



POLITÉCNICA

INTERNATIONAL  
CAMPUS OF  
EXCELLENCE

COORDINATION PROCESS OF  
LEARNING ACTIVITIES  
PR/CL/001



E.T.S. de Ingenieros de  
Telecomunicacion

# ANX-PR/CL/001-01

## LEARNING GUIDE

### SUBJECT

**93001071 - Data Science Foundations And Applications**

### DEGREE PROGRAMME

09AQ - Master Universitario en Ingenieria de Telecomunicacion

### ACADEMIC YEAR & SEMESTER

2019/20 - Semester 1

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## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	93001071 - Data Science Foundations And Applications
<b>No of credits</b>	2 ECTS
<b>Type</b>	Optional
<b>Academic year of the programme</b>	Second year
<b>Semester of tuition</b>	Semester 3
<b>Tuition period</b>	September-January
<b>Tuition languages</b>	English
<b>Degree programme</b>	09AQ - Master Universitario en Ingenieria de Telecomunicacion
<b>Centre</b>	09 - Escuela Tecnica Superior de Ingenieros de Telecomunicacion
<b>Academic year</b>	2019-20

## 2. Faculty

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### 2.1. Faculty members with subject teaching role

<b>Name and surname</b>	<b>Office/Room</b>	<b>Email</b>	<b>Tutoring hours *</b>
Eduardo Lopez Gonzalo	C-330	eduardo.lopez@upm.es	Sin horario. Appointment arranged by email
Federico Alvarez Garcia (Subject coordinator)	D103	federico.alvarez@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 \*

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#### 3.1. Skills to be learned

CE1 - Capacidad para aplicar métodos de la teoría de la información, la modulación adaptativa y codificación de canal, así como técnicas avanzadas de procesamiento digital de señal a los sistemas de comunicaciones y audiovisuales.

CG1 - 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.

CG2 - 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.

CG4 - 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.

CG5 - 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.

CT1 - Capacidad para comprender los contenidos de clases magistrales, conferencias y seminarios en lengua inglesa.

CT3 - Capacidad para adoptar soluciones creativas que satisfagan adecuadamente las diferentes necesidades planteadas.

CT4 - Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo.

CT5 - 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

RA305 - Capability to design, develop and evaluate machine-learning techniques for a wide range of application areas

RA315 - capacity to understand the data science foundations and most relevant applications

RA194 - Conocer y aplicar técnicas de análisis de datos

RA10 - Saber realizar una presentación de carácter técnico, ante una audiencia de pares, que describa el trabajo realizado y sus resultados, de forma clara y bien estructurada, en el tiempo establecido, y usando un lenguaje preciso

\* 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

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### 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	Face-to-face classroom activities	Face-to-face laboratory activities	Other face-to-face activities	Assessment activities
1	<b>Introduction and case studies</b> Duration: 00:30 Lecture  <b>Presentation and introduction to applications with AI: Machine Learning, Deep Learning and Reinforced Learning</b> Duration: 01:30 Lecture			
2	<b>Presentation and introduction to applications with AI: Machine Learning, Deep Learning and Reinforced Learning (continuation)</b> Duration: 02:00 Lecture			
3	<b>Lab 1: introduction to BigData and Machine Learning programming</b> Duration: 02:00 Cooperative activities			
4	<b>Lab 1 (continuation): introduction to BigData and Machine Learning programming</b> Duration: 02:00 Cooperative activities			
5				
6	<b>Conference / seminar 1</b> Duration: 01:30 Cooperative activities			<b>Conferences</b> Other assessment Continuous assessment Duration: 01:00
7				
8	<b>Conference / seminar 2</b> Duration: 01:30 Cooperative activities			
9				<b>Conferences</b> Other assessment Continuous assessment Duration: 01:00
10				
11	<b>Data Science Foundations</b> Duration: 02:00 Lecture			



12	<b>Data Science Applications</b> Duration: 02:00 Lecture			
13	<b>Data Science Frameworks</b> Duration: 02:00 Lecture			
14	<b>Analysis of case studies and trends</b> Duration: 01:30 Cooperative activities			
15				
16				
17				<p><b>Test / short questions on the theoretical content presented in the lectures</b></p> <p>Written test Continuous assessment Duration: 02:00</p> <p><b>Elaboration of the analysis of one/several case studies</b></p> <p>Individual presentation Continuous assessment Duration: 00:20</p> <p><b>exam on the contents of the conferences and lectures, and presentation of individual homeworks.</b></p> <p>Written test Final examination Duration: 02:00</p>

The independent study hours are training activities during which students should spend time on individual study or individual assignments.

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 subject schedule is based on a previous theoretical planning of the subject plan and might go through experience some unexpected changes along throughout the academic year.

## 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	Face-to-face	01:00	10%	5 / 10	CG4 CT1
9	Conferences	Other assessment	Face-to-face	01:00	10%	5 / 10	CG4 CT1
17	Test / short questions on the theoretical content presented in the lectures	Written test	Face-to-face	02:00	30%	4 / 10	CT4 CT1 CG5 CT5 CG4 CG2 CT3 CG1 CE1
17	Elaboration of the analysis of one/several case studies	Individual presentation	Face-to-face	00:20	50%	4 / 10	CG4 CT4 CG2 CG1

#### 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	CG4 CT3 CT4 CT1 CT5 CG2 CG5 CG1 CE1

### 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	CT4 CT1 CG5 CT5 CG4 CG2 CT3 CG1 CE1

### 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 continuous 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 continuous 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 continuous 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)

## 7. Teaching resources

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### 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