional and research field.

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

Throughout the semester practical programming work will be proposed and must be solved in the laboratory. For this purpose teams will be formed by a certain number of students to be fixed at the beginning of the course. The papers presented by the students will be graded with a quantitative rating from 0 to 10. To obtain those grades programs will be assessed according to specifications, the quality of its design and presentation, proper application of the methods of resolution, time spent, and the ability of each team member to explain and justify the design done.

The practical laboratory programming grade, weighs 30% of the final grade for the course.

Throughout the semester homework sheets for individual work will be published, from which students may submit, no later than the date specified in each sheet, a certain number of exercise solutions to be set at the beginning of the course. The exercises presented by the students will be graded with a quantitative grade of 0 to 10.

The individual work exercises grade will weig 20% of the final grade for the course.

At the beginning of the semester a list of advanced topics in bioinformatics will be presented from which each student must select one. From the chosen topics students will do a written essay that must also be presented in public. The presentation will take place on the dates specified.

The mark obtained for this essay and presentation ponders 50% of the final grade for the course.

Global evaluation: The global evaluation of the course consists of two parts:

Individual laboratory programming test. In each call a practical laboratory programming test will be given, which will propose the student exercises similar to those made in the lab classes or in class. The grade obtained weighs 20% of the final grade for the course.

In the written exam the student must solve problems similar to the weekly exercises proposed during the semester, he must also answer conceptual questions and provide solution to exercises that prove his achievement of the learning results required in the course. The grade obtained weighs 80% of the final grade for the course.

SUMMARY:

Recommended option:
Laboratory Practice (Group) during the semester: 30%.
Individual exercises during the semester: 20%.
Essay and presentation on advanced topic: 50%.

Option based solely on final exams:
(Individual) laboratory programming test: 20%.
Final written exam: 80%.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented such as:

1. The presentation of the contents of the course by teachers as well as performing exercises in class.
2. Autonomous work and study of the subject by students and class participation in solving the exercises.
3. The development of practical work by students, guided by teachers who develop theoretical knowledge.

Keep in mind that the course has both theoretical and practical orientation. Therefore, the learning process emphasizes both in student attendance at lectures, as in the performance of experiments in the laboratory, in solving simple problems of increasing difficulty, and in the autonomous work and study.

4.2.Learning tasks

The course includes the following learning tasks:

- 1 Classes taught in the classroom will develop the syllabus of the course.
- 2 In the classes of problems the concepts and techniques presented in the course syllabus will be applied.
- 3 The practise sessions take place in a computer lab.

4.3.Syllabus

The course will address the following topics:

1. Introduction to bioinformatics. Basics of molecular biology. Algorithms for strings.
2. Methods of alignment. Pairwise alignment. Heuristic search methods for biological repositories. Multiple alignments.
3. Prediction of genes and promoters. Finding signals. Hidden Markov Models.
4. Learning algorithms in bioinformatics.
5. Computational phylogenetics.
6. Structural Bioinformatics.

4.4.Course planning and calendar

Calendar of sessions and homework presentation

The schedule of classes, practices and examinations as well as delivery dates of assignment work will be announced well in advance, according to the sessions and dates set by the school.

Student Work

The time needed by the student to achieve the learning outcomes in this course is estimated in 150 hours distributed as follows:

- 45 hours, approximately, of classroom and lab activities (theoretical and problem-solving classes, lab practise);
- 50 hours for performing practical work and essays;
- 35 hours of effective personal study (study notes and texts, problem-solving, lab class preparation);
- 5 hours of essay presentation and practical exercises.

The exam date and deadlines for homework and lab assignments will be announced well in advance.

4.5.Bibliography and recommended resources

[BB: Bibliografía básica / BC: Bibliografía complementaria]

http://psfunizar7.unizar.es/br13/egAsignaturas.php?codigo=30260&Identificador=15424

- [BB] Bo?ckenhauer, Hans-Joachim. Algorithmic Aspects of Bioinformatics / H.-J. Böckenhauer, D. Bongartz. Berlin ; New York : Springer, 2007
- [BC] Jin, Xiong. Essential Bioinformatics / J. Xiong New York : Cambridge University Press, 2006
- [BC] Jones, N.C. An introduction to bioinformatics algorithms / N.C. Jones, P. A. Pevzner. Cambridge : MIT Press, 2004.

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- Página de la asignatura [http://webdiis.unizar.es/asignaturas/Bio/]