ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000371 - Biomedical Informatics

DEGREE PROGRAMME

10AJ - Master Universitario En Inteligencia Artificial

ACADEMIC YEAR & SEMESTER

2023/24 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	103000371 - Biomedical Informatics
No of credits	5 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	10AJ - Master Universitario en Inteligencia Artificial
Centre	10 - Escuela Tecnica Superior De Ingenieros Informaticos
Academic year	2023-24

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Miguel Garcia Remesal	2206	miguel.garcia.remesal@upm.es	Tu - 11:00 - 14:00 Th - 11:00 - 14:00
Victor Manuel Maojo Garcia (Subject coordinator)	2102	victormanuel.maojo@upm.es	Tu - 12:30 - 15:30 W - 12:30 - 15:30
David Perez Del Rey	2104	david.perez.rey@upm.es	Sin horario.

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- Artificial Intelligence

4. Skills and learning outcomes *

4.1. Skills to be learned

CEIA1 - Capacidad de integrar tecnologías y sistemas propios de la Inteligencia Artificial, con carácter generalista, y en contextos más amplios y multidisciplinares

CEIA2 - Capacidad de conectar la tecnología puntera en Inteligencia Artificial con las necesidades de los clientes

CEIA9 - Comprensión del mercado, sus hábitos y necesidades de productos o servicios en el ámbito de la Inteligencia Artificial.

CG11 - Integración del conocimiento a partir de disciplinas diferentes, así como el manejo de la complejidad.

CG12 - Comprensión amplia de las técnicas y métodos aplicables en una especialización concreta, así como de sus límites.

CG8 - Planteamiento y resolución de problemas también en áreas nuevas y emergentes de su disciplina

CG9 - Aplicación de los métodos de resolución de problemas más recientes o innovadores y que puedan implicar el uso de otras disciplinas.

CGI1 - Adquirir conocimientos científicos avanzados del campo de la informática que le permitan generar nuevas ideas dentro de una línea de investigación.

CGI3 - Capacidad para valorar la importancia de las fuentes documentales, manejarlas y buscar la información para el desarrollo de cualquier trabajo de investigación.

CGI4 - Capacidad de leer y comprender publicaciones dentro de su ámbito de estudio/investigación, así como su catalogación y valor científico.

CGI5 - Que el estudiante adquiera el conocimiento necesario sobre los mecanismos de financiación de la investigación y transferencia de la tecnología, y sobre la legislación vigente sobre protección de resultados

4.2. Learning outcomes

RA84 - To be able to analyse the state of the art in a given subject, understanding what the main achievements and challenges are, and draw conclusions for one?s own work

RA85 - Once the aforementioned points have been understood, students should be able to successfully apply them to the analysis and solution of problems with a complexity proportional to their level of experience

RA86 - To be able to use the terminology appropriately and perform public presentations on the topics of the module

RA83 - To be able to analyse and solve biomedical informatics problems

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

An often-cited definition of the area has been proposed by Ted Shortliffe: The rapidly developing scientific field that deals with the storage, retrieval, and optimal use of biomedical information, data, and knowledge for problem solving and decision making. It accordingly touches on all basic and applied fields in biomedical science and is closely tied to modern information technologies, notably in the areas of computing and communications. Many areas have been established, including topics such as decision support systems, electronic health records, hospital information systems, data and text mining, information retrieval, bibliographic systems, medical imaging, etc. Over the last 20 years, new areas have been introduced, such as merging medical informatics with bioinformatics, into what is called biomedical informatics. Then, areas such as translational bioinformatics have emerged. Fundamental new topics include precision medicine, Web-based applications, the introduction of social networks, biomedical ontologies, semantic interoperability, Big Data research and others. We emphasize topics of biomedical informatics related to artificial Intelligence, such as ontologies, machine learning, text mining or knowledge-based systems.

Over the last years, particularly after the introduction of ChatGPT and other Large Language Models into the mainstream of AI, a strong need for ethical considerations of different aspects has appeared, enhanced by national and international organizations. We will analyze the limitations of those AI systems, their ethical considerations, and other related issues.

5.2. Syllabus

1. Introduction

    1.1. Biomedical informatics: the concept.

    1.2. Historical analysis of biomedical informatics development since the 50s.

    1.3. Differences among areas (Medical Informatics, Bioinformatics, Biomedical Engineering and Biotechnology).

    1.4. Future trends

2. Data Management in Biomedicine

    2.1. Data, information and knowledge.

    2.2. Types of data in biomedicine

    2.3. Acquisition, storage and management of data

3. Artificial Intelligence in Biomedicine

   3.1. Medical reasoning methods.

   3.2. Information extraction. Data and text mining

      3.2.1. Information retrieval

      3.2.2. Database integration

   3.3. Advanced decision support systems

4. Medical Information Systems

   4.1. Electronic Health records; concept and clinical contents

   4.2. Electronic Health Records: models and tools.

5. Vocabularies and Standards

   5.1. Medical vocabularies and terminologies.

   5.2. Models and standards.

   5.3. Ontologies

6. Large Language Models in medicine

   6.1. ChatGPT in medicine: limitations and challenges

   6.2. Ethical aspects of LLMs and AI in medicine

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**Introduction to biomedical informatics** Duration: 02:00 Lecture		**In principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Not Presential Duration: 00:00
2	**Data, information and knowledge in biomedicine** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Not Presential Duration: 00:00
3	**Artificial Intelligence in medicine: medical reasoning and diagnosis** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Not Presential Duration: 00:00
4	**Artificial Intelligence in medicine: expert systems** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Presential Duration: 00:00
5	**Artificial intelligence in medicine: text mining and Natural Language Processing** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Not Presential Duration: 00:00
6	**Artificial intelligence in medicine: text mining and Natural Language Processing (II)** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Presential Duration: 00:00
7	**Biomedical Vocabularies and ontologies (I)** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Not Presential Duration: 00:00

8	**Biomedical vocabularies and ontologies (II)** Duration: 02:00 Additional activities		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Presentation of assignment** Individual presentation Continuous assessment Not Presential Duration: 00:00
9	**Electronic Health Records** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Not Presential Duration: 00:00
10	**Database integration and semantic interoperability** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Not Presential Duration: 00:00
11	**Artificial Intelligence in medicine: Big data and machine learning (I)** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Not Presential Duration: 00:00
12	**Artificial Intelligence in Medicine: Big data and machine learning (II). Large Language Models and ethical issue** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Not Presential Duration: 00:00
13	**Biomedical standards (I)** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Not Presential Duration: 00:00
14	**Biomedical standards (II)** Duration: 02:00 Lecture		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Participation in teaching activities, in class and on-line** Individual work Continuous assessment Not Presential Duration: 00:00
15	**Final summary** Duration: 02:00 Additional activities		**IN principle, no classes will be virtual, unless there is an indication of the UPM about it** Duration: 00:00 Lecture	**Presentation of a classwork assignment** Individual presentation Continuous assessment Not Presential Duration: 00:00
16				
17				**Final examination (if the student was not able to complete the course assignments due to some justified reason).** Written test Final examination Not Presential Duration: 02:00

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year,

especially considering the COVID19 evolution.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Participation in teaching activities, in class and on-line	Individual work	No Presential	00:00	%	/ 10	CG11
2	Participation in teaching activities, in class and on-line	Individual work	No Presential	00:00	%	/ 10	
3	Participation in teaching activities, in class and on-line	Individual work	No Presential	00:00	%	/ 10	
4	Participation in teaching activities, in class and on-line	Individual work	Face-to-face	00:00	%	/ 10	
5	Participation in teaching activities, in class and on-line	Individual work	No Presential	00:00	%	/ 10	
6	Participation in teaching activities, in class and on-line	Individual work	Face-to-face	00:00	%	/ 10	
7	Participation in teaching activities, in class and on-line	Individual work	No Presential	00:00	%	/ 10	
8	Presentation of assignment	Individual presentation	No Presential	00:00	50%	5 / 10	CG8 CG11 CG12 CGI1 CEIA1 CEIA2 CEIA9 CG9 CGI3 CGI5 CGI4
9	Participation in teaching activities, in class and on-line	Individual work	No Presential	00:00	%	/ 10	
10	Participation in teaching activities, in class and on-line	Individual work	No Presential	00:00	%	/ 10	
11	Participation in teaching activities, in class and on-line	Individual work	No Presential	00:00	%	/ 10	
12	Participation in teaching activities, in class and on-line	Individual work	No Presential	00:00	%	/ 10	

13	Participation in teaching activities, in class and on-line	Individual work	No Presential	00:00	%	/ 10	
14	Participation in teaching activities, in class and on-line	Individual work	No Presential	00:00	%	/ 10	
15	Presentation of a classwork assignment	Individual presentation	No Presential	00:00	50%	5 / 10	CG8 CG11 CG12 CGI1 CEIA1 CEIA2 CEIA9 CG9 CGI3 CGI5 CGI4

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Final examination (if the student was not able to complete the course assignments due to some justified reason).	Written test	No Presential	02:00	100%	5 / 10	CG8 CG11 CG12 CGI1 CEIA1 CEIA2 CEIA9 CG9 CGI3 CGI5 CGI4

7.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

7.2. Assessment criteria

Two assignments will be presented during the length of the course. There is a possibility of a third assignment, which will be considered during the first five weeks of the course, depending on the needs of the students, as considered by the professors.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
de la Calle, G., García-Remesal, M., Chiesa, S., de la Iglesia, D., and Maojo, V. ?BIRI: a new approach for automatically discovering and indexing available public bioinformatics resources from the literature?. BMC Bioinformatics. 2009 Oct 7; 10:320.	Bibliography	
Bernstam, E.V., Smith, J.W., and Johnson, T.R. ?What is biomedical informatics?? J Biomed Inform. 2010 Feb;43 (1):104-10.	Bibliography	
Open papers and journals in Internet and Pubmed (JAMIA, JBI, JMIR, Nature and Lancet groups, etc)	Bibliography	
Devices for online teaching,	Equipment	If they are necessary, depending on the course of the pandemic

9. Other information

9.1. Other information about the subject

The attendance to the course is required and the student will be required to sign and participate everyday. This is a course that requires the participation of students. We recommend students to take a different course if they cannot attend it