



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**

**103000857 - Image Mining**

**DEGREE PROGRAMME**

10AZ - Master Universitario en Innovación Digital

**ACADEMIC YEAR & SEMESTER**

2019/20 - Semester 2

## Index

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### Learning guide

1. Description.....	1
2. Faculty.....	1
3. Prior knowledge recommended to take the subject.....	2
4. Skills and learning outcomes .....	2
5. Brief description of the subject and syllabus.....	3
6. Schedule.....	6
7. Activities and assessment criteria.....	8
8. Teaching resources.....	11
9. Other information.....	13

## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	103000857 - Image Mining
<b>No of credits</b>	3 ECTS
<b>Type</b>	Optional
<b>Academic year of the programme</b>	First year
<b>Semester of tuition</b>	Semester 2
<b>Tuition period</b>	February-June
<b>Tuition languages</b>	English
<b>Degree programme</b>	10AZ - Master Universitario en Innovación Digital
<b>Centre</b>	10 - Escuela Tecnica Superior de Ingenieros Informaticos
<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>
Consuelo Gonzalo Martin (Subject coordinator)	4207	consuelo.gonzalo@upm.es	Sin horario. Contact the professor by e-mail
Angel Mario Garcia Pedrero	4211	angelmario.garcia@upm.es	Sin horario. Contact the professor

\* 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

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#### 3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

#### 3.2. Other recommended learning outcomes

- Machine Learning
- Signal and image processing

### 4. Skills and learning outcomes \*

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#### 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

CG03 - La capacidad de usar la lengua inglesa de manera competente, es decir, con capacitación para tareas complejas de trabajo y estudio.

CG05 - Comprensión de los principios de la gestión de proyectos, riesgo y cambio, así como poseer la capacidad de aplicar metodologías y procesos para gestionar proyectos y mitigar los riesgos.

CG06 - Capacidad para gestionar la información.

## 4.2. Learning outcomes

RA9 - Analyse qualitative data to specify the design requirements related to the context of use

RA14 - Apply the acquired knowledge in real contexts

RA17 - Acquire specialized knowledge from innovative fields of studies

RA94 - Understand and design information extraction systems

RA95 - Understand and apply information retrieval systems

RA38 - Understand how to process information and what are the limitations and diversity of human beings in their interaction with computer systems

\* 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

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### 5.1. Brief description of the subject

It is estimated that close to 80% of data generated around the world is visual information: images and videos. Capitalizing on the value of this huge amount of information requires technologies and methods that allow this information to be organized, stored, retrieved and interpreted automatically.

In this scenario, Image Mining provides the framework and tools needed for extracting implicit knowledge, useful data and image data relationship from images stored in large image databases.

Since, the course does not assume previous knowledge in Image Processing, the first part of the course is focus

on providing to the students the concepts and methods required to understand how to structure the information contained in the images, which is the first step to start a image mining project.

Specially emphasis will be done through the course on the idea of semantic gap, with the aim of finishing the course introducing different techniques that allow to bridge such gap.

## 5.2. Syllabus

### 1. Introduction

1.1. Motivation and Objectives

1.2. Definition of Image Mining

1.3. Applications

### 2. Image Acquisition

2.1. Visual Perception

2.2. Electromagnetic Spectrum

2.3. Theory of Image Formation

2.4. Digital Image Acquisition

### 3. Digital Images

3.1. Digital Image Characteristics

3.2. Digital Image Representation

3.3. Digital image Visualization

### 4. Image Processing Fundamentals

4.1. Operations based on Histogram

4.2. Filtering in the Spatial Domain

4.3. Discrete Fourier Transform

4.4. Filtering in the Frequency Domain

4.5. Image Segmentation

## 5. Image Indexing and Retrieval

### 5.1. Image Feature Extraction

### 5.2. Semantic GAP

### 5.3. Semantic Annotation

### 5.4. Machine Learning to bridge the Semantic GAP

## 6. Course Project

## 6. Schedule

### 6.1. Subject schedule\*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Other face-to-face activities	Assessment activities
1	<b>Unit 1</b> Duration: 02:00		<b>Individual tutoring</b> Duration: 00:00	
2	<b>Unit 2</b> Duration: 02:00		<b>Individual tutoring</b> Duration: 00:00	<b>Online questionnaire Unit 2</b>  Continuous assessment Duration: 00:30
3			<b>Presentation Project Assignment</b> Duration: 02:00	
4	<b>Unit 3</b> Duration: 02:00		<b>Individual tutoring</b> Duration: 00:00	<b>Online questionnaire Unit 3</b>  Continuous assessment Duration: 00:30
5	<b>Unit 4</b> Duration: 02:00		<b>Individual tutoring</b> Duration: 00:00	
6	<b>Unit 4</b> Duration: 02:00		<b>Individual tutoring</b> Duration: 00:00	
7	<b>Unit 4</b> Duration: 02:00		<b>Individual tutoring</b> Duration: 00:00	<b>Online questionnaire Unit 4</b>  Continuous assessment Duration: 00:30
8	<b>Mid-semester project presentation</b> Duration: 02:00		<b>Individual tutoring</b> Duration: 00:00	<b>Evaluation mid-semester Project</b>  Continuous assessment Duration: 02:00
9	<b>Unit 5</b> Duration: 02:00		<b>Individual tutoring</b> Duration: 00:00	
10	<b>Unit 5</b> Duration: 02:00		<b>Individual tutoring</b> Duration: 00:00	
11	<b>Unit 5</b> Duration: 02:00		<b>Individual tutoring</b> Duration: 00:00	<b>Online questionnaire Unit 5</b>  Continuous assessment Duration: 00:30
12			<b>Compulsory Final Project tutoring</b> Duration: 02:00	



13			<b>Compulsory Final Project tutoring</b> Duration: 02:00	
14				<b>Evaluation Project Assignment Presentation</b>  Continuous assessment Duration: 02:00
15				<b>Evaluation Project Assignment Presentation</b>  Continuous assessment Duration: 02:00
16				<b>Evaluation Project Assignment Presentation</b>  Continuous assessment Duration: 02:00
17				<b>Final Exam</b>  Continuous assessment Duration: 02:00  <b>Final Exam</b>  Final examination Duration: 02:00

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.

## 7. Activities and assessment criteria

### 7.1. Assessment activities

#### 7.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
2	Online questionnaire Unit 2		No Presential	00:30	3%	4 / 10	CB07 CG06
4	Online questionnaire Unit 3		No Presential	00:30	4%	4 / 10	CB07 CG06
7	Online questionnaire Unit 4		No Presential	00:30	4%	4 / 10	CG06 CB07
8	Evaluation mid-semester Project		Face-to-face	02:00	20%	4 / 10	CB06 CG03 CB08 CG06
11	Online questionnaire Unit 5		No Presential	00:30	4%	4 / 10	CG06 CB07
14	Evaluation Project Assignment Presentation		Face-to-face	02:00	15%	4 / 10	CB06 CB07 CB09 CG03 CG05 CB08 CG06
15	Evaluation Project Assignment Presentation		Face-to-face	02:00	15%	4 / 10	CB06 CB07 CB09 CG03 CG05 CB08 CG06
16	Evaluation Project Assignment Presentation		Face-to-face	02:00	15%	4 / 10	CB06 CB07 CB09 CG03 CG05 CB08 CG06

17	Final Exam		Face-to-face	02:00	20%	4 / 10	CB06 CB07
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### 7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Final Exam		Face-to-face	02:00	100%	5 / 10	CB06 CB07 CB09 CG03 CG05 CB08 CG06

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

No se ha definido la evaluación extraordinaria.

## 7.2. Assessment criteria

### Continuous evaluation:

The course will be evaluated by:

4 Questionnaires

1 Final Project

1 Exam

Attendance is mandatory (It is allowed not to attend up to 6 hours without proper justification).

Project assignments will be done in groups among those enrolled in the course at the beginning of the academic year (nature and number of components will be established at the beginning of the course, depending on the number of students enrolled).

In order to pass the course the requirements are:

1. To obtain a minimum of 50 points out of 100 in the added evaluation.
2. It is MANDATORY to do the exam and the project assignment.
3. In the exam and on the project assignments students must obtain a minimum of 40 points out of 100.

Final score will be calculated as follows:

- 15% Questionnaires (3% questionnaire unit 2 and 4% each of the other 3 proposed questionnaires)
- 20% Mid-semester project evaluation: 10% Memory + 10% Oral presentation
- 45% Final project: 30% Memory + 15% Oral presentation
- 20% Final exam

**Final exam evaluation.** Those students whose extraordinary circumstances cannot perform the continuous evaluation, and having done the final exam evaluation written petition during the first 15 days of the course, will perform the final exam evaluation without having the opportunity to do the continuous evaluation;

Those students failing to attend 85% of the lectures will also do the final evaluation.

In these premises, the final exam evaluation will consist of an exam as stated by the head of studies.

Measures against copies and fraud Rights and duties of college students are gathered on the statutes of the

Universidad Politécnica de Madrid (BOCM de 15 de noviembre de 2010) and in the statutes of the college student (RD 1791/2010 de 30 de diciembre). Article 124 a) of EUPM fixes the duty of the student... "to follow with responsibility and taking advantage of the learning process, knowledge acquisition correspondent to its condition of college student"... and the article 13 of the statutes of the college student in its point d) also specifies as duty of the college student "abstain from the use or cooperation in fraudulent procedures in the evaluation assessments, in the assignments developed or in the official documents of the university". In the case that in the development of the evaluation assessments it is appreciated a breach in the duties as college student, the subject coordinator may communicate the headmaster as established in the article 74 (n) of EUPM to have the competences to "propose the initiation of a disciplinary procedure to any College member, by its own initiative or as instance from the "Comisión de Gobierno"" to the Rector, pursuant to the statutes and rules of application.

## 8. Teaching resources

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### 8.1. Teaching resources for the subject

Name	Type	Notes
Moodle	Web resource	<a href="http://moodle.upm.es">http://moodle.upm.es</a>
Digital Image Processing, 4th Edition Rafael C. Gonzalez, Richard E. Woods, 4th Edition, Pearson (2017)	Bibliography	<a href="https://www.pearson.com/us/higher-education/program/Gonzalez-Digital-Image-Processing-4th-Edition/PGM241219.html">https://www.pearson.com/us/higher-education/program/Gonzalez-Digital-Image-Processing-4th-Edition/PGM241219.html</a>

Knowledge Discovery and Data Mining: Challenges and Realities Edit by Zhu, Xingquan (2007)	Bibliography	<a href="https://books.google.es/books?hl=es&amp;lr=&amp;id=-9SU65qKgR8C&amp;oi=fnd&amp;pg=PP1&amp;dq=Image+Mining+book&amp;ots=aALEvEzflw&amp;sig=d0b5Yp3S73c_xDnbM3RFSQ6dOhE&amp;authuser=1#v=onepage&amp;q=Image%20Mining%20book&amp;f=false">https://books.google.es/books?hl=es&amp;lr=&amp;id=-9SU65qKgR8C&amp;oi=fnd&amp;pg=PP1&amp;dq=Image+Mining+book&amp;ots=aALEvEzflw&amp;sig=d0b5Yp3S73c_xDnbM3RFSQ6dOhE&amp;authuser=1#v=onepage&amp;q=Image%20Mining%20book&amp;f=false</a>
Principles of Applied Remote Sensing Siamak Khorram, Cynthia F. van der Wiele, Frank H. Koch, Stacy A. C. Nelson, Matthew D. Potts Springer (2016).	Bibliography	
Medical Image Analysis, A. P. Dhawan, 2013, Edit. Lajos Hanzo, IEEE Press	Bibliography	
ImageProcessingBasics.com Digital image processing tutorials and interactive applets	Others	<a href="http://www.imageprocessingbasics.com">http://www.imageprocessingbasics.com</a>
Scientific articles	Bibliography	Specific scientifics articles will be recommended for each project assignment
Python.	Others	<a href="https://www.w3schools.com/python/default.asp">https://www.w3schools.com/python/default.asp</a> .
Jupyter notebook	Others	Jupyter notebook. <a href="https://jupyter-notebook.readthedocs.io/en/stable/notebook.html">https://jupyter-notebook.readthedocs.io/en/stable/notebook.html</a>
OpenCV	Others	<a href="https://opencv-python-tutroals.readthedocs.io/en/latest/">https://opencv-python-tutroals.readthedocs.io/en/latest/</a>

## 9. Other information

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### 9.1. Other information about the subject

This course presents contents related mainly to the following Sustainable Development Objectives (SDOs):

OD3, OD6, OD11, OD12, OD14 and OD15. Good Health and Well-Being, Clean Water and Sanitation, Sustainable Cities and Communities, Responsible Production and Consumption, Underwater Life, Life of Terrestrial Ecosystems.

Image processing in medical images and Earth observation, driven by the needs of Society and by the improvement in different technologies, have become an essential tool for understanding the different modalities of images that provide information about health and managing interactions between Earth and Man.