ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000971 - Medical Data Intelligent Analysis

DEGREE PROGRAMME

09AU - Master Universitario En Ingenieria Biomedica

ACADEMIC YEAR & SEMESTER

2023/24 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	93000971 - Medical Data Intelligent Analysis
No of credits	3 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	09AU - Master Universitario en Ingenieria Biomedica
Centre	09 - Escuela Tecnica Superior De Ingenieros De Telecomunicacion
Academic year	2023-24

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Gema Garcia Saez (Subject coordinator)	B302.2	gema.garcia.saez@upm.es	Th - 12:00 - 14:00 It is necessary first to schedule an appointment via email.
Alejandro Rodriguez Gonzalez	CTB	alejandro.rg@upm.es	Sin horario. It is necessary to schedule an appointment via e-mail

Ernestina Menasalvas Ruiz	ETSII	ernestina.menasalvas@upm.es	Sin horario. It is necessary to schedule an appointment via e-mail
Antonio Jesus Diaz Honrubia	ETSII	antoniojesus.diaz@upm.es	Sin horario. It is necessary to schedule an appointment via e-mail

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

2.3. External faculty

Name and surname	Email	Institution
Jose Tapia Galisteo	jose.tapia.galisteo@upm.es	ETSIT UPM

3. Skills and learning outcomes *

3.1. Skills to be learned

CB06 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB07 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio

CB08 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios

CB09 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CE-MIB01 - Utilizar el lenguaje especializado empleado en entornos biomédicos y los fundamentos de las ciencias biomédicas para su aplicación en la resolución de problemas médicos de la Ingeniería Biomédica.

CE-MIB03 - Ser capaz de aplicar los métodos y tecnologías actuales en investigación biomédica aplicadas en la prevención, diagnóstico y tratamiento de enfermedades.

CG-MIB01 - Resolver problemas e integrar conocimiento en temas nuevos o escasamente definidos y en entornos multidisciplinares del área de la Ingeniería Biomédica

CG-MIB02 - Analizar y aplicar la reglamentación correspondiente a la sensibilidad social y ética en los ámbitos de operación que pueden darse en Ingeniería Biomédica

CG-MIB03 - Utilizar la filosofía, el método científico y el método experimental para la búsqueda de innovación, la curiosidad científica y el desarrollo de actitudes creativas

CG-MIB04 - Utilizar las tecnologías de la información y la comunicación para la búsqueda de información, datos bibliográficos y adquisición de nuevo conocimiento para la formación permanente y el trabajo autónomo

CG-MIB05 - Utilizar técnicas de expresión oral y escrita para comunicar trabajos y conclusiones a comunidades de iguales o divulgación científica, elaboración de artículos, manuales de estilo y herramientas de edición para fomentar la capacidad de comunicación y diseminación de resultados

CG-MIB06 - Aplicar técnicas de trabajo colaborativo en equipos multidisciplinares internacionales y liderazgo, así como utilizar métodos para asumir la responsabilidad de orientar y dirigir trabajos científicos en el ámbito de la ingeniería Biomédica

CG-MIB07 - Utilizar la lengua inglesa como herramienta de trabajo

3.2. Learning outcomes

RA24 - Utilizar los métodos y algoritmos más adecuados al análisis inteligente de datos médicos y aprender a aplicarlos de forma práctica.

* 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.

4. Brief description of the subject and syllabus

4.1. Brief description of the subject

The main goal is to learn the most appropriate methods and algorithms to be used in intelligent analysis of medical data.

Secondary objectives are:

- To learn visual data analytics methods and tools.

- To learn artificial machine learning algorithms, which can be applied to specific medical problems such as monitoring, diagnosis, prediction or treatment adjustment.

- To learn software tools to use big data analysis in practice.

4.2. Syllabus

1. 1. Characteristics of medical knowledge and clinical data. Knowledge management and medical reasoning processes

2. 2. Advanced visualization of health data

    2.1. Design of visual data analytics applications

    2.2. Interactive techniques

    2.3. Practical session

3. 3. Machine learning algorithms applied to medical data.

    3.1. Types of problems, feature selection and pre-processing

    3.2. Classification, estimation, clustering, association

    3.3. Evaluation methods

    3.4. Software tools and practical session

4. 4. Big data in health. Selection of data sources. Tools to analyse massive data: Mahout, Spark

    4.1. Selection of data sources

    4.2. Tools to analyze massive data: Mahout, Spark

    4.3. Practical session - Big data

5. Schedule

5.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**1. Introduction. Characteristics of medical knowledge and clinical data. Knowledge management and medical reasoning processes** Duration: 02:00 Lecture **2. Advanced visualization of health data. Design of visual data analytics applications. Interactive techniques.** Duration: 02:00 Lecture			
2	**2. Advanced visualization of health data. Design of visual data analytics applications. Interactive techniques.** Duration: 02:00 Laboratory assignments	**2. Advanced visualization of health data. Design of visual data analytics applications. Interactive techniques.** Duration: 02:00 Laboratory assignments		**Test 1** Online test Continuous assessment Presential Duration: 00:20
3	**3. Machine learning algorithms applied to medical data. Types of problems. Features selection and pre-processing algorithms.** Duration: 02:00 Lecture			**Practical work 1** Group work Continuous assessment Not Presential Duration: 12:00
4	**3. Machine learning algorithms applied to medical data. Types of problems. Features selection and pre-processing algorithms.** Duration: 02:00 Lecture	**3. Machine learning algorithms applied to medical data. Software tools.** Duration: 02:00 Laboratory assignments		**Test 2** Online test Continuous assessment Presential Duration: 00:30
5		**3. Machine learning algorithms applied to medical data. Types of problems. Features selection and pre-processing algorithms.** Duration: 02:00 Additional activities		**Test 3** Online test Continuous assessment Not Presential Duration: 00:20
6	**4. Big data in health. Selection of data sources.** Duration: 02:00 Lecture	**4. Big data in health. Selection of data sources. Tools to analyse massive data: Mahout, Spark and SparkR.** Duration: 02:00 Laboratory assignments		**Test 4** Online test Continuous assessment Not Presential Duration: 00:20 **Practical work 2** Group work Continuous assessment Not Presential Duration: 12:00

7	**4. Big data in health. Tools to analyse massive data: Mahout, Spark, SparkR** Duration: 02:00 Lecture	**4. Big data in health. Selection of data sources. Tools to analyse massive data: Mahout, Spark and SparkR.** Duration: 02:00 Laboratory assignments		
8		**4. Big data in health. Selection of data sources. Tools to analyse massive data: Mahout, Spark and SparkR.** Duration: 02:00 Laboratory assignments **4. Big data in health. Selection of data sources. Tools to analyse massive data: Mahout, Spark and SparkR.** Duration: 02:00 Laboratory assignments		**Practical work 3** Group work Continuous assessment Not Presential Duration: 12:00 **Written work + presentation** Group work Continuous assessment Presential Duration: 04:00
9				
10				
11				
12				
13				
14				
15				
16				
17				**Written work + presentation** Group work Final examination Presential Duration: 01:00 **Practical work 1** Individual work Final examination Not Presential Duration: 02:00 **Practical work 2** Individual work Final examination Not Presential Duration: 02:00 **Practical work 3** Individual work Final examination Not Presential Duration: 02:00 **Final exam** Problem-solving test Final examination Presential Duration: 01:00

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.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
2	Test 1	Online test	Face-to-face	00:20	5%	0 / 10	CB07 CB08 CG-MIB07
3	Practical work 1	Group work	No Presential	12:00	20%	0 / 10	CB06 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01
4	Test 2	Online test	Face-to-face	00:30	5%	0 / 10	CB06 CG-MIB04 CG-MIB07 CG-MIB01
5	Test 3	Online test	No Presential	00:20	5%	0 / 10	CB08 CG-MIB07 CG-MIB01
6	Test 4	Online test	No Presential	00:20	5%	0 / 10	CB07 CE-MIB01
6	Practical work 2	Group work	No Presential	12:00	20%	0 / 10	CB06 CB07 CB09 CB08 CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02
8	Practical work 3	Group work	No Presential	12:00	20%	0 / 10	CB06 CB10 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02

8	Written work + presentation	Group work	Face-to-face	04:00	20%	5 / 10	CB06 CB07 CB09 CB08 CB10 CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02 CE-MIB01 CE-MIB03

6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Written work + presentation	Group work	Face-to-face	01:00	20%	5 / 10	CB06 CB07 CB09 CB08 CB10 CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02 CE-MIB01 CE-MIB03
17	Practical work 1	Individual work	No Presential	02:00	20%	5 / 10	CB06 CB07 CB09 CB08 CB10 CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02 CE-MIB01 CE-MIB03
		Individual					CB06 CB07 CB09 CB08 CB10 CG-MIB03 CG-MIB04

17	Practical work 2	work	No Presential	02:00	20%	5 / 10	CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02 CE-MIB01 CE-MIB03
17	Practical work 3	Individual work	No Presential	02:00	20%	5 / 10	CB06 CB07 CB09 CB08 CB10 CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02 CE-MIB01 CE-MIB03
17	Final exam	Problem-solving test	Face-to-face	01:00	20%	5 / 10	CB06 CB07 CB09 CB08 CB10 CG-MIB03 CG-MIB05 CG-MIB07 CG-MIB02 CE-MIB01 CE-MIB03

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills

Practical sessions	Individual work	Face-to-face	03:00	60%	5 / 10	CB06 CB07 CB09 CB08 CB10 CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02 CE-MIB01 CE-MIB03
Written report + presentation	Individual presentation	Face-to-face	01:00	20%	5 / 10	CB06 CB07 CB09 CB08 CB10 CG-MIB03 CG-MIB04 CG-MIB05 CG-MIB06 CG-MIB07 CG-MIB01 CG-MIB02 CE-MIB01 CE-MIB03
Final exam	Individual presentation	Face-to-face	01:00	20%	5 / 10	CB06 CB07 CB09 CB08 CB10 CG-MIB05 CG-MIB07 CG-MIB01 CG-MIB02 CE-MIB01 CE-MIB03

6.2. Assessment criteria

Students will be qualified through **progressive assessment** by default. Students will need to obtain a score of 5 or above to pass the course. Where there is a minimum score indicated in a specific activity, it is required to get the minimum score to calculate the final score.

All the deliverables that are requested must be the result of the student's personal work. Copy detection in an activity will mean failing the activity.

The evaluation will assess if students have acquired all the competencies of the subject.

Progressive assessment:
In order to pass the course, students have to deliver the requested material about the 3 practical works, a written report related to a group work and present its content before the end of the course. Delays in handing in of deliverables will be penalized by 20%. Passing score for the whole course is 5/10.

Global assessment

Students who can not follow the progressive assessment can deliver the practical sessions at the end of the course, one day before the date of the global assessment approved by Junta de Escuela for the current academic semester and year; they should complete the practical sessions on their own and with their own means. The written work report + presentation could be delivered and done at the ordinary exam date, if requested sending an email via Moodle to the coordinator one week before the exam date approved by Junta de Escuela for the current academic semester and year. A practical exam related to the practical works delivered will be done with a weight of 20% over the final score.

Extraordinary assessment

Extraordinary assessment is based on the same evaluation techniques as in the global assessment, with the following weights:

- Practical sessions: 60%

- Exam: 20%

- Written work + presentation: 20%

The score of practical sessions delivered at the progressive or global assessment can be kept for the extraordinary evaluation in agreement with the student.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
Vipin Kumar, Michael Steinbach, Pang-Ning Tan. Introduction to data mining. Addison-Wesley Companion Book Site . 2006	Bibliography	
Quinlan, J.R. (1979). Discovering rules by induction from large collections of examples. In D. Michie (Ed.), Expert systems in the micro electronic age. Edinburgh University Press	Bibliography	
Bishop, Christopher (2006). Pattern Recognition and Machine Learning Springer	Bibliography	

Munzner. A Nested Model of Visualization Design and Validation?. IEEE TVCG 15(6):921-928, 2009 (Proc. InfoVis 2009)	Bibliography	
Mining of Massive Datasets. J. Leskovec, A. Rajaraman, J. Ullman, Cambridge University Press 2014	Bibliography	
Hadoop: The definitive guide. Tom White. Ed. O?Reilly Media, 2015	Bibliography	
Big data essentials. Anil Maheshwari, 2016	Bibliography	
Hadoop Wiki	Web resource	http://wiki.apache.org/lucene-hadoop/

8. Other information

8.1. Other information about the subject

The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. This course is related to SDG 3 and 4, specifically to points:

- 3.D Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks.

- 4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship