Universitat Autònoma de Barcelona

2023/2024

Introduction to Human and Computer Vision

Code: 44772
ECTS Credits: 6

Degree	Type	Year	Semester
4318299 Computer Vision	OB	0	1

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Teachers

Javier Vazquez Corral

Javier Ruiz Hidalgo

Ramon Morros Rubio

Verónica Vilaplana Besler

Philippe Salembier Clairon

Prerequisites

Degree in Engineering, Maths, Physics or similar

Objectives and Contextualisation

Module Coordinator: Dr. Philippe Salembier

The aim of this module is introduce the students to computer vision including basics of human visual system and image perception, acquisition and processing. In terms of processing, the module deals with low-level pixel-based transforms, linear, nonlinear and morphological filtering, Fourier analysis, multiscale representations, extraction of simple features and image descriptions. Furthermore, elementary grouping, segmentation and classification strategies will be discussed as well as quality and assessment methodologies for image processing algorithms. To put into practice the algorithms and techniques, the students will work on a concrete project along the course. The aim is to provide an applied knowledge of a broad variety of Computer Vision techniques applied to solve a real-world vision problem. The project goal is to detect specific objects in images using basic CV techniques such as linear and non-linear filtering segmentation, grouping, template matching, modeling, etc. The knowledge obtained can be used in a wide variety of applications, for instance, quality control, generic object detection, security applications, etc.

Learning Outcomes

- CA06 (Competence) Achieve the objectives of a project of vision carried out in a team.
- KA01 (Knowledge) Identify low level modules such as pre-processing, extraction or grouping of characteristics necessary for solving a problem of vision.
- KA08 (Knowledge) Select the best algorithms for use with each of the components defined to solve a low level problem of vision.
- SA01 (Skill) Apply and evaluate low level processing techniques to solve a specific problem.
- SA07 (Skill) Apply data analysis and performance evaluation techniques for different problems.
- SA08 (Skill) Select the best software tools to code techniques to solve low level problems of vision.
- SA15 (Skill) Prepare a report that describes, justifies and illustrates the development of a project of vision.
- SA17 (Skill) Prepare oral presentations that allow debate of the results of a project of vision.

Content

1. Human visual system and perception
2. Image formation and color representation
3. Image processing assessment and pixel-based processing
4. Morphological and nonlinear filtering
5. Space-frequency representation, Fourier transform and linear filtering (I)
6. Space-frequency representation, Fourier transform and linear filtering (II)
7. Scale-space theory and multi-scales image processing
8. Feature extraction
9. Grouping, Segmentation and Classification

Methodology

Supervised sessions: *(some of these sessions could be online synchronous)*
• Lecture Sessions, where the lecturers will explain general contents about the topics. Some of them will be used to solve the problems.

Directed sessions:
• Project Sessions, where the problems and goals of the projects will be presented and discussed, students will interact with the project coordinator about problems and ideas on solving the project (approx. 1 hour/week).
• Presentation Session, where the students give an oral presentation about how they have solved the project and a demo of the results.
• Exam Session, where the students are evaluated individually. Knowledge achievements and problem-solving skills

Autonomous work:
• Student will autonomously study and work with the materials derived from the lectures.
• Student will work in groups to solve the problems of the projects with deliverables:
• Code
• Reports
• Oral presentations

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lecture Sessions	20	0.8	KA01, KA08, KA01
Type: Supervised			
Supervised sessions	8	0.32	SA01, SA07, SA08, SA01
Type: Autonomous			
Homework	113	4.52	CA06, SA01, SA07, SA15, SA17, CA06

Assessment

The final marks for this module will be computed with the following formula:

Final Mark = 0.4 x Exam + 0.55 x Project+ 0.05 x Attendance

where,

Exam: is the mark obtained in the Module Exam (must be >= 3).

Attendance: is the mark derived from the control of attendance at lectures (minimum 70%)

Project: is the mark provided by the project coordinator based on the weekly follow-up of the project and deliverables (must be >= 5). All accordingly with specific criteria such as:

- Participation in discussion sessions and in team work (inter-member evaluations)
- Delivery of mandatory and optional exercises.
- Code development (style, comments, etc.)
- Report (justification of the decisions in your project development)
- Presentation (Talk and demonstrations on your project)

Only those students that fail (Final Mark < 5.0) can do a retake exam.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Attendance	5%	0.5	0.02	CA06
Exam	40%	2.5	0.1	KA01, KA08, SA01, SA07, SA08
Project	55%	6	0.24	CA06, SA01, SA07, SA08, SA15, SA17

Bibliography

1. Rafael C. Gonzalez, Richard E. Woods*, "Digital Image Processing", 3rd Edition.*
2. David Marr, "*Vision: A Computational Investigation into the Human Representation and Processing of Visual Information"*, Freeman, 1982.
3. Richard Szeliski, "*Computer Vision: Algorithms and Applications"*, Springer-Verlag New York, Inc. New York, USA 2010.

Software

Tools for Python programming with special attention to computer vision and image processing libraries