Universidad Zaragoza

Academic Year/course: 2024/25

69737 - Deep Learning solutions for Biomedical Data Science

Syllabus Information

Academic year: 2024/25
Subject: 69737 - Deep Learning solutions for Biomedical Data Science
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 633 - Master's Degree in Biomedical Engineering
ECTS: 3.0
Year: 1
Semester: Second semester
Subject type: Optional
Module:

1. General information

The general objective of the course is to introduce students to the discipline of deep neural networks, showcasing some of their applications in the field of biomedical engineering. This course extends concepts and applications from previous subjects in the first bimester (Machine Learning/Técnicas de reconocimiento de patrones and Medical image analysis/Análisis de imágenes médicas), although there are no exclusive prerequisites.

Machine learning tools based on deep neural networks are revolutionizing many scientific fields and everyday life due to their excellent performance in solving complex problems and tasks. Hence, the growing and recent interest from both companies and research. This course proposes deep neural network-based solutions for the analysis of biomedical data: medical images, sequences with clinical information (genomics, proteomics, metabolomics), and clinical data in table format.

2. Learning results

- To be able to design, implement, and evaluate machine learning systems based on deep neural networks for segmentation and registration of medical images
- To be able to design, implement, and evaluate machine learning systems based on deep neural networks for the analysis of sequences of biomedical data (genomics, proteomics, metabolomics)
- To understand deep neural network approaches for the analysis of clinical data in table format
- To understand deep neural network approaches for the analysis of data structured as graphs

3. Syllabus

Topic 1. Deep neural networks for medical image segmentation and registration.
Topic 2. Analysis of tabular data with deep neural networks.
Topic 3. Analysis of sequences using deep neural networks. Examples for genomics and proteomics.
Topic 4. Analysis of graph-structured data with neural networks.
Topic 5. Bayesian paradigm of neural networks.

4. Academic activities

The following training activities are proposed:

- **Participative master class** (18 hours): presentation by the teacher of the main contents of the subject. The computer will be extensively used in explanations and examples.
- **Case study presentations** (4 hours). Extensive use of the computer will be made in explanations and examples.
- **Laboratory work** (8 hours). Each student will individually carry out two practical assignments or projects, which may include an oral defense in front of the professor, and in some cases, in front of other classmates. One project will focus on neural networks for segmentation/registration of medical images, and the other on the analysis of biomedical sequence data.
- **Tutoring**. Personalized attention to students in order to review and discuss the materials and topics presented in the theoretical and practical classes.
- **Evaluation** (3h) Set of theoretical-practical written tests and presentation of reports or papers used in the evaluation of the student's progress. Details can be found in the section corresponding to the assessment activities.
- **Individual study**.

This course is English Language Friendly, meaning that the course syllabus is also available in English; study and class materials are in English; the course faculty is willing to conduct tutorials in English; students are allowed to take their evaluation

tests in English.

5. Assessment system

There are two evaluation procedures to choose from:

a) Mixed evaluation, which is the recommended procedure, given the practical focus of the course. It consists of two distinct parts:

- Projects of the subject (40%): for each of the two mandatory projects, a brief report with the most relevant results and conclusions will be submitted, which may include an oral presentation. There may be an oral presentation. These assignments will be carried out continuously throughout the weeks of the course with previously established and announced deadlines. The evaluation will assess aspects of originality in the proposed solutions, efficiency of the applied methods, presentation of the report and eventual oral presentation. It will be necessary to present both projects, with a minimum grade of 4 points in each of the projects.
- Final exam (60%) Written test, graded from 0 to 10 points. This test will be written, and the computer may be eventually used for some of its parts. The student must obtain a minimum total grade of 4 points out of 10 in the final exam.

b) Simple evaluation, which will consist of a single global test, to be carried out on the date of each of the two official calls. This global test will consist of a global written test, similar to the final exam previously described, and therefore will have a theoretical/conceptual part, and a practical part related to the tasks/projects carried out during the academic year. The practical part of the global test will be evaluated with the results delivered and potentially an oral defence before the teacher.

6. Sustainable Development Goals

3 - Good Health & Well-Being
8 - Decent Work and Economic Growth
9 - Industry, Innovation and Infrastructure