Computer-vision Systems

Code: 104368
ECTS Credits: 6

2025/2026

Degree	Type	Year
Data Engineering	OT	4

Contact

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

The course has no prerequisites. However, its contents extend and complement those previously seen in the subjects of "Signal, image and video processing" and "Neural networks and deep learning", which must be mastered. Likewise, in the course different vision systems will be developed, for which it is necessary to have a good level of programming in Python.

Objectives and Contextualisation

The training objectives of the subject are:

- Depening the design of computer vision systems, given a specific problem to be solved.
- Identifying the necessary data that must be captured to develop a system, as well as the appropriate metrics to analyze its performance.
- Knowing the main open software libraries to develop both traditional vision systems and those based on deep learning.
- Acquiring practical experience in the application of state-of-the-art techniques for the extraction of knowledge from the data of a computer vision system.

Competences

- Conceive, design and implement smart systems for autonomous leaning and predictive capacity systems.
- Conceive, design and implement the most appropriate data acquisition system for the specific problem to be solved.
- Demonstrate sensitivity towards ethical, social and environmental topics.
- Prevent and solve problems, adapt to unforeseen situations and take decisions.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.

Learning Outcomes

1. Choose and interpret the most suitable predictive models for environmental management in Smart Cities.
2. Demonstrate sensitivity towards ethical, social and environmental topics.
3. Design the most efficient data acquisition system for a system to support autonomous driving.
4. Prevent and solve problems, adapt to unforeseen situations and take decisions.
5. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
6. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.

Content

- Introduction to Computer Vision systems
- Cameras
- Optics
- Ilumination
- Monocular systems
- Stereo systems and range sensors
- Multiview systems
- Robust estimators
- Super-resolution
- Image fusion
- Pan-sharpening

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Assessment Test	2	0.08	2, 6, 5
Practical work sessions	9	0.36	2, 3, 1, 4
Problem sessions	10	0.4	4, 6
Theory Sessions	17	0.68	6, 5
Type: Supervised			
Preparation of practical work	30	1.2	2, 3, 1, 4
Problem solving outside the classroom	6	0.24	4, 6
Project preparation and monitoring	44	1.76	2, 3, 1, 4
Type: Autonomous			
Study	30	1.2	6, 5
Tutoring and consultation	2	0.08	6

The different activities that will be carried out in the subject are organized as follows:

Theory sessions: The basic concepts of the subject are exposed and indications are given on how to complete and deepen this content.

Problem sessions: Problems are solved and case studies are discussed. With the proposed activities, autonomous and cooperative work is promoted, the capacity for analysis and synthesis, critical reasoning, and the student is trained in problem solving.

Practices: During the course practical work is carried out in groups of 2 people (exceptionally 1 or 3). Challenge-projects are proposed where the group applies techniques worked on in theory and problems sessions.

Project: A team project is developed. In this project, the students will be trained under supervision in a selected data process topic, they will have to make an exhibition, as well as develop a computer system that serves as a demonstrator of the techniques related to the topic studied.

Use of Artificial Intelligence

In this subject, the use of Artificial Intelligence (AI) technologies is allowed as an integral part of the development of the project work, provided that the final result reflects a significant contribution of the student in the analysis and personal reflection. The student must clearly identify which parts have been generated with this technology, specify the tools used and include a critical reflection on how these have influenced the process and the final result of the activity. The lack of transparency in the use of AI will be considered a lack of academic honesty and may lead to a penalty in the grade of the activity, or greater sanctions in serious cases.

General considerations

The 'Campus virtual' platform will be used to disseminate informationto students. The dates of continuous evaluation and delivery of works will be published through this medium, and may be subject to possible programming changes for reasons of adaptation to possible incidents. 'Campus virtual' will be used to inform about these possible changes, since this is the platform for the exchange of information between the teaching staff and the students.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
[E1]-Ex: Exam	30%	0	0	2, 6, 5
[E2]-Prob: Delivered activities	10%	0	0	4, 6
[E3]-Prac: Practical work	30%	0	0	2, 3, 1, 4
[E4]-Proj: Project	30%	0	0	2, 3, 1, 4

a) Programmed evaluation process and activities

The evaluation of the subject will be carried out continuously from the learning evidences collected in the following processes:

- [E1]. Individual written tests (exams).
- [E2]. Resolution and delivery of questionnaires and exercises proposed in the theory and problem sessions, individually.
- [E3]. Carrying out practical work evaluated from different activities and deliveries, in groups.
- [E4]. Carrying out a project evaluated from different activities and deliveries, in groups.

The course consists of the following assessment activities, each assessed with a grade between 0 and 10 (both inclusive):

- [E1]-Ex, examination of essential contents, 30% on the final grade.
- [E2]-Prob, resolution of exercises proposed in the theory and problem sessions, 10% on the final grade.
- [E3]-Prac, practical activities, 30% on the final grade.
- [E4]-Proj, project activities, 30% on the final grade.

In order to pass the course through continuous assessment, you will have to get a grade equal to or greater than 5 in the following expressions:

- (1,0*Grade[E1]-Ex) + (0,1*Grade[E2]-Prob)
- (1,0*Grade[E4]-Proj) + (0,1*Grade[E2]-Prob)

In the case of passing all the conditions to pass, the final mark of the subject will be calculated from the weighted average of the grades, using the expression:

- (0,3*Grade[E1]-Ex) + (0,1*Grade[E2]-Prob) + (0,3*Grade[E3]-Prac) + (0,3*Grade[E4]-Proj)

In the case of NOT passing all the conditions to pass, the student's final grade will be the lower value between 4.5 and the weighted average of the grades, using the expression:

- min(4.5, ((0,3*Grade[E1]-Ex) + (0,1*Grade[E2]-Prob) + (0,3*Grade[E3]-Prac) + (0,3*Grade[E4]-Proj)))

Keep in mind that:

- The exercises that make up the activity [E2]-Prob must be delivered within an established period, and will be evaluated with a mark between 0 and 10 (both inclusive). Exercises not delivered within their deadline will be evaluated with a grade of 0 and cannot be recovered.
- Activities [E3]-Prac and [E4]-Proj will be evaluated based on different proposed sub-activities, which will have an established deadline for completion and delivery. Each subactivity will be evaluated with a score between 0 and 10 (both inclusive). Sub-activities not carried out or delivered after their deadline will be evaluated with a score of 0 and cannot be recovered.

In case of irregularities in the evaluation activities, what is detailed in section f) will be applied.

It is important to bear in mind that evaluation activities will not be carried out on a date or time other than that established, except for justified reasons, duly informed in advance to the teaching staff.

b) Programming of evaluation activities

The calendar of the different evaluation activities is detailed in the 'Campus Virtual' platform, in the Moodle classroom of l'assignatura. The dates of completion of the written tests will also be made public on the website of the School of Engineering, in the exams section.

c) Recovery process

The only recoverable assessment activities are

- the written test [E1]-Ex.
- the project [E4]-Proj

Each of these activities can be recovered by taking an associated written recovery test (exam).

The student can present himself to recover or improve the mark of these activities as long as he has presented himself to a set of activities that represent a minimum of two thirds of the total qualification of the subject.

In order to compute the final grade of the subject, the mark obtained in the recovery exam will replace the corresponding one obtained in the continuous assessment.

In accordance with the coordination of the Degreeand the direction ofthe School of Engineering, the following activities cannot be recovered:

- [E2]-Prob, 10% on the final grade.
- [E3]-Prac, 30% on the final grade.

d) Procedure for the review of qualifications

For assessment activities based on written tests a procedure for booking a revision date ant time will be established in which the student will be able to review the activity with the teaching staff. In this context, claims can be made about the activity grade, which will be evaluated by the teachers responsible for the subject. Likewise, it is possible to arrange with the teaching staff the review of the rest of the assessment activities up to two weeks before the recovery exams.

e) Special qualifications

If the student has not performed the test [E1]-Ex the "Non-assessable" grade will be assigned. It must be remarked that according to current regulations "Non-assessable" qualifications also exhaust convocation.

As many honors registrations will be assigned as the current regulations allow, as long as the grade is higher than 9.0. The assignment of the registrations will be done following the order of grades. In the event of a tie, the results of the partial tests will be taken into account and, if necessary, supplementary activities will be proposed to determine who is awarded the honor roll.

f) Irregularities by the student, copy and plagiarism.

Notwithstanding other disciplinary measures deemed appropriate, assessment activities will receive a zero whenever a student commits academic irregularities that may alter such assessment. Therefore, copying, plagiarizing, cheating, ... in any of the assessment activities will imply suspending it with a zero.

g) Evaluation of repeating students
From the second enrollment, repeating students may request to validate the evaluation of the activities [E3]-Prac, taking the grade obtained in a previous course as long as the grade is equal to or greater than 5. In order to be able to opt for this differentiated evaluation, repeating students must ask the faculty through an email.

h) Single evaluation

This subject does not provide for the single assessment system.

Bibliography

- Shree Nayar, T.C. Chang, First Principles of Computer Vision, video lectures (http://fpcv.cs.columbia.edu/)
- Richard Szeliski, Computer Vision: Algorithms and Applications, 2nd Edition. Springer (Texts in computer Science) 2021. (http://szeliski.org/Book/)
- Lumimax knowled base v092023, Useful facts acout machine vision lighting systems. iiM AG, 2022. (http://www.iim-ag.com/en/lumimax/useful-facts.html)

- Adrian Kaehler, Gary Bradsky, Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library, O'Reilly.
- Aurélien Géron, Hands-On Machine Learning with Scikit-Learn & TensorFlow, O'Reilly, 2017.

Software

To develop different computer vision systems, both in practice and in problems sessions, the Python programming language will be used, working with Jupyter Notebooks. Work will be done in the classroom with the laptop brought by the student himself, or by sharing a laptop with a classmate.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	81	Catalan	second semester	morning-mixed