COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001

INTERNATIONAL
CAMPUS OF
EXCELLENCE

POLITÉCNICA

E.T.S. de Ingenieros
Informaticos

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

Image Mining

DEGREE PROGRAMME

EIT DIGITAL MASTER ON HUMAN COMPUTER INTERACTION AND DESIGN

ACADEMIC YEAR & SEMESTER

2018/19 - Semester 2

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1. Description

1.1. Subject details

Name of the subject	Image Mining
No of credits	3 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	EIT Digital Master on Human Computer Interaction and Design
Centre	10 - Escuela Técnica Superior de Ingenieros Informáticos
Academic year	2018-19

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Consuelo Gonzalo Martín (Subject coordinator)	4207	consuelo.gonzalo@upm.es	Contact the professor

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

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3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

There are not previous recommended subjects for this subject in this Master's Degree.

3.2. Other recommended learning outcomes

- Signal and image processing

- Machine Learning

4. Skills and learning outcomes *

4.1. Skills to be learned

CB07 - That students know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study.

CB10 - Students possess the learning skills that will enable them to continue studying in a way that will be largely self-directed or autonomous.

CE01 - Capacity for the integration of technologies, applications, services and systems specific to Computer Engineering, in general terms, and in broader and more multidisciplinary contexts.

CE04 - Ability to model, design, define the architecture, implement, manage, operate, administer and maintain applications, networks, systems, services and computer content.

CE16 - Ability to make connections between consumer or customer wishes and needs and what technology can offer

CG09 - Appreciation of the limits of current knowledge and practical application of the latest technology

CG12 - Ability to work independently in your professional field

4.2. Learning outcomes

RA13 - RA5 - 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

5.1. Brief description of the subject

It is estimated that close of the 80% of data generated around the world is visual information: images and videos. Capitalizing the value of this huge amount of information requires the technologies and methods that automatically allow organizing, storing, retrieving and interpreting it.
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 data bases.

Since, the course does not assume previous knowledge in Image Processing, the first part of the course is focus in provide to the students the concepts and methods required to understand how to structure the information contained in the images, first step to go into the mining image process.

Specially emphasis will be done through the course in 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. Challenges of Big Data for Images Analysis
    1.2. Definition of Image Mining
2. Fundamentals of Human Vision
    2.1. Visual Perception
    2.2. Electromagnetic Spectrum
    2.3. Theory of Image Formation
3. Digital Images
    3.1. Digital Image Definition
    3.2. Digital Image Characteristics
    3.3. Digital image Representation/visualization
4. Image Processing Fundamentals
    4.1. Taxonomy
    4.2. Operations based on histogram
    4.3. Filtering in the Spatial Domain
    4.4. Discrete Fourier Transform
    4.5. Filtering in the Frequency Domain
    4.6. Geometrical Operations
5. Structuring the Image Information
    5.1. Segmentation
    5.2. Low-features extraction
6. Indexing and retrieval
    6.1. Semantic GAP
    6.2. Semantic Annotation
    6.3. Object ontology to define high -level concepts
    6.4. Machine learning to bridge the semantic GAP
7. Applications
    7.1. Earth Observation
    7.2. Medical Images

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	**Unit 1** Duration: 02:00 Lecture		Individual tutoring Duration: 00:00	
2	**Unit 2** Duration: 2:00 Lecture		Individual tutoring Duration: 00:00	**Unit 2** Online Questionary
3	**Unit 3** Duration: 02:00 Lecture		Individual tutoring Duration: 00:00	**Unit 3** Online Questionary
4	**Unit 3** Duration: 01:00 Lecture		Individual tutoring Duration: 00:00	**Unit 3** Practical assignment
5	**Unit 4** Duration: 01:00 Lecture		Individual tutoring Duration: 00:00	
6	**Unit 4** Duration: 02:00 Lecture		Individual tutoring Duration: 00:00	
7	**Unit 4** Duration: 01:00 , Explanation practical assignment		**Unit 3:** Duration 1:00 Presentation practical assignment Individual tutoring Duration: 00:00	**Unit 4** Practical assignment
8	**Unit 5** Duration: 02:00 Lecture		Individual tutoring Duration: 00:00	**Unit 5** Online Questionary
9	**Unit 6** Duration: 01:00 Lecture		**Unit 4:** Duration 1:00 Presentation practical assignment Individual tutoring Duration: 00:00	
10	**Unit 6** Duration: 02:00 Lecture		Individual tutoring Duration: 00:00	**Unit 6** Online Questionary
11	**Unit 7** Duration: 02:00 Lecture		Individual tutoring Duration: 00:00	
12	**Unit 7** Explanation final projects Duration: 1:00		Individual tutoring Duration: 00:00	**Unit 7** Final Project assignment
13			Compulsory Final project tutoring Duration 1:00	

14				**Unit 7** Duration: 1:00 Discussion final projects development	
15				**Evaluation Assigment Unit 7** Group presentation Continuous assessment Duration: 02:00
16				
17				**Exam** Written test Continuous assessment Duration: 02:00 **Exam** Written test Final examination

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 to through experience some unexpected changes along throughout the academic year.

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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
2	Evaluation contents unit 2	Questionnaire	Individual activity	0:15	3%	4/10	CB07 CG12
3	Evaluation contents unit 3	Questionnaire	Individual activity	0:15	3%	4/10	CB07 CG12
7	Evaluation First practical assignment	Group presentation	Face-to-face	1:00	12%	4/10	CB10 CE16
8	Evaluation contents unit 5	Questionnaire	Individual activity	0:15	3%	4/10	CB07 CG12
9	Evaluation 2nd practical assignment	Group presentation	Face-to-face	1:00	16%	4/10	CB10 CE16
10	Evaluation contents unit 6	Questionnaire	Individual activity	0:15	3%	4/10	CB07 CG12
15	Evaluation Final project assignment	Group presentation	Face-to-face	1:00	35%	4/10	CE01 CE04 CG09
17	Exam	Written test	Face-to-face	02:00	25%	4 / 10	CB07 CE01 CE04

7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Exam	Written test	Face-to-face	02:00	100%	5 / 10	CB07, CB10, CE01, CE04, CE16, CG09, CG12

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Exam in July	Written test	Face-to-face	02:00	100%	5 / 10	

7.2. Assessment criteria

The "only final exam" evaluation will only be offered if the UPM "Normativa Reguladora de los Sistemas de Evaluación" requires so in the academic year 2015-2016, and the procedure to opt in will be as stated by the head of studies.

Continuous evaluation: The course will be evaluated by:

    4 Questionnaires
    1   practical assignments
    1 Final Project
    1 Exam

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

Practical 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 stablished 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, the practical assignments.
 * 3. In the exam and on the practical assignments students must obtain a minimum of 40

Final score will be calculated as follows:

 * 12% Questionnaires (3% each of the 4 proposed questionnaires)
 * 28% Practical assignment: 12% first practical assignment + 16% second practical assignment
 * 35% Final project: 25% Memory + 10% Oral presentation
 * 25% 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 statues 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 responsability and taking advantage of the learning process, knowledge adquisition 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 initation 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.

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8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Moodle	Web resource	http://moodle.upm.es
Digital Image Processing, 4th Edition Rafael C. Gonzalez, Richard E. Woods, 4th Edition, Pearson (2017)	Bibliography	https://www.pearson.com/us/higher-education/program/Gonzalez-Digital-Image-Processing-4th-Edition/PGM241219.html
Knowledge Discovery and Data Mining: Challenges and Realities Edit by Zhu, Xingquan (2007)	Bibliography	https://books.google.es/books?hl=es&lr=&id=-9SU65qKgR8C&oi=fnd&pg=PP1&dq=Image+Mining+book&ots=aALEvEzfLw&sig=d0b5Yp3S73c_xDnbM3RFSQ6dOhE&authuser=1#v=on epage&q_Image%20Mining%20book&f_false
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**	Java Applets	http://www.imageprocessingbasics.com
Fiji	Open Source Software	https://imagej.net/Fiji/Downloads
QGIS	Open Source Software	https://qgis.org/es/site/forusers/download.html