UAB
Universitat Autònoma de Barcelona

Signal, Image and Video Processing

Code: 104346
ECTS Credits: 6

2024/2025

Degree	Type	Year
2503758 Data Engineering	OB	2

Contact

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Teachers

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Teaching groups languages

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

Prerequisites

There are no prerequisites. This course is fairly self-contained. However, this course will touch topics related to mathematical calculations, probability and signal theory. Problems and practices in many cases will be small programs, so a good foundation in mathematics and programming is necessary.

Objectives and Contextualisation

The objectives of the subject can be summarized in:

Knowledge:

Understand and know how to model the acquisition with different sensors, especially with cameras.
Describe and relate the phases of a solution to a problem of signal processing analysis.
Identify the advantages and disadvantages of image processing algorithms.
Solve real problems related to image processing techniques.
Understand the result and limitations of vision techniques in different case studies.
Know how to choose the most suitable image processing algorithm to solve a given task.
Know how to choose the most appropriate computer vision techniques to solve contextualized problems.

Skills:

Recognize situations in which the application of image processing algorithms may be adequate to solve a problem.

Analyze the problem to solve and design the optimal solution applying the techniques learned.
Write technical documents related to the analysis and solution of a problem.
Program the basic algorithms to solve the proposed problems.
Evaluate the results of the implemented solution and evaluate the possible improvements.
Defend the decisions made in the solution of the proposed problems.

Competences

- 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.
- Develop critical thinking and reasoning and know how to communicate it effectively in both your own language and in English.
- Search, select and manage information and knowledge responsibly.
- 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.

Learning Outcomes

1. Choose the most suitable knowledge-representation methods for extracting the objects present in the scene, image or video and subsequently analysing them.
2. Demonstrate sensitivity towards ethical, social and environmental topics.
3. Design a system for obtaining images and videos and apply the basic methods of image processing to specific problems.
4. Develop critical thinking and reasoning and know how to communicate it effectively in both your own language and in English.
5. Extract and analyse movement from a video (following objects, characteristic points throughout a video, etc.)
6. Search, select and manage information and knowledge responsibly.
7. 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.

Content

1. Introduction to signal, image and video processing
2. Image formation
3. Image processing
4. Linear (spatial) filtering
5. Frequency filtering
6. Non-linear filtering
7. Geometric transformations
8. Segmentation
9. Features
10. Classification

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes

Type: Directed			
Laboratori classes	15	0.6	1, 2, 3, 4, 5, 6, 7
Problem seminars	14	0.56	1, 2, 3, 4, 5, 6, 7
Theory lectures	12	0.48	1, 2, 3, 5, 6, 7
Type: Supervised			
Analysis and design of the project	15	0.6	1, 2, 3, 4, 6, 7
Project documentation	10	0.4	1, 2, 3, 4, 6, 7
Type: Autonomous			
Individual study	45	1.8	1, 3, 5, 6, 7
Study in group	30	1.2	1, 2, 3, 4, 5, 6, 7

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

Master classes

The main concepts and algorithms of each theory topic will be presented. These subjects are the starting point in the work of the subject.

Problem seminars

They will be classes with small groups of students that facilitate interaction. In these classes, practical cases will be considered that require the design of a solution in which the methods seen in the theory classes are used.

Laboratory practices

There will be a series of common practical exercises that will allow achieving basic competencies in issues related to signal, image and video processing. Some of the sessions will be marked as control sessions where a practice exercise should be delivered. In these sessions the groups must explain the work done and the teacher will ask questions to all group members to assess the work. Attendance at these sessions is mandatory.

In the second part of the semester, the students in groups of 4 or 5 will prepare presentations on different topics and will prepare some mini-practices for their colleagues from the other groups.

The groups and the topics to be distributed will be determined the week after the Midterm Exam.

The coordination of the class will be done through the Virtual Campus (https://cv.uab.cat/), which will be used to view the materials, manage the practice groups, make the corresponding deliveries, view the notes, communicate with teachers, etc.

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
Group project	25%	1	0.04	1, 2, 3, 4, 5, 6, 7
Individual written tests	30%	6	0.24	1, 3, 4, 5
Lab validations	45%	2	0.08	1, 3, 4, 5, 6, 7

This class does not allow the unique assessment system. The evaluation is continuous. The student will have information about their progress at all times.

There are two distinct blocks:

Block 1

The grade for Block 1 will be based on the average of the lab grades and the result of a written Midterm exam. The Midterm exam will evaluate both theoretical topics and knowledge about the implementations of the labs. 30% of the Block 1 grade will be from the Midterm Exam. The lab assignments are done in group but will be evaluated individually during control sessions.

Block 2

Deliveries will be made in groups of 4 or 5 students. Each group will prepare and present a topic from the syllabus. In addition to the presentation, the group will have to prepare three test-type questions for the Final Exam and a mini lab for their classmates. The feedback they provide to classmates will also be evaluated. This gorup project is 50% of the grade for Block 2. The grade will be individual as it will be multiplied by a factor based on a co-evaluation among group members.

The weight of the final exam is 30% of the grade for Block 2, and the submissions of practice tasks are 20% of that grade.

The Final Grade of the class is obtained by combining the assessment of the two blocks

Final Grade = 0.5 * Block 1 Grade + 0.5 Block 2 Grade

There are no minimum grades in any of the assessments except the final grade. The grade to pass the subject is 5.0.

Recovery process: The two exams, as well as 50% of the labs can be recovered. The student can opt for recovery as long as they have submitted assesment tasks that represent a minimum of two-thirds of the total qualification of the class. Of these, students who have an average grade higher than 3.5 may apply for recovery.

Criteria for Honors Grade (MH): Awarding an honors grade is the decisionof the teachingstaff responsible for the class. UAB regulations indicate that MH can only be granted to students who have obtained a final grade equal to or higher than 9.00. Up to 5% of the students can be awarded MH.

Criteria for the grade Not Assessable (NA): A student will be considered not assessable (NA) only if they have not been present for the written exams of Block 1 and Block 2.

Scheduling of assessment activities: The dates of continuous assessment and submission of assignments will be published on the Virtual Campus and may be subject to schedule changes for reasons of adaptation to possible incidents; information will always be provided on the Virtual Campus about these changes, as the Virtual Campus is the usual mechanisms for exchanging information between professors and students

Review procedure: For each assessment activity, a review location, date and time will be indicated in which the student can review the activity with the professor. In this context, claims can be made about the grade of the activity, which will be evaluated by the teaching staff responsible for the class. If the student is not present for this review, this activity will not be reviewed at later time.

Use of AI tools (eg GPT chat): The use of such tools will only be restricted in written tests (theory exams, problem exams and practice validation tests). This means that it is important that you make critical use of these tools, that is, that you use them to learn, not to copy.

Note on plagiarism: Without prejudice to other disciplinary measures that are deemed appropriate, and in accordance with current academic regulations, irregularities committed by a student will be graded with a zero (0). Assessment activities qualified in this way and by this procedure will not be recoverable.
Theseirregularities include, among others:

- the total or partial copy of apractice, report, or any otherassessment activity;
- allowing copying;
- present a group work not done entirely by the members of thegroup (applied to all members, not only those who have not worked);
- present as own materials prepared by a third party, even if they are translations or adaptations, and in general works with non-original and exclusive elements of the student;
- have communication devices (such as mobile phones, smart watches, pens with cameras, etc.) accessible during individual theoretical-practical assessment tests (exams);
- talk with colleagues during individual theoretical-practical assessment tests (exams);
- copy or attempt to copy from other students during theoretical-practical assessment tests (exams);
- use or try to use writings related to the subject during the theoretical-practical assessment tests (exams), when these have not been explicitly allowed.

The numerical grade of the course will be the lower value between 3.0 and the weighted average of the grades in the event that the student has committed irregularities in an evaluation act.
In short: copying, allowing copying or plagiarism in any of the assessment activities is equivalent to a SUSPENSION with a grade below 3.0.

Bibliography

- Richard Szeliski, Computer Vision: Algorithms and Applications, Springer (Texts in computer Science) 2011. (http://szeliski.org/Book/)
- Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing (3rd Edition), Prentice Hall 2007.
- Paolo Prandoni and Martin Vetterli: Signal Processing for Communications (https://www.sp4comm.org/)
- Steven L. Brunton and J. Nathan Kutz: Data-driven Science and Engineering (https://www.databookuw.com/)

Software

MatLab

Python

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	81	English	second semester	morning-mixed
(PAUL) Classroom practices	82	Catalan	second semester	morning-mixed