ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000857 - Image Mining

DEGREE PROGRAMME

10AZ - Master Universitario En Innovación Digital

ACADEMIC YEAR & SEMESTER

2022/23 - Semester 2

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	103000857 - Image Mining
No of credits	3 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	10AZ - Master Universitario en Innovación Digital
Centre	10 - Escuela Tecnica Superior De Ingenieros Informaticos
Academic year	2022-23

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Angel Mario Garcia Pedrero (Subject coordinator)	4211	angelmario.garcia@upm.es	Sin horario. Contact the professor by e-mail
Consuelo Gonzalo Martin	4207	consuelo.gonzalo@upm.es	Sin horario. Contact the professor by e-mail

* 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

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

3.2. Other recommended learning outcomes

- Machine Learning

- Signal and image processing

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

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

RA14 - Apply the acquired knowledge in real contexts

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

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

5.1. Brief description of the subject

About 80% of the data generated worldwide is visual information: images and videos. To capitalize on the value of this enormous amount of information, various technologies are needed to organize, store, retrieve and interpret this information automatically.

In this scenario, image mining provides the framework and tools needed to extract the implicit knowledge, useful data and relationship between image data from the images stored in large image databases.

Since the course does not presuppose prior knowledge of image processing, the first part of the course focuses on providing students with the concepts and methods needed to understand how to structure the information contained in images, which is the first step in starting an image mining project.

5.2. Syllabus

1. Introduction
    1.1. Motivation and Objectives
    1.2. Definition of Image Mining
    1.3. Applications
2. Digital Images
    2.1. Image Acquisition
    2.2. Digital Image Characteristics
    2.3. Digital Image Representation
3. Image Processing Fundamentals
    3.1. Operations based on Histogram
    3.2. Filtering in the Spatial Domain
    3.3. Discrete Fourier Transform
    3.4. Filtering in the Frequency Domain
4. Image as Visual Data
    4.1. Image Feature Extraction
5. Image Mining Applications
    5.1. Image Indexing and Retrieval
    5.2. Image Classification
    5.3. Object detection

6. Schedule

6.1. Subject schedule*

Week	Classroom activities	Laboratory activities	Distant / On-line	Assessment activities
1	**Unit 1** Duration: 02:00			
2	**Unit 2** Duration: 02:00			**Questionnaire Unit 2** Continuous assessment Not Presential Duration: 00:30
3	**Unit 3** Duration: 02:00			
4	**Unit 3** Duration: 02:00			**Questionnaire Unit 3** Continuous assessment Not Presential Duration: 00:30
5				**Project Proposal** Continuous assessment Not Presential Duration: 00:00
6	**Unit 4** Duration: 02:00			
7	**Unit 4** Duration: 02:00			
8	**Unit 4** Duration: 02:00			**Questionnaire Unit 4** Continuous assessment Not Presential Duration: 00:30
9				**Midterm Progress Project Report** Continuous assessment Not Presential Duration: 00:00
10	**Unit 5** Duration: 02:00			
11	**Unit 5** Duration: 02:00			

12	**Unit 5** Duration: 02:00			
13	**Compulsory Final Project Tutoring** Duration: 02:00			**Questionnaire Unit 5** Continuous assessment Not Presential Duration: 00:30
14	**Compulsory Final Project Tutoring** Duration: 02:00			
15	**Compulsory Final Project Tutoring** Duration: 02:00			
16				**Evaluation of Project Assignment** Continuous assessment Not Presential Duration: 02:00 **Evaluation Project Assignment Presentation** Continuous assessment Presential Duration: 02:00
17				**Examen** Final examination 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.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
2	Questionnaire Unit 2		No Presential	00:30	6.25%	0 / 10	CB07 CG06
4	Questionnaire Unit 3		No Presential	00:30	6.25%	0 / 10	CB06 CB07 CG06
5	Project Proposal		No Presential	00:00	10%	/ 10	CB06 CB07 CB08 CB09 CG03 CG05 CG06
8	Questionnaire Unit 4		No Presential	00:30	6.25%	0 / 10	CB07 CG06
9	Midterm Progress Project Report		No Presential	00:00	15%	/ 10	CB06 CB07 CB08 CB09 CG03 CG05 CG06
13	Questionnaire Unit 5		No Presential	00:30	6.25%	0 / 10	
16	Evaluation of Project Assignment		No Presential	02:00	30%	0 / 10	CB06 CB07 CB08 CB09 CG05 CG06
16	Evaluation Project Assignment Presentation		Face-to-face	02:00	20%	0 / 10	CB06 CB07 CB08 CB09 CG03 CG05 CG06

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Examen		No Presential	00:00	100%	5 / 10	CB07 CB08 CB09 CB06

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
The grade of this exam will be 100% of the total grade.		Face-to-face	00:00	100%	5 / 10	CB06 CB07 CB08 CB09 CG05 CG06

7.2. Assessment criteria

Progressive **evaluation:**

The course will be evaluated by:

- 4 Questionnaires
- 1 Final Project divided into three deliveries and a final presentation.

Project assignments will be done in groups among those enrolled in the course at the beginning of the academic year (number of the elements of each group 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 all the phases of the project assignment.

Final score will be calculated as follows:

- 25% Questionnaires (6.25% each)
- 75% Final project: 10% Project Proposal+ 15% Midterm report + 30% Final report + 20% Final Oral presentation

Global evaluation.

Students who have not passed the progressive evaluation may sit for the global evaluation which will correspond to a 100% final grade.

Referred (re-sit) examination. If the course is not passed during the ordinary call, the student will have to deliver the lab works in case it has not been done and take an exam. The grade of this exam will be 100% of the total grade. The minimum grade to pass is 50/100. The Head of Studies will determine the dates on which the exams will be held.

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 UPM statutes 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 UPM statutes 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

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?id=-9SU65qKgR8C&lpg=PP1&dq=Image%20Mining%20book&lr&hl=es&pg=PP1#v=onepage&q=Image%20Mining%20book&f=false
Szeliski, R. (2010). Computer vision: algorithms and applications. Springer Science & Business Media.	Bibliography	Book available free online: http://szeliski.org/Book/
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	http://www.imageprocessingbasics.com
Scientific articles	Bibliography	Specific scientifics articles will be recommended for each project assignment
Python	Others	https://www.w3schools.com/python/default.asp.
Jupyter notebook	Others	Jupyter notebook. https://jupyter-notebook.readthedocs.io/en/stable/notebook.html
OpenCV	Others	https://opencv-python-tutroals.readthedocs.io/en/latest/
ImageJ	Others	https://imagej.nih.gov/ij/

9. Other information

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.

The topics addressed during this course could be used in different domains such as Medical Imaging and Earth observation, driven by the needs of Society and by the improvement in different technologies, these topics have become an essential tool for understanding the different modalities of images that provide information about health and managing interactions between Earth and Man.