ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000820 - Vision analysis and deep learning

DEGREE PROGRAMME

09AQ - Master Universitario En Ingenieria De Telecomunicacion

ACADEMIC YEAR & SEMESTER

2018/19 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	93000820 - Vision analysis and deep learning
No of credits	6 ECTS
Type	Optional
Academic year ot the programme	Second year
Semester of tuition	Semester 3
Tuition period	September-January
Tuition languages	English
Degree programme	09AQ - Master universitario en ingenieria de telecomunicacion
Centre	09 - Escuela Tecnica Superior de Ingenieros de Telecomunicacion
Academic year	2018-19

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Carlos Roberto Del Blanco Adan	C-306	carlosrob.delblanco@upm.es	Sin horario.
Carlos Cuevas Rodriguez (Subject coordinator)	C-306	carlos.cuevas@upm.es	Sin horario.
Luis Salgado Alvarez De Sotomayor	C-325	luis.salgado@upm.es	Sin horario.

Narciso Garcia Santos	C-324	narciso.garcia@upm.es	Sin horario.
Julian Cabrera Quesada	C-320	julian.cabrera@upm.es	Sin horario.

* 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

El plan de estudios Master Universitario en Ingenieria de Telecomunicacion no tiene definidas asignaturas previas recomendadas para esta asignatura.

3.2. Other recommended learning outcomes

- Study simultaneously the subject Predictive and descriptive learning

- Study simultaneously the subject Machine learning lab

- Digital Signal Processing

- Digital Image Processing

- Signals and Systems

- Random Signals

4. Skills and learning outcomes *

4.1. Skills to be learned

CE1 - Capacidad para aplicar métodos de la teoría de la información, la modulación adaptativa y codificación de canal, así como técnicas avanzadas de procesado digital de señal a los sistemas de comunicaciones y audiovisuales.

CG1 - 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.

CG2 - 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.

CG4 - 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.

CG5 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CT3 - Capacidad para adoptar soluciones creativas que satisfagan adecuadamente las diferentes necesidades planteadas.

CT5 - Capacidad para gestionar la información, identificando las fuentes necesarias, los principales tipos de documentos técnicos y científicos, de una manera adecuada y eficiente.

4.2. Learning outcomes

RA279 - To know the theory and applications of video filtering algorithms

RA280 - To know the theory and applications of segmentation, detection and tracking algorithms

RA275 - Manage the mathematical and conceptual tools that serve as a basis for the Digital Video Processing techniques

RA274 - Knowledge of the practical problems that can be solved with video processing techniques

RA276 - Knowledge of the applications based on the spatio-temporal analysis of video signals

RA281 - Handle some of the fundamental computer tools for the implementation of Digital Video Processing algorithms

RA273 - Knowledge, characterization, acquisition and manipulation of video signals

RA277 - To know the theory and applications related to the algorithms of motion estimation and analysis

* 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

The goal of this subject is to provide the student with the knowledge required for the description, analysis, and manipulation of video signals. Students are expected to gain an overview of the theory required for video signal processing, covering the fields of motion estimation and analysis, filtering, spatial and temporal segmentation, and detection and tracking of visual objects. Moreover, the last part of the subject is focused on the fundamentals of machine learning and deep learning for image-based applications. The laboratory sessions will allow the better assimilation of the theoretical concepts. Additionally, to bring theoretical knowledge into practice, many specific applications will also be presented as examples of using the studied techniques. Therefore, an applied and participatory methodology is used.

5.2. Syllabus

1. Introduction to image and video processing
    1.1. 3D/2D projection
    1.2. Digital image and video
    1.3. Spatio-temporal sampling
2. Motion estimation
    2.1. Introduction
    2.2. Algorithms
    2.3. Applications
3. Video filtering
    3.1. Noise reduction
    3.2. Video stabilization
    3.3. Applications
4. Video segmentation and tracking
    4.1. Image segmentation
    4.2. Foreground segmentation
    4.3. Temporal video segmentation
    4.4. Tracking
    4.5. Applications
5. Deep learning for computer vision
    5.1. Machine learning fundamentals
    5.2. Deep learning solutions
    5.3. 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	**Chapter 1** Duration: 04:00 Lecture			
2	**Chapter 1** Duration: 02:00 Lecture **Chapter 2** Duration: 02:00 Lecture			**Individual work** Individual work Continuous assessment Duration: 10:00
3	**Chapter 2** Duration: 04:00 Lecture			
4	**Chapter 2** Duration: 02:00 Lecture	**Laboratory 1** Duration: 02:00 Laboratory assignments		**Individual work** Individual work Continuous assessment Duration: 10:00
5	**Chapter 3** Duration: 04:00 Lecture			**Lab report** Group work Continuous assessment and final examination Duration: 05:00 **Individual work** Individual work Continuous assessment Duration: 10:00
6	**Chapter 4** Duration: 04:00 Lecture			
7	**Chapter 4** Duration: 02:00 Lecture	**Laboratory 2** Duration: 02:00 Laboratory assignments		
8	**Chapter 4** Duration: 02:00 Lecture	**Laboratory 3** Duration: 02:00 Laboratory assignments		**Lab report** Group work Continuous assessment and final examination Duration: 05:00
9	**Chapter 4** Duration: 02:00 Lecture **Chapter 5** Duration: 02:00 Lecture			**Individual work** Individual work Continuous assessment Duration: 10:00 **Lab report** Group work Continuous assessment and final examination Duration: 05:00

10	**Chapter 5** Duration: 04:00 Lecture			
11	**Chapter 5** Duration: 04:00 Lecture			
12	**Chapter 5** Duration: 04:00 Lecture			
13	**Chapter 5** Duration: 02:00 Lecture	**Laboratory 4-5** Duration: 02:00 Laboratory assignments		**Individual work** Individual work Continuous assessment Duration: 10:00
14		**Laboratory 4-5** Duration: 04:00 Laboratory assignments		
15				**Lab report** Group work Continuous assessment and final examination Duration: 05:00
16				
17				**Final exam** Written test Final examination Duration: 02:00 **Classroom assessment** Other assessment Continuous assessment 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 theorical planning of the subject plan and might go to 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	Individual work	Individual work	No Presential	10:00	10%	/ 10	CT5 CG2 CG5 CG1 CE1
4	Individual work	Individual work	No Presential	10:00	10%	/ 10	CT5 CG2 CG5 CG1 CE1
5	Lab report	Group work	No Presential	05:00	7%	/ 10	CG4 CT3 CT5 CG2 CG5 CG1 CE1
5	Individual work	Individual work	No Presential	10:00	10%	/ 10	CT5 CG2 CG5 CG1 CE1
8	Lab report	Group work	No Presential	05:00	7%	/ 10	CG4 CT3 CT5 CG2 CG5 CG1 CE1
9	Individual work	Individual work	No Presential	10:00	10%	/ 10	CT5 CG2 CG5 CG1 CE1

9	Lab report	Group work	No Presential	05:00	7%	/ 10	CG4 CT3 CT5 CG2 CG5 CG1 CE1
13	Individual work	Individual work	No Presential	10:00	10%	/ 10	CT5 CG2 CG5 CG1 CE1
15	Lab report	Group work	No Presential	05:00	14%	/ 10	CG4 CT3 CT5 CG2 CG5 CG1 CE1
17	Classroom assessment	Other assessment	Face-to-face	02:00	15%	/ 10	CG4 CT3 CT5 CG2 CG5 CG1 CE1

7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
5	Lab report	Group work	No Presential	05:00	7%	/ 10	CG4 CT3 CT5 CG2 CG5 CG1 CE1
8	Lab report	Group work	No Presential	05:00	7%	/ 10	CG4 CT3 CT5 CG2 CG5 CG1 CE1
9	Lab report	Group work	No Presential	05:00	7%	/ 10	CG4 CT3 CT5 CG2 CG5 CG1 CE1

15	Lab report	Group work	No Presential	05:00	14%	/ 10	CG4 CT3 CT5 CG2 CG5 CG1 CE1
17	Final exam	Written test	Face-to-face	02:00	65%	5 / 10	CG4 CT3 CT5 CG2 CG5 CG1 CE1

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Extraordinary examination	Written test	Face-to-face	02:00	100%	5 / 10	CG4 CT3 CT5 CG2 CG5 CG1 CE1

7.2. Assessment criteria

Students will be qualified through continuous evaluation by default. According to the Normativa de Evaluación del Aprendizaje de la Universidad Politécnica de Madrid, students willing to renounce to continuous evaluation must complete the Moodle task entitled "Renounce to continuous evaluation" before the 4th week of the course (deadline will be announced in Moodle).

Evaluation will assess if students have acquired all the competences of the subject. Thus, evaluation through final assessment will be carried out considering all the evaluation techniques used in continuous evaluation (EX, ET, TG, etc.), and will be celebrated in the exam period approved by Junta de Escuela for the current academic semester and year. Evaluation activities that assess learning outcomes that cannot be evaluated through a single exam can be carried out along the semester.

Extraordinary examination will be carried out exclusively by the final assessment method.

For any evaluation modality, the student will overcome the subject when a grade higher or equal to 50% of the total score is obtained.

Performing all laboratory sessions, as well as obtaining an overall qualification equal or greater to 50% in their overall evaluation, is required to pass the course in any evaluation modality.

Performing all individual works, as well as obtaining an overall qualification equal or greater to 50% in their evaluation, is required to pass the course through continuous evaluation modality.

Obtaining a qualification equal or greater to 50% in the evaluation of the final exam is required to pass the course through final assessment or extraordinary examination modalities

Regular call: Continuous evaluation

The final score is obtained as follows:

FINAL SCORE = 15% classroom assessment + 35% lab reports + 50% individual works

Regular call: Final assessment

The final score is obtained as follows:

FINAL SCORE = 65% final exam + 35% lab reports

Extra call:

The final score is obtained as follows:

FINAL SCORE = 65% final exam + 35% lab exam

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Slides of the subject	Web resource	Available at UPM's Moodle repository
R.C. Gonzalez y R.E. Woods, Digital Image Processing, Prentice-Hall, 2008 (3rd. Edition).	Bibliography	
A. Murat Tekalp, Digital Video Processing, (2nd Edition) Prentice Hall, 2015	Bibliography	
I. Koprinska, S. Carrato, Temporal video segmentation: A survey, Signal processing: Image communication, vol. 16, no, 5, 2001, Elsevier	Bibliography	
T. Bouwmans, Traditional and recent approaches in background modeling for foreground detection: An overview, Computer Science Review, Vol.11 2014, Elsevier	Bibliography	

R.M. Haralick, L.G. Shaphiro, Computer and Robot Vision, Volumne I y II, Addison-Wesley 1992	Bibliography	
C. M. Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics), 2006, Springer-Verlag New York, Inc., Secaucus, NJ, USA.	Bibliography	
D. A. Forsyth and Jean Ponce, Computer Vision: A Modern Approach (2nd ed.), 2011, Prentice Hall Professional Technical Reference	Bibliography	
R. Szeliski, Computer Vision: Algorithms and Applications (1st ed.), 2010, Springer-Verlag New York, Inc., New York, NY, USA.	Bibliography	
Laboratory of signals (A-202-L)	Equipment	Workroom for the realization (in pairs) of laboratory sessions