



POLITÉCNICA

INTERNATIONAL  
CAMPUS OF  
EXCELLENCE

COORDINATION PROCESS OF  
LEARNING ACTIVITIES  
PR/CL/001



E.T.S. de Ingenieros  
Informáticos

# ANX-PR/CL/001-01

## LEARNING GUIDE

### SUBJECT

**103001020 - Big Data**

### DEGREE PROGRAMME

10AN - Master Universitario En Ingeniería Informática

### ACADEMIC YEAR & SEMESTER

2023/24 - Semester 1

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## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	103001020 - Big Data
<b>No of credits</b>	3 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>	10AN - Master Universitario en Ingeniería Informática
<b>Centre</b>	10 - Escuela Técnica Superior De Ingenieros Informaticos
<b>Academic year</b>	2023-24

## 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>
Antonio Latorre De La Fuente (Subject coordinator)	4101	a.latorre@upm.es	Sin horario.
Julian Arenas Guerrero	4204	julian.arenas.guerrero@upm.es	Sin horario.
Jorge Acosta Hernandez	4201	jorge.acosta@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. Skills and learning outcomes \*

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### 3.1. Skills to be learned

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.

CB7 - 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

CE10 - Capacidad para comprender y poder aplicar conocimientos avanzados de computación de altas prestaciones y métodos numéricos o computacionales a problemas de ingeniería.

CG2 - Capacidad de gestionar la información

### 3.2. Learning outcomes

RA108 - Conocer técnicas de visualización y procesos de análisis de datos, y de programación, diseño y depuración de algoritmos, para computación de altas prestaciones.

RA39 - Ser capaz de procesar datos masivos

RA109 - Conocer cómo se aplican las técnicas de computación científica en algún campo específico de ciencia o ingeniería

\* 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

This course will allow the student to gain the fundamentals for the analysis of large volumes of data. With an eminently practical approach, the technologies and fundamentals necessary to successfully accomplish the whole data analysis process will be presented in the context of Big Data, from the raw data to the models derived from them.

### 4.2. Syllabus

1. Introduction to Big Data
  - 1.1. Architectures and applications
  - 1.2. Data types
  - 1.3. Visual analytics
2. Big Data Ecosystem
3. Big Data Technologies
  - 3.1. Technological Challenges
  - 3.2. Basic solution: gfs + MapReduce
  - 3.3. Hadoop (hdfs + yarn)
  - 3.4. Pig
  - 3.5. Hive
  - 3.6. Beyond MapReduce
    - 3.6.1. Tez
    - 3.6.2. Spark
    - 3.6.3. Flink
4. Spark
  - 4.1. Spark Basics
  - 4.2. Spark Applications
  - 4.3. Spark SQL

## 5. Machine Learning with Spark

### 5.1. Brief review of Machine Learning basics

### 5.2. Spark MLlib

## 5. Schedule

### 5.1. Subject schedule\*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1				
2				
3				
4				
5				
6				
7				
8				
9	<b>Lesson 1</b> Duration: 02:00 Lecture  <b>Lesson 2</b> Duration: 01:00 Lecture			
10	<b>Lesson 2</b> Duration: 01:00 Lecture			
11	<b>Lesson 3</b> Duration: 01:00 Lecture	<b>Practical Work</b> Duration: 02:00 Laboratory assignments		
12	<b>Lesson 3</b> Duration: 01:00 Problem-solving class	<b>Practical Work</b> Duration: 02:00 Laboratory assignments		
13	<b>Lesson 4</b> Duration: 01:00 Lecture  <b>Lesson 4</b> Duration: 01:00 Problem-solving class	<b>Practical Work</b> Duration: 01:00 Laboratory assignments		
14	<b>Lesson 4</b> Duration: 01:00 Lecture  <b>Lesson 4</b> Duration: 01:00 Problem-solving class	<b>Practical Work</b> Duration: 01:00 Laboratory assignments		
15	<b>Lesson 4</b> Duration: 01:00 Lecture	<b>Practical Work</b> Duration: 02:00 Laboratory assignments		

16	<p><b>Lesson 5</b> Duration: 01:00 Lecture</p> <p><b>Lesson 5</b> Duration: 01:00 Problem-solving class</p>	<p><b>Practical Work</b> Duration: 01:00 Laboratory assignments</p>		<p><b>Assignment Deadline</b> Group work Continuous assessment and final examination Not Presential Duration: 00:00</p>
17				<p><b>Final Exam</b> Written test Continuous assessment and final examination Presential Duration: 02:00</p>

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
16	Assignment Deadline	Group work	No Presential	00:00	80%	4 / 10	CB7 CB10 CG2 CE10
17	Final Exam	Written test	Face-to-face	02:00	20%	4 / 10	CB7 CB10 CG2 CE10

#### 6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
16	Assignment Deadline	Group work	No Presential	00:00	80%	4 / 10	CB7 CB10 CG2 CE10
17	Final Exam	Written test	Face-to-face	02:00	20%	4 / 10	CB7 CB10 CG2 CE10

#### 6.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

## 6.2. Assessment criteria

### Regular call

This section covers the evaluation criteria for this course. All the students enrolled in this course will be subject, by default, to the progressive evaluation scheme. For this reason, this learning guide will be focused on this evaluation approach and it details all the evaluation activities in the timeline of the course.

The evaluation of the course will take into account both the theoretical and the practical knowledge acquired in the lectures and in the practical work carried out during the course, respectively.

This course will be evaluated in two ways:

- **Final exam.** At the end of the course, there will be a final exam covering all the contents presented during the course.
- **Practical work.** This assignment will be presented during the course, at class, in the date detailed in the timeline of the course. There will be some classes devoted to this assignment, in which the students will count with the support of the instructor, which should be, in general, complemented with autonomous work by the student. The deadline for the assignment will be fixed at the end of the term, as shown in the timeline of the course. No late assignments will be accepted for evaluation. The delivery of the assignment is considered a mandatory activity in order to pass the course.

The **final grade** for this course will be computed as follows: 20% for the final exam and 80% for the assignment. To pass the course, a **minimum score of 4** is required for each of these parts and a **grand mean** of 5 is needed combining these two items of evaluation.

### Extraordinary call

If the students do not succeed in this course, they will have to repeat the evaluation activities not passed in the ordinary evaluation. There will be a new call for the final exam as well as a new deadline for the assignment with the same requirements as in the regular call.

## 7. Teaching resources

### 7.1. Teaching resources for the subject

Name	Type	Notes
Book 1	Bibliography	Jiawei Han, Micheline Kamber, Data Mining : Concepts and Techniques, 2nd edition, Morgan Kaufmann, ISBN 1558609016, 2006.
Book 2	Bibliography	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Addison Wesley, ISBN: 0321321367, 2005
Book 3	Bibliography	Ian Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, 2nd Edition, Morgan Kaufmann, ISBN: 0120884070, 2005.
Book 4	Bibliography	Ian Witten, Eibe Frank, Mark Hall, Data Mining: Practical Machine Learning Tools and Techniques, 3rd Edition, Morgan Kaufmann, ISBN: 978-0-12-374856-0, 2011.
Book 5	Bibliography	Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia. Learning Spark: Lightning-Fast Big Data Analysis. O'Reilly Media. 2015.
Book 6	Bibliography	Sandy Ryza, Uri Laserson, Sean Owen, Josh Wills. Advanced Analytics with Spark: Patterns for Learning from Data at Scale. O'Reilly Media. 2015.
Spark documentation	Web resource	<a href="http://spark.apache.org/docs/latest/">http://spark.apache.org/docs/latest/</a>

Web site of the course	Web resource	UPM Moodle
Hive documentation	Web resource	<a href="https://cwiki.apache.org/confluence/display/Hive/Home">https://cwiki.apache.org/confluence/display/Hive/Home</a>

## 8. Other information

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### 8.1. Other information about the subject

This course is jointly offered with other Master Programmes and lectures are delivered in English.