



## Teaching Guide

Identifying Data					2022/23
Subject (*)	Data Analytics with HPC	Code	614473108		
Study programme	Mestrado Universitario en Computación de Altas Prestacións / High Performance Computing (Mod. Presencial)				
Descriptors					
Cycle	Period	Year	Type	Credits	
Official Master's Degree	2nd four-month period	First	Optional	6	
Language	English				
Teaching method	Face-to-face				
Prerequisites					
Department	Enxeñaría de Computadores				
Coordinador	López Taboada, Guillermo	E-mail	guillermo.lopez.taboada@udc.es		
Lecturers	López Taboada, Guillermo Rodríguez Álvarez, Gabriel	E-mail	guillermo.lopez.taboada@udc.es gabriel.rodriguez@udc.es		
Web	aula.cesga.es				
General description	<p>The increasing amount of information available through the Internet calls for the efficient processing of large amounts of data. This has led to the development of new storage and processing techniques to deal with huge amounts of data, namely Big Data techniques, that naturally adapt to distributed systems.</p> <p>The main goal of this subject is to learn suitable processing techniques for large amounts of information in the Big Data world, particularly using the Hadoop ecosystem, and compare these techniques with the traditional ones employed in HPC environments. This will allow the student to select the optimal tools to solve a particular problem.</p>				

## Study programme competences

Code	Study programme competences
A1	CE1 - Define, evaluate and select the most appropriate architecture and software to solve a problem
A2	CE2 - Analyze and improve the performance of a given architecture or software
B1	CB6 - Possess and understand the knowledge that give a baseline or opportunity to be original in the development and/or application of ideas, often in a research environment
B2	CB7 - The students have to know how to apply the acquired knowledge and their capacity to solve problems in new or hardly explored environment inside wider contexts (or multidisciplinary) related to its area of development
B6	CG1 - Be able to search and select useful information to solve complex problems, using the bibliographic sources of the field
B8	CG3 - Be able to maintain and extend properly funded theoretical hypothesis to allow the introduction and exploitation of novel and advanced technologies in the field
B10	CG5 - Be able to work in teams, specially multidisciplinary, and do a proper time and people management and decision taking
C1	CT1 - Use the basic technologies of the information and computing technology field required for the professional development and the long-life learning
C4	CT4 - Value the importance of research, innovation and the technological development in the socioeconomical and cultural advance of the society

## Learning outcomes

Learning outcomes	Study programme competences		
The student will be capable of installing, configuring, and managing the basic software for massive data processing.	AJ1 AJ2	BJ2 BJ6 BJ8 BJ10	CJ1
The student will be capable of coding massive data processing applications using domain-specific languages.	AJ2	BJ1 BJ2 BJ10	CJ1



The student will learn about Data Engineering tools (for Intake/Storage/Processing/Visualization).	AJ1	BJ1	CJ1
	AJ2	BJ2	CJ4
The student will learn the skills to search, select and manage Big data-related resources (bibliography, software, etc.).	AJ1	BJ1	CJ1
	AJ2	BJ6	CJ4

Contents	
Topic	Sub-topic
1. Introduction to Data Engineering	1.1 HPC vs Big Data: similarities and differences in data management. 1.2 Hardware and Software Technologies for High Performance Data Engineering 1.3 Data Engineering in HPC infrastructures vs. Cloud environments
2. Introduction to Data Analytics	2.1 Exploratory Data Analytics 2.2 Introduction to Machine Learning
3. Data Engineering phases	3.1 Modeling (Formats, Compression, Designing Schemas) 3.2 Intake (Periodicity, Transformations, Tools) 3.3 Storage (HDFS and NoSQL DBs, HBase, MongoDB, Cassandra) 3.4 Processing (Batch, Real-Time) 3.5 Orchestration 3.6 Analysis (SQL, Machine Learning, Graphs, UI) 3.7 Governance 3.8 Integration with BI (Visualization)
4. Use cases	4.1 Applications to Internet of Things (Smart environments and Industry 4.0) 4.2 Applications to sciences and engineering

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 A2 B1 C4	18	0	18
Laboratory practice	B1 B8 B10	20	60	80
Supervised projects	A1 A2 B1 B2 B8	0	45	45
Directed discussion	B6 C1 C4	4	2	6
Personalized attention		1	0	1

(\*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Taught by a professor. Classes include theoretical contents, as well as seminars.
Laboratory practice	Problem solving and practical cases.
Supervised projects	Semi-autonomous work on larger practical cases, under the professors' guidance.
Directed discussion	Guidance to solve individual / group assignments, problem solving and continuous evaluation activities.

Personalized attention	
Methodologies	Description
Directed discussion	During laboratory practice, supervised projects, and directed discussions, students will be able to ask questions, doubts, etc. The teacher, after listening to the students feedback, will go over difficult concepts, solve new problems, or use any appropriate methodology to answer the questions.
Laboratory practice	
Supervised projects	

Assessment
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Methodologies	Competencies	Description	Qualification
Laboratory practice	B1 B8 B10	Grading the assignments submitted by students.	50
Supervised projects	A1 A2 B1 B2 B8	Grading the supervised projects submitted by students.	50

#### Assessment comments

Not graded: Students that do not present any practical exercise or guided project will not be graded.

Second opportunity (June/July): Resubmit those laboratory practices or supervised projects not previously presented or submitting improved versions of previously presented practices/projects.

In the case of fraudulent performance of practices or projects the regulations of the University will be applied.

#### Sources of information

<b>Basic</b>	- Tom White (2015). Hadoop: The Definitive Guide. O'Reilly (4 <sup>a</sup> ed.) - Wes McKinney (2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython. O'Reilly (2 <sup>a</sup> ed.)
<b>Complementary</b>	- Alex Holmes (2014). Hadoop in practice. Manning (2 <sup>a</sup> ed.)

#### Recommendations

Subjects that it is recommended to have taken before

Subjects that are recommended to be taken simultaneously

Subjects that continue the syllabus

#### Other comments

Recommendations Due to the large practical component of the subject, it is advisable to be up-to-date with practices and guided projects during the semester.

Observations The course makes intensive use of online communication tools: Video calls, chats, etc. In-person classes will be recorded for later perusing. An online learning management will be using for distributing notes, creating forums, etc.

The software tools used in this course are generally open-source or have free license for students.

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.