INTERNATIONAL
CAMPUS OF
EXCELLENCE

POLITÉCNICA

ETSIT UPM

E.T.S. de Ingenieros de
Telecomunicacion

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000949 - Application Projects

DEGREE PROGRAMME

09AT - Master Universitario En Teoria De La Señal Y Comunicaciones

ACADEMIC YEAR & SEMESTER

2021/22 - Semester 2

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Learning guide

1. Description

1.1. Subject details

Name of the subject	93000949 - Application Projects
No of credits	4 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
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 *
Luis Alfonso Hernandez Gomez (Subject coordinator)	C-330	luisalfonso.hernandez@upm.es	Sin horario. Appointment arranged by email
Santiago Zazo Bello	C-326	santiago.zazo@upm.es	Sin horario. Appointment arranged by email

Carlos Roberto Del Blanco Adan	C-306	carlosrob.delblanco@upm.es	Sin horario. Appointment arranged by email
Jose Luis Blanco Murillo	C303	jl.blanco@upm.es	Sin horario. Appointment arranged by email
Juan Parras Moral	C-301	j.parras@upm.es	Sin horario. Appointment arranged by email
Mateo Jose Camara Largo	C-301	mateo.camara@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. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

- Aprendizaje Predictivo Y Descriptivo

- TÉcnicas De OptimizaciÓn Para AnÁlisis De Datos Masivos

- Series Temporales

- Laboratorio De TÉcnicas De Aprendizaje AutomÁtico

3.2. Other recommended learning outcomes

- Previous exposure to a programming language, such as MATLAB, R or Python

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4. Skills and learning outcomes *

4.1. 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

CB07 - 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

CB08 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios

CB09 - 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

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

CE02 - Evaluar y sintetizar los resultados de un trabajo en equipo en proyectos relacionados con 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.

CT01 - Capacidad para comprender los contenidos de clases magistrales, conferencias y seminarios en lengua inglesa

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

CT04 - Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo

CT05 - Capacidad para gestionar la información, identificando las fuentes necesarias, los principales tipos de documentos técnicos y científicos, de una manera adecuada y eficiente

CT06 - Capacidad para emitir juicios sobre implicaciones económicas, administrativas, sociales, éticas y

medioambientales ligadas a la aplicación de sus conocimientos

4.2. Learning outcomes

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

RA22 - Knowing conduct a technical presentation before an audience of peers, describing the work and results clearly and well structured, on time, and using precise language

RA32 - Capability for planning, design and implement applications, incorporating signal processing, statistical analysis and machine learning

* 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.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

The main objective of this course is to offer complementary skills to our Master's students proposing different activities they can choose freely. The proposed activities may be given as seminars, workshops or conferences provided by industrial and/or academic partners.

Activities may change every course but as an example of possible ones we give the following examples:

- Seminar on advanced Deep Learning techniques: Deep belief networks or Deep Boltzmann Machines, Variational Autoencoders, Generative adversarial networks (GANs)
- Seminra on Data Analysis and Visualization.

- Workshop on Data Science Workbenches, as IBM, AWS, Google Cloud, Databricks etc.
- Seminars on the integration of Machine Learning and Artificial Intelligence into Big Data Platforms.
- Seminars where students starting their Master Theses can present and debate with other students about the topic, methodology, machine learning development strategies, etc.
- Seminars or conferences from different companies or academia. These activities will be mainly directed to learn from real use-cases the value of Data Analysis and Visualization or the role of Machine Learning in different application areas.
- Seminar to debate ethical issues that may arise when developing big data analysis, machine learning or Artificial Intelligence applications.
- Meet-up with former Master students to learn from first-hand current job opportunities and possibilities for

professional development.

5.2. Syllabus

1. Issues when developing Machine Learning and Artificial Intelligence

    1.1. Privacy and Security

    1.2. Ethical Issues

2. Integrating Machine Learning in Big Data Platforms

    2.1. IBM, AWS, Google Cloud, Databricks

    2.2. Uses cases from industry

3. Data Analysis and Visualization

    3.1. Introduction to visualization and tools

    3.2. Practical use cases

4. Advanced Deep Learning techniques

    4.1. Deep belief networks or Deep Boltzmann Machines, Variational Autoencoders, Generative adversarial networks (GANs)

5. Applications of Machine Learning

    5.1. Telecommunication applications

    5.2. Internet-of-Things

    5.3. Robotics

    5.4. Smart Grids

    5.5. Predictive maintenance and preventive maintenance

    5.6. Finantial Systems

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6. Schedule

6.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1	**Course introduction** Duration: 03:00 Lecture			
2	**Ethical issues when developing Machine Learning and Artificial Intelligence** Duration: 03:00 Lecture			
3	**Students' presentations and debate** Duration: 03:00 Cooperative activities			
4	**Data Science Platforms: Introduction Use cases** Duration: 03:00 Lecture			
5		**Data Science Platforms: Practical Examples** Duration: 03:00 Laboratory assignments		
6	**Practical Development of Artificial Intelligence for Geospatial Information** Duration: 03:00 Lecture			
7		**Practical project: Geospatial Intelligence Applications** Duration: 03:00 Laboratory assignments		
8	**Students' projects presentation and debate** Duration: 03:00 Cooperative activities			
9	**Seminar: Data Analysis and Visualization** Duration: 03:00 Additional activities			
10		**Seminar: Data Analysis and Visualization** Duration: 03:00 Laboratory assignments		
11	**Conferences: understanding the role of Machine Learning in different application areas** Duration: 03:00 Lecture			

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12	**Seminar: Advanced Deep Learning** Duration: 03:00 Lecture			
13		**Seminar: Advanced Deep Learning** Duration: 03:00 Laboratory assignments		
14	**Conferences: debating the role of Machine Learning in different application areas** Duration: 03:00 Cooperative activities			
15				
16				
17				**Final Evaluation: reporting course activities** Individual work Final examination Not Presential Duration: 00:00 **Final evaluation: reporting course activities** Individual work Continuous assessment Not Presential Duration: 00:00

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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7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Final evaluation: reporting course activities	Individual work	No Presential	00:00	100%	/ 10	CB07 CT03 CB08 CT01 CB09 CB06 CE02 CT04 CT06 CE03 CT05 CB10

7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Final Evaluation: reporting course activities	Individual work	No Presential	00:00	100%	/ 10	CT01 CB07 CT03 CB08 CB09 CB06 CE02 CT04 CT06 CE03 CT05 CB10

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Final Evaluation: reporting course activities	Individual work	Face-to-face	00:00	100%	/ 10	CT01 CB07 CT03 CB08 CB09 CB06 CE02 CT04 CT06 CE03 CT05 CB10

7.2. 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 fourth week of the semester (deadline will be announced in Moodle).

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 assessment method.

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Continuous assessment:

Assesment will be based on a written report where each student must detail all her/his activities along the course. Every achievement, new skill or knowledge derived from seminars and conferences will be clearly supported by detailed descriptions, and, when applicable, including generated materials (student's presentations, programs, notebooks, dashboards, etc.) (100% of final grade).

Final assessmen and Extraordinary examination:

Both Final assessment and Extraordinary examination will be based on a detailed activities report that must follow the same guidelines than those previously detailed for Continuous assessment (100% of final grade).

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Weapons of Math Destruction	Bibliography	O. Neill, C. (2016). Weapons of Math Destruction. How Big Data Increases Inequality and Threatens Democracy.
Deep Learning	Bibliography	Deep Learning. An MIT Press book. Ian Goodfellow and Yoshua Bengio and Aaron Courville
Python for data analysis	Bibliography	McKinney, Wes. Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.", 2012.
Google Cloud Tutorials	Web resource	https://cloud.google.com/gcp/getting-started
Introducing Tableau	Web resource	https://www.tableau.com
Cloud AI Fast, large scale and easy to use AI services	Web resource	https://cloud.google.com/products/machine-learning/

Databricks Unified Analytics	Web resource	https://databricks.com/
Aprendizaje automático en AWS	Web resource	https://aws.amazon.com/es/machine-learning/
AWS Sagemaker	Web resource	https://aws.amazon.com/es/sagemaker/
Unsupervised Feature Learning and Deep Learning	Web resource	http://ufldl.stanford.edu/tutorial/
Master the art of data science	Web resource	https://datascience.ibm.com/

9. Other information

9.1. Other information about the subject

This course will contribute to Goal 4.4 in Sustainable Development Goals (SDGs) 2030 United Nations Agenda providing our students to have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

This course will also help students to learn the crucial role of including ethical principles in the development of data analysis projects. This will contribute to learn how to design data projects to contribute to several SDGs goals: end poverty (Goal 1), promote well-being (Goal 2), and promote sustainable management of water, energy, economic growth and industrialization (Goals 5, 6, 7, and 8) as well as to reduce inequality among countries (Goal 10).

Due to the value of data in developing future applications in a broad range of areas, the course will also contribute to SDG Goal 17 Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development, in particular working on systemic issues on Data monitoring and accountability (17.18 and 17.19)