



## Teaching Guide

Identifying Data					2022/23
Subject (*)	Machine Learning II	Code	614544014		
Study programme	Máster Universitario en Intelixencia Artificial				
Descriptors					
Cycle	Period	Year	Type	Credits	
Official Master's Degree	2nd four-month period	First	Optional	3	
Language	English				
Teaching method	Hybrid				
Prerequisites					
Department	Ciencias da Computación e Tecnoloxías da Información				
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Lecturers	Fernández Blanco, Enrique	E-mail	enrique.fernandez@udc.es		
Web					
General description	The subject introduces students to machine learning techniques applicable in environments that present restrictions in the distribution of the data used in the generation of the models: treatment of flows, incorporation of new experiences, evolution of concepts over time or the preservation of the privacy of the information. Their consideration requires specific training in the application of incremental learning techniques, detection of obsolescence and confidentiality in the handling of datasets.				

## Study programme competences

Code	Study programme competences
A11	CE10 - Ability to implement, validate and apply a stochastic model starting from the observed data on a real system, and to perform a critical analysis of the obtained results, selecting those ones most suitable for problem solving
A12	CE11 - Understanding and command of the main techniques and tools for data analysis, both from the statistical and the machine learning viewpoints, including those devised for large volumes of data, and ability to select those ones most suitable for problem solving
A13	CE12 - Ability to outline, formulate and solve all the stages of a data project, including the understanding and command of basic concepts and techniques for information search and filtering in big collections of data
A16	CE15 - Knowledge of computer tools in the field of machine learning and ability to select those ones most suitable for problem solving
B2	CG02 - Successfully addressing each and every stage of an AI project
B3	CG03 - Searching and selecting that useful information required to solve complex problems, with a confident handling of bibliographical sources in the field
B4	CG04 - Suitably elaborating written essays or motivated arguments, including some point of originality, writing plans, work projects, scientific papers and formulating reasonable hypotheses in the field
B5	CG05 - Working in teams, especially of multidisciplinary nature, and being skilled in the management of time, people and decision making
B6	CB01 - Acquiring and understanding knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, frequently in a research context
B7	CB02 - The students will be able to apply the acquired knowledge and to use their capacity of solving problems in new or poorly explored environments inside wider (or multidisciplinary) contexts related to their field of study
B8	CB03 - The students will be able to integrate different pieces of knowledge, to face the complexity of formulating opinions (from information that may be incomplete or limited) and to include considerations about social and ethical responsibilities linked to the application of their knowledge and opinions
B9	CB04 - The students will be able to communicate their conclusions, their premises and their ultimate justifications, both to specialised and non-specialised audiences, using a clear style language, free from ambiguities
C3	CT03 - Use of the basic tools of Information and Communications Technology (ICT) required for the student's professional practice and learning along her life
C4	CT04 - Acquiring a personal development for practicing a citizenship under observation of the democratic culture, the human rights and the gender perspective
C7	CT07 - Developing the ability to work in interdisciplinary or cross-disciplinary teams to provide proposal that contribute to a sustainable environmental, economic, political and social development



C8	CT08 - Appreciating the importance of research, innovation and technological development in the socioeconomic and cultural progress of society
C9	CT09 - Being able to manage time and resources: outlining plans, prioritising activities, identifying criticisms, fixing deadlines and sticking to them

Learning outcomes			
Learning outcomes	Study programme competences		
To acquire knowledge of how the main incremental learning techniques work.	AC10 AC11 AC12 AC15	BC2 BC3 BC4 BC5 BC6 BC7 BC8 BC9	CC3 CC4 CC7 CC8
To apply incremental learning techniques for the analysis of real-time data in stationary and non-stationary environments	AC10 AC11 AC12 AC15	BC2 BC3 BC4 BC5 BC6 BC7 BC8 BC9	CC3 CC4 CC7 CC8 CC9
To know the working principle of the main privacy-preserving learning paradigms	AC10 AC11 AC12 AC15	BC2 BC3 BC4 BC5 BC6 BC7 BC8 BC9	CC3 CC4 CC7 CC8 CC9

Contents	
Topic	Sub-topic
1. Online and incremental learning	1.1 Incremental algorithms for supervised and unsupervised learning. 1.2 Detection and treatment of data obsolescence and the concept drift.
2. Data privacy-preserving learning paradigms	2.1 Federated learning

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A11 A12 A13 A16 B3 B6 B7 B8 B9 C3 C4 C8	10	10	20
Seminar	A11 A12 A13 A16 B2 B4 B5 C7 C9	4	20	24
ICT practicals	A11 A12 A13 A16 B3 B6 B7 B8 C3 C4 C8	7	21	28



Mixed objective/subjective test	A11 A12 A13 A16 B4 B6 B7	1	0	1
Personalized attention		2	0	2
(*)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	The contents of the course will be taught indistinctly between lectures and interactive classes. The completion of all the proposed activities is necessary, as well as the attendance to all the classes (lectures and interactive) to pass the course.  Expository classes (theory): will consist of the explanation of the different sections of the course syllabus, with the help of electronic media (presentations, videos, etc.)
Seminar	Case studies: students may be presented with real or fictional work scenarios that present certain problems. Students will have to apply the theoretical and practical knowledge of the subject to find a solution to the question or questions posed. As a general rule, case studies will be carried out in groups. The different working groups will present and share their solutions.
ICT practicals	Interactive classes (practical): different practical problems related to the content of the subject will be posed for the student to solve individually or in groups. Project-based learning: students may be given practical projects whose scope requires them to dedicate a significant part of their time to the subject. Autonomous work: the scope and objectives of the projects, use cases and/or practical problems may require autonomous work on the part of the students, albeit under the supervision of the teaching staff.
Mixed objective/subjective test	A mixed test which can contain quiz questions, short-answer questions or development questions. It is going to evaluate the theoretical part of the subject and it can contain questions about the content of the seminars or practical exercises

Personalized attention	
Methodologies	Description
Guest lecture / keynote speech ICT practicals Seminar	Office hours: Office hours will be used to solve students' doubts related to the contents of the subject. These office hours can be both face-to-face and virtual (via email, virtual campus or Microsoft Teams platform).

Assessment			
Methodologies	Competencies	Description	Qualification
Mixed objective/subjective test	A11 A12 A13 A16 B4 B6 B7	Subjective test which can be a mixture model with quiz questions and some short-answer or development questions.	60
ICT practicals	A11 A12 A13 A16 B3 B6 B7 B8 C3 C4 C8	This mark includes the evaluation exercises made during the practical lessons and the developed project.	30
Seminar	A11 A12 A13 A16 B2 B4 B5 C7 C9	This is going to include the grading of the practical exercises and the projects developed in the seminars.	10

Assessment comments



Attendance to the interactive and expository classes is compulsory and will be taken into account for the evaluation of the subject. Attendance to at least 80% of the sessions will be compulsory (except for very justified reasons, according to regulations). In order to pass the course, the student will have to carry out all the proposed activities and pass the corresponding exams.

**First opportunity:** To pass the subject, the student must have attended the classes, have delivered and passed the proposed activities during seminars and practical sessions (40% of the final grade) and pass the final exam (60% of the grade).

**Mid-term exams:** no mid-term exams will be held

**Second opportunity:** The grade obtained in the practices during the course is maintained, as well as its weight in the final grade. Students who have not reached the cut-off mark in the activities proposed during the previous call, may submit, prior to the second chance final exam, similar activities, which will be proposed by the teachers. Once both parts have been passed separately, the exam will account for the 60% of the final mark and the practices for the 40%.

**Exemption from attendance:** In case of exemption from attendance, students will be relieved of the obligation to attend classes, but it will still be compulsory to carry out and pass the proposed activities, as well as to pass the final exam. Once both parts have been passed separately, the exam will account for the 60% of the final mark and the practices for the 40%.

**Repeat students:** Repeat students from previous years will be exempted from the obligation to attend classes. In order to pass the subject, it will be compulsory to complete and hand in the proposed activities on the same dates established for the rest of the students, as well as to pass the final exam. Once both parts have been passed separately, the exam will account for the 60% of the final mark and the practices for the 40%.

**No-show:** the student will receive the qualification of "no-show" when he/she does not take the final exam.

**Fraudulent performance of exercises or tests:** For cases of fraudulent performance of exercises or tests, the provisions of the current regulation of the USC about this topic will apply.

**Evaluation of competences:** In general, the development of the practical activities, projects and use cases, as well as the preparation of the theoretical topics will allow students to work on the basic, general and transversal competences of the subject. Specifically, through the projects and use cases, the competences CT7, CT9, CG5, CG4, CG2 will be assessed. The development of the practices, as well as the final test, will allow the evaluation of the specific competences: CE10, CE11, CE12, CE15.

### Sources of information

<b>Basic</b>	<ul style="list-style-type: none"> <li>- Géron, Aurélien (2022). Hands-on Machine Learning with Scikit-Learn &amp; TensorFlow : Concepts, Tools, and Techniques to build Intelligent Systems. 2nd Edition. O'Reilly</li> <li>- WANG, Jianyu, et al. (2021). A field guide to federated optimization. arXiv preprint</li> <li>- GEPPERTH, Alexander; HAMMER, Barbara (2016). Incremental learning algorithms and applications. European symposium on artificial neural networks (ESANN)</li> </ul>
<b>Complementary</b>	<ul style="list-style-type: none"> <li>- HE, Haibo, et al (2011). Incremental learning from stream data. IEEE Transactions on Neural Networks, vol. 22, no 12, p. 1901-1914.</li> <li>- BONAWITZ, Keith, et al. (2019). Towards federated learning at scale: System design. Proceedings of Machine Learning and Systems, 2019, vol. 1, p. 374-388</li> <li>- Emily Glanz, Nova Fallen (2021). What Is Federated Learning?. O'Reilly</li> <li>- Quian Yang et al (2019). Federated Learning. Morgan &amp; Claypool</li> </ul>

### Recommendations

#### Subjects that it is recommended to have taken before

Machine Learning I /614544012

#### Subjects that are recommended to be taken simultaneously

#### Subjects that continue the syllabus

#### Other comments

The students should be familiar with mid-level programming concepts, linear algebra, calculus and statistics. The knowledge of basic concurrence and parallel architecture is also helpful

(\*)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.