



POLITÉCNICA

INTERNATIONAL
CAMPUS OF
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COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



E.T.S. de Ingenieros de
Telecomunicación

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000942 - Data Science Foundations And Applications

DEGREE PROGRAMME

09AT - Master Universitario En Teoria De La Señal Y Comunicaciones

ACADEMIC YEAR & SEMESTER

2024/25 - Semester 1

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1. Description

1.1. Subject details

Name of the subject	93000942 - Data Science Foundations And Applications
No of credits	2 ECTS
Type	Optional
Academic year of the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	09AT - Master Universitario en Teoría de la Señal y Comunicaciones
Centre	09 - Escuela Técnica Superior De Ingenieros De Telecomunicación
Academic year	2024-25

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Luis Alfonso Hernandez Gomez	C-330	luisalfonso.hernandez@upm.es	Sin horario. Appointment arranged by email
Federico Alvarez Garcia (Subject coordinator)	D103	federico.alvarez@upm.es	Sin horario. Appointment arranged by email

Eduardo Lopez Gonzalo	C-330	eduardo.lopez@upm.es	Sin horario. Appointment arranged by email
Jose Luis Blanco Murillo		jl.blanco@upm.es	Sin horario. Appointment arranged by email

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

3. Skills and learning outcomes *

3.1. Skills to be learned

CT01 - Capacidad para comprender los contenidos de clases magistrales, conferencias y seminarios en lengua inglesa

CT03 - Capacidad para adoptar soluciones creativas que satisfagan adecuadamente las diferentes necesidades planteadas

CT04 - Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo

CT05 - Capacidad para gestionar la información, identificando las fuentes necesarias, los principales tipos de documentos técnicos y científicos, de una manera adecuada y eficiente

3.2. Learning outcomes

RA26 - Ability of oral and written communication

RA1 - Capacidad para desarrollar técnicas de tratamiento de señal específicas para datos masivos y diseñar aplicaciones sobre señales como: imágenes, señales de video, voz, audio y las procedentes de sensores de diversanaturaleza

RA7 - Capacidad para desarrollar y evaluar técnicas de aprendizaje automático y diseñar sistemas de aprendizaje para datos masivos

RA22 - Knowing conduct a technical presentation before an audience of peers, describing the work and results clearly and well structured, on time, and using precise language

* 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 course provides an overview of the scientific foundations and major technological challenges when extracting knowledge from the rich variety of signals and data provided by current and future communication systems. A main focus is placed on large, diverse, distributed and heterogeneous data sets that can be described by the Big Data paradigm. The course also presents application scenarios covering a wide range of industrial sectors: Cognitive Radio, Cognitive Networks, Future Internet Services, Social Networks and Multimedia Analytics, Internet-of-Things, Machine-to-Machine, Smart Cities, Smart Grids, Biomedical Applications, Biometrics and Forensics, Financial Services, Robotic systems through Case studies and debates which are addressed over a set of conferences bringing together leading experts in different sectors. Seminars are devoted to special topics such as Privacy and Big Data, Big Data Project Management or the connections between Next-Generation Communications, Internet-of-Things, Big Data Platforms and Cognitive and Knowledge-based Services.

The main outcome of the course will be to reinforce the applicability of the contents acquired during the MSc to the market, follow the trends and real cases from the big data applications market and increase the contact of the student with professionals from the sector. This will enhance their skills for developing their future professional carriers.

A basic outcome of this course will be to help students to have a global perspective on contents, complementarity and practical values of the different courses in this Track.

Another important course outcome will be to prepare students to critically assess the value of scientific and technological

approaches to derive knowledge from data in real-world applications.

4.2. Syllabus

1. Presentation and study of several case studies and basic frameworks and languages
 - 1.1. Computation frameworks for BigData
 - 1.2. Programming BigData: practical cases, languages and basic tools. Lab.
 - 1.3. Applications of BigData for telecom operators
 - 1.4. Applications of BigData for fintech
 - 1.5. BigData business opportunities
 - 1.6. BigData in retail
 - 1.7. BigData next steps
2. Analysis of case studies and state of play

5. Schedule

5.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	Introduction and case studies Duration: 00:30 Lecture Presentation and introduction to applications with AI: Machine Learning, Deep Learning and Reinforced Learning Duration: 01:30 Lecture			
2	Presentation and introduction to applications with AI: Machine Learning, Deep Learning and Reinforced Learning (continuation) Duration: 02:00 Lecture			
3	Lab 1: introduction to BigData and Machine Learning programming Duration: 02:00 Cooperative activities			
4	Lab 1 (continuation): introduction to BigData and Machine Learning programming Duration: 02:00 Cooperative activities			
5				
6	Conference / seminar 1 Duration: 01:30 Cooperative activities			Conferences report submission or questionnaire Other assessment Progressive assessment Not Presential Duration: 00:00
7				
8	Conference / seminar 2 Duration: 01:30 Cooperative activities			Conferences report submission or questionnaire Other assessment Progressive assessment Not Presential Duration: 00:00
9				
10				
11	Data Science Applications Duration: 02:00 Lecture			

12	Data Science Frameworks Duration: 02:00 Lecture			
13		Analysis of case studies and trends Duration: 01:30 Cooperative activities		
14		Presentation of study cases Duration: 02:00 Cooperative activities		Elaboration of the analysis of one/several case studies Individual presentation Progressive assessment Presential Duration: 02:00 Elaboration of the analysis of one/several case studies Individual presentation Global examination Presential Duration: 02:00
15				
16				
17				Test / short questions on the theoretical content presented in the lectures and conferences Written test Progressive assessment Presential Duration: 02:00 Test / short questions on the theoretical content presented in the lectures and conferences Written test Global examination 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.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
6	Conferences report submission or questionnaire	Other assessment	No Presential	00:00	10%	5 / 10	CT01 CT05
8	Conferences report submission or questionnaire	Other assessment	No Presential	00:00	10%	5 / 10	CT01 CT05
14	Elaboration of the analysis of one/several case studies	Individual presentation	Face-to-face	02:00	40%	4 / 10	CT03 CT04 CT05
17	Test / short questions on the theoretical content presented in the lectures and conferences	Written test	Face-to-face	02:00	40%	4 / 10	CT03 CT04 CT05

6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
14	Elaboration of the analysis of one/several case studies	Individual presentation	Face-to-face	02:00	40%	4 / 10	CT03 CT04 CT05
17	Test / short questions on the theoretical content presented in the lectures and conferences	Written test	Face-to-face	02:00	60%	4 / 10	CT01 CT03 CT04 CT05

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Conferences proof or equivalent request	Other assessment	Face-to-face	02:00	20%	5 / 10	CT01 CT05

Recovering: Elaboration of the analysis of one/several case studies	Group work	Face-to-face	00:20	40%	4 / 10	CT03 CT04 CT05
Test / short questions on the theoretical content presented in the lectures and conferences	Written test	Face-to-face	02:00	40%	4 / 10	CT03 CT04 CT05

6.2. Assessment criteria

Evaluation will assess if students have acquired all the competences of the subject. Evaluation activities that assess learning outcomes that cannot be evaluated through a single exam can be carried out along the semester (conferences and work in pairs).

Extraordinary examination will be carried out with the same approach.

The evaluation will be based on 3 elements:

- 1.- Conferences and seminars attendance (weight 20%) Note: the attendance to the 85% of the conferences is mandatory to get the minimal mark 5/10
- 2.- Elaboration of the analysis of one/several case studies (written) and presentation in the classroom to the rest of students (weight 40%) - minimal mark 4/10
- 3.- Test / short questions on the theoretical content presented in the lectures, seminar and conferences (weight 40%) - minimal mark 4 / 10

According to the nature of this subject, the evaluation will be done following the scheme presented above. This subject does not include the possibility to carry out an assessment without attending the conferences and seminars, and the elaboration of the analysis requested.

Extraordinary examination:

- Same approach, but the activities should be carried out during the ordinary period (conferences can only take place in the indicated times and cannot be carried out again in the extraordinary exam period, therefore a work can be requested to replace) to be carried out again for the extraordinary exam if the minimal mark is not reached.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners	Bibliography	This book provides a view into BigData with the overview of big data and its notable characteristics; high performance computing architectures for analytics; comprehensive coverage of data mining, text analytics; and machine learning predictive modeling

8. Other information

8.1. Other information about the subject

In this subject we align with the the Sustainable Development Goals (SDG) 4, 5 and 9.

Especially this subject will support in the activities to be carried out:

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

5.B Enhance the use of enabling technology, in particular information and communications technology, to promote

the empowerment of women

9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending