



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

**103000390 - Image processing and analysis**

### DEGREE PROGRAMME

10AK - Master Universitario en Software y Sistemas

### ACADEMIC YEAR & SEMESTER

2017/18 - Semester 1

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## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	103000390 - Image processing and analysis
<b>No of credits</b>	4 ECTS
<b>Type</b>	Optional
<b>Academic year of the programme</b>	First year
<b>Semester of tuition</b>	Semester 1
<b>Tuition period</b>	September-January
<b>Tuition languages</b>	English
<b>Degree programme</b>	10AK - Master Universitario en Software y Sistemas
<b>Centre</b>	Escuela Tecnica Superior de Ingenieros Informaticos
<b>Academic year</b>	2017-18

## 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>
Jose Crespo Del Arco (Subject coordinator)	5214	jose.crespo@upm.es	Th - 14:00 - 20:00 (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

El plan de estudios Master Universitario en Software y Sistemas no tiene definidas asignaturas previas recomendadas para esta asignatura.

#### 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

CEM7 - Evaluar y aplicar las diversas teorías matemáticas y estadísticas, y los procesos, métodos y técnicas disponibles para la extracción y descubrimiento de conocimiento a partir de grandes volúmenes de datos

CEM8 - Aplicar los fundamentos teóricos y matemáticos adecuados al procesamiento y análisis de funciones y datos de diversa naturaleza, y evaluar y diseñar los métodos relacionados para su aplicación en dominios prácticos

## 4.2. Learning outcomes

RA67 - Ser capaz de aplicar y evaluar comparativamente métodos de análisis en imágenes para segmentar zonas de interés y obtener parámetros característicos, considerando su implementación eficiente

RA65 - Comprender los fundamentos teóricos del procesamiento y análisis de datos tipo imagen

RA66 - Ser capaz de aplicar y evaluar comparativamente técnicas de procesamiento de imágenes, considerando su implementación eficiente, y conocer las problemáticas de los sistemas de almacenamiento de los datos tipo imagen

\* 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 explores major image processing and analysis techniques. These days, image information availability is growing and adequate techniques and methods are needed to process and analyse the relevant information for this data type.

This course will stress morphological processing and analysis, which is particularly useful for image processing and analysis systems because it can satisfactorily account for image structure patterns within a sound and elegant formal framework based, above all, on set and lattice theory.

This subject will address both the filtering and the region of interest analysis and segmentation phases, discussing their distinctive features.

This subject will deal with algorithmic and implementation-related issues of some operators and techniques, examining efficient implementations. The use of queuing algorithms will be examined. Aspects of data structures, formats and storage will be commented.

## Learning Goals

Understand the theoretical foundations of image data processing and analysis

Be aware of filtering techniques, including the qualitative differences between the different filter and operator classes

Study segmentation methods for separating regions of interest

Know how to apply and adapt techniques and methods in practical domains, relating what they have learned to research topics

Be aware of efficient implementations of major operators and techniques

## 5.2. Syllabus

### 1. Theoretical and mathematical foundations

#### 1.1. Introduction

#### 1.2. Foundations: linear vs. non-linear processing, image processing and analysis and the artificial vision problem

#### 1.3. Image data format

### 2. Preprocessing: image operators and filters

#### 2.1. Introduction to image operators and filters

#### 2.2. Some aspects of linear filters

#### 2.3. Erosions, dilations, openings, closings. Other morphological operators and filters

### 3. Image segmentation and analysis

#### 3.1. Introduction to image segmentation

#### 3.2. Edge-based, region-based and hybrid methods

#### 3.3. The watershed method and region-merging methods

#### 3.4. Applications

## 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>Topic 1</b> Duration: 02:00 Lecture			
2	<b>Topic 2</b> Duration: 02:00 Lecture			
3	<b>Topic 2</b> Duration: 02:00 Lecture			
4		<b>Topic 2</b> Duration: 02:00 Laboratory assignments		
5	<b>Topic 2</b> Duration: 02:00 Lecture			<b>Computer assignment 1</b> Online test Continuous assessment and final examination Duration: 02:00
6		<b>Topic 2</b> Duration: 02:00 Laboratory assignments		
7	<b>Topic 2</b> Duration: 02:00 Lecture			
8		<b>Topic 2</b> Duration: 02:00 Laboratory assignments		
9	<b>Topic 2</b> Duration: 02:00 Lecture			<b>Computer assignment 2</b> Online test Continuous assessment and final examination Duration: 01:30
10		<b>Topic 2</b> Duration: 02:00 Laboratory assignments		
11	<b>Topic 3</b> Duration: 02:00 Lecture			
12		<b>Topic 3</b> Duration: 02:00 Laboratory assignments		<b>Computer assignment 3</b> Online test Continuous assessment and final examination Duration: 01:00

13	<b>Topic 3</b> Duration: 02:00 Lecture			
14		<b>Topic 3</b> Duration: 01:00 Laboratory assignments		<b>Computer assignment 4</b> Online test Continuous assessment and final examination Duration: 01:30  <b>Assignment 5 (Presentation and Report).</b> <b>Note: several days.</b> Individual presentation Continuous assessment and final examination Duration: 01:00
15	<b>Topic 3</b> Duration: 01:00 Lecture			<b>Assignment 5 (Presentation and Report).</b> <b>Note: several days.</b> Individual presentation Continuous assessment and final examination Duration: 01:00
16				<b>Written or oral exam</b> Problem-solving test Continuous assessment and final examination Duration: 02:00
17				<b>Assignment 5 (Presentation and Report).</b> <b>Note: several days.</b> Individual presentation Continuous assessment and 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
5	Computer assignment 1	Online test	No Presential	02:00	15%	/ 10	CEM8 CEM7
9	Computer assignment 2	Online test	No Presential	01:30	15%	/ 10	CEM8 CEM7
12	Computer assignment 3	Online test	No Presential	01:00	25%	/ 10	CEM7 CEM8
14	Computer assignment 4	Online test	No Presential	01:30	20%	/ 10	CEM8 CEM7
14	Assignment 5 (Presentation and Report). Note: several days.	Individual presentation	Face-to-face	01:00	5%	5 / 10	CEM8 CEM7
15	Assignment 5 (Presentation and Report). Note: several days.	Individual presentation	Face-to-face	01:00	5%	5 / 10	CEM8 CEM7
16	Written or oral exam	Problem-solving test	Face-to-face	02:00	10%	5 / 10	CEM8 CEM7
17	Assignment 5 (Presentation and Report). Note: several days.	Individual presentation	Face-to-face	02:00	5%	5 / 10	CEM7

#### 7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
5	Computer assignment 1	Online test	No Presential	02:00	15%	/ 10	CEM8 CEM7
9	Computer assignment 2	Online test	No Presential	01:30	15%	/ 10	CEM8 CEM7
12	Computer assignment 3	Online test	No Presential	01:00	25%	/ 10	CEM7 CEM8
14	Computer assignment 4	Online test	No Presential	01:30	20%	/ 10	CEM8 CEM7

14	Assignment 5 (Presentation and Report). Note: several days.	Individual presentation	Face-to-face	01:00	5%	5 / 10	CEM8 CEM7
15	Assignment 5 (Presentation and Report). Note: several days.	Individual presentation	Face-to-face	01:00	5%	5 / 10	CEM8 CEM7
16	Written or oral exam	Problem-solving test	Face-to-face	02:00	10%	5 / 10	CEM8 CEM7
17	Assignment 5 (Presentation and Report). Note: several days.	Individual presentation	Face-to-face	02:00	5%	5 / 10	CEM7

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

No se ha definido la evaluación extraordinaria.

## 7.2. Assessment criteria

The indicated dates are tentative.

The weight of Assignment 5 (Presentation and Report) is 15 %.

The weight of the written or oral exam is: 10 %.

-Normal evaluation in January:

(1) Assignments, and (2) written or oral exam. It is necessary to pass both parts to successfully pass the course.

-Extraordinary evaluation period in July:

(1) Assignments, and (2) written or oral exam as in the normal evaluation period. It is necessary to pass both parts to successfully pass the course.

## 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	
"Image Analysis and Mathematical Morphology: Volume 1", Jean Serra; Londres: Academic Press, 1982.	Bibliography	
"Fundamentals of Digital Image Processing", Anil K. Jain; Prentice Hall, 1988.	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