

# ANX-PR/CL/001-01

## LEARNING GUIDE

### SUBJECT

**103000889 - Image Processing, Analysis And Classification**

### DEGREE PROGRAMME

**10AZ - Master Universitario En Innovación Digital**

### ACADEMIC YEAR & SEMESTER

**2023/24 - Semester 2**

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## 1. Description

### 1.1. Subject details

<b>Name of the subject</b>	103000889 - Image Processing, Analysis And Classification
<b>No of credits</b>	5 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>	2023-24

## 2. Faculty

### 2.1. Faculty members with subject teaching role

<b>Name and surname</b>	<b>Office/Room</b>	<b>Email</b>	<b>Tutoring hours *</b>
Jose Crespo Del Arco (Subject coordinator)	5214	jose.crespo@upm.es	W - 14:30 - 20:30 (Note: planned office hours. See possible changes in Moodle.)
Raul Alonso Calvo	2315	raul.alonso@upm.es	M - 10:00 - 13:00 W - 10:00 - 13:00 (Note: planned office hours. See possible changes in Moodle.)

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\* 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

- Program development in a general purpose language such as C, C++, Java.
- Programming skills.

### 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

CE-CD04 - Capacidad para aplicar métodos avanzados para clasificación, modelado, segmentación y predicción a partir de un conjunto de datos

## 4.2. Learning outcomes

RA54 - Poseer destrezas fundamentales de la programación que permitan la implementación de algoritmos y el uso de estructuras de datos típicos en ciencia de datos. e distintos tipos de herramientas (software o metodológicas y conceptuales) necesarias para el correcto y eficaz desarrollo de software, incluyendo entornos y librerías en el contexto de ciencia de datos.

\* 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

#### Outline

This subject covers techniques for image processing and analysis techniques, as well as methods for image classification.

Morphological approaches will be covered within the image processing and analysis,

For image classification, relevant features for clustering and learning will be treated. Approaches and applications for image indexation and image searching will be studied.

#### Learning Goals

Be aware of the foundations of image processing and analysis

Learn filtering techniques, and segmentation methods for separating regions of interest

Extract relevant features of input images.

Analyse some relevant image classification methods, and study image indexation and image searching techniques and applications.

## 5.2. Syllabus

1. Introduction
2. Filtering
  - 2.1. Introduction
  - 2.2. Morphological filtering
  - 2.3. Other techniques
3. Segmentation and extraction of features and regions of interest
  - 3.1. Introduction to image segmentation and feature extraction
  - 3.2. Morphological approaches
  - 3.3. Other methods
4. Image classification
  - 4.1. Introduction
  - 4.2. Image features for clustering and learning
  - 4.3. Indexation of images
  - 4.4. Image search applications

## 6. Schedule

### 6.1. Subject schedule\*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	<b>Topic 1,2</b> Duration: 03:00 Lecture	<b>Topic 2</b> Duration: 01:00 Laboratory assignments		
2	<b>Topic 2</b> Duration: 02:00 Lecture	<b>Topic 2</b> Duration: 02:00 Laboratory assignments		
3	<b>Topic 3</b> Duration: 02:00 Lecture	<b>Topic 3</b> Duration: 02:00 Laboratory assignments		<b>Computer assignment 1</b> Online test Continuous assessment Not Presential Duration: 02:00
4	<b>Topic 3</b> Duration: 02:00 Lecture	<b>Topic 3</b> Duration: 02:00 Laboratory assignments		
5	<b>Topic 4</b> Duration: 02:00 Lecture	<b>Topic 4</b> Duration: 02:00 Laboratory assignments		<b>Computer assignment 2</b> Online test Continuous assessment Presential Duration: 02:00
6	<b>Topic 4</b> Duration: 01:00 Lecture	<b>Topic 4</b> Duration: 02:00 Laboratory assignments		<b>Presentation and Report. Note: several days</b> Individual presentation Continuous assessment Presential Duration: 01:00
7	<b>Topic 2</b> Duration: 01:00 Lecture	<b>Topic 4</b> Duration: 02:00 Laboratory assignments		<b>Presentation and Report. Note: several days</b> Individual presentation Continuous assessment Presential Duration: 01:00
8		<b>Topic 4</b> Duration: 02:00 Laboratory assignments		<b>Presentation and Report. Note: several days</b> Individual presentation Continuous assessment Presential Duration: 02:00  <b>Computer assignment 3</b> Online test Continuous assessment Not Presential Duration: 02:00

9				<p><b>Computer assignment 1</b> Online test Final examination Not Presential Duration: 02:00</p> <p><b>Computer assignment 2</b> Online test Final examination Not Presential Duration: 02:00</p> <p><b>Presentation and Report. Note: several days</b> Individual presentation Final examination Presential Duration: 04:00</p> <p><b>Computer assignment 3</b> Online test Final examination Not Presential Duration: 02:00</p> <p><b>Written or oral exam</b> Problem-solving test Final examination Presential Duration: 03:00</p> <p><b>Written or oral exam</b> Problem-solving test Continuous assessment Presential Duration: 03:00</p>
10				
11				
12				
13				
14				
15				
16				
17				

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.



## 7. Activities and assessment criteria

### 7.1. Assessment activities

#### 7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
3	Computer assignment 1	Online test	No Presential	02:00	10%	/ 10	CB06
5	Computer assignment 2	Online test	Face-to-face	02:00	25%	/ 10	CB06
6	Presentation and Report. Note: several days	Individual presentation	Face-to-face	01:00	5%	5 / 10	CB06
7	Presentation and Report. Note: several days	Individual presentation	Face-to-face	01:00	5%	5 / 10	CB06
8	Presentation and Report. Note: several days	Individual presentation	Face-to-face	02:00	5%	5 / 10	CB06
8	Computer assignment 3	Online test	No Presential	02:00	35%	/ 10	CB06 CE-CD04
9	Written or oral exam	Problem-solving test	Face-to-face	03:00	15%	5 / 10	CB06

#### 7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
9	Computer assignment 1	Online test	No Presential	02:00	10%	/ 10	CB06
9	Computer assignment 2	Online test	No Presential	02:00	25%	/ 10	CB06
9	Presentation and Report. Note: several days	Individual presentation	Face-to-face	04:00	15%	5 / 10	CB06
9	Computer assignment 3	Online test	No Presential	02:00	35%	/ 10	CB06 CE-CD04
9	Written or oral exam	Problem-solving test	Face-to-face	03:00	15%	5 / 10	CB06

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

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
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Exam	Problem-solving test	Face-to-face	00:30	15%	5 / 10	CB06
Presentation and Report	Individual presentation	Face-to-face	00:20	15%	5 / 10	CB06
Computer assignments	Problem-solving test	Face-to-face	02:15	70%	/ 10	CB06 CE-CD04

## 7.2. Assessment criteria

To pass the subject, at least 50 % of the total points must be achieved.

The indicated dates are tentative.

## 8. Teaching resources

### 8.1. Teaching resources for the subject

Name	Type	Notes
"Digital image processing", Rafael C. Gonzalez, Richard E. Woods; Prentice Hall, 2nd. ed., 2002.	Bibliography	
"Morphological Image Analysis: Principles and Applications", Pierre Soille; Heidelberg: Springer, 2nd. ed., 2003.	Bibliography	
"Python Data Science Handbook", Jake VanderPlas, O'Reilly, 2016.	Bibliography	
"Deep Learning with Python", Francois Chollet, Manning Publications, 2017.	Bibliography	

Moodle	Web resource	
<a href="http://www.dlsiis.fi.upm.es/master_muss/asigPAI.html">http://www.dlsiis.fi.upm.es/master_muss/asigPAI.html</a>	Web resource	
BoofCV: <a href="http://boofcv.org/">http://boofcv.org/</a>	Web resource	
OpenCV: <a href="http://opencv.org/">http://opencv.org/</a>	Web resource	
Classroom	Others	
Computers	Equipment	

## 9. Other information

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### 9.1. Other information about the subject