COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001

INTERNATIONAL
CAMPUS OF
EXCELLENCE

POLITÉCNICA

ETSIT UPM   E.T.S. de Ingenieros de
Telecomunicacion

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

2021/22 - Semester 1

Index

Learning guide

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 ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	09AT - Master Universitario en Teoria de la Señal y Comunicaciones
Centre	09 - Escuela Tecnica Superior De Ingenieros De Telecomunicacion
Academic year	2021-22

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
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

Luis Alfonso Hernandez Gomez	C-330	luisalfonso.hernandez@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

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

CE01 - Analizar y aplicar técnicas para el diseño y desarrollo avanzado de equipos y sistemas, basándose en la teoría de la señal y las comunicaciones, en un entorno internacional

CE03 - Valorar y contrastar la utilización de las diferentes técnicas disponibles para la resolución de problemas reales dentro del área de teoría de la señal y comunicaciones.

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

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

RA34 - Capability to develop and evaluate machine-learning techniques and to design big data learning systems

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

RA41 - Ability to select and apply adequate machine learning techniques to large-scale multimedia datasets and evaluate their performance

* 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.

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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 oportunities

    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	Face-to-face classroom activities	Face-to-face laboratory 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** Other assessment Continuous assessment Not Presential Duration: 01:00
7				
8	**Conference / seminar 2** Duration: 01:30 Cooperative activities			
9				**Conferences** Other assessment Continuous assessment Not Presential Duration: 01:00
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 Continuous assessment Presential Duration: 00:20
15				
16				
17				Test / short questions on the theoretical content presented in the lectures Written test Continuous assessment Presential Duration: 02:00 exam on the contents of the conferences and lectures, and presentation of individual homeworks. Written test Final 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.

* 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.

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6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
6	Conferences	Other assessment	No Presential	01:00	10%	5 / 10	CE03 CT05
9	Conferences	Other assessment	No Presential	01:00	10%	5 / 10	CE03 CT05
14	Elaboration of the analysis of one/several case studies	Individual presentation	Face-to-face	00:20	50%	4 / 10	CE01 CT03 CB06 CT05
17	Test / short questions on the theoretical content presented in the lectures	Written test	Face-to-face	02:00	30%	4 / 10	CE03

6.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	exam on the contents of the conferences and lectures, and presentation of individual homeworks.	Written test	Face-to-face	02:00	100%	5 / 10	CE01 CT03 CB06 CE03 CT05

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
exam on the contents of the conferences and lectures, and presentation of individual homeworks.	Written test	Face-to-face	02:00	100%	5 / 10	CE01 CE03 CT05 CT03 CB06

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6.2. Assessment criteria

Students will be qualified through continuous evaluation by default. According to the "Normativa de Evaluación del Aprendizaje de la Universidad Politécnica de Madrid", students willing to renounce to continuous evaluation must complete the Moodle task entitled "Renounce to continuous evaluation" before the end of the 4th week from the subject start date.

Evaluation will assess if students have acquired all the competences of the subject. Thus, evaluation through final assessment will be carried out considering all the evaluation techniques used in continuous evaluation (EX, ET, TG, etc.), and will be celebrated in the exam period approved by "Junta de Escuela" for the current academic semester and year. Evaluation activities that assess learning outcomes that cannot be evaluated through a single exam can be carried out along the semester.

Extraordinary examination will be carried out exclusively by the final examination method.

The continous evaluation will be based on 3 elements, covered in the evaluation:

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 50%) - minimal mark 4/10

3.- Test / short questions on the theoretical content presented in the lectures (weight 30%) - 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 a continuous assessment without attending the conferences and seminars, and the elaboration of the analysis requested.

Students opting out the continuous assessment should take part in the final exam which will consist of:

- 50% of the mark the assessment of the presentation of the analysis of one case study which will be done during the exam, under the same conditions of the students taking part in the continous assessment (minimal mark 4 out of 10 in this part)

- 20% showing proof of the attendance to the conferences, or the student should carry out an oral exam on the conferences contents (minimal mark 5 out of 10 in this part)

- 30% Test / short questions on the theoretical content presented in the lectures - minimal mark 4 out of 10

Extraordinary exam:

- 50% of the mark: the assessment of the presentation of the analysis of one case study which will be done during the exam, under the same conditions of the students taking part in the continous assessment (minimal mark 4 out of 10 in this part)

- 20% showing proof of the attendance to the conferences, or that the student have acquired the competences through oral exam on the contents (minimal mark 5 out of 10 in this part)

- 30% Test / short questions on the theoretical content presented in the lectures (minimal mark 4 out of 10)

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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 allign with the the Sustainable Development Goals (SDG) 4, 5 and 9.

Especifically 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

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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