ESCUELA POLITÉCNICA SUPERIOR DE CÓRDOBA

GRADO DE INGENIERÍA INFORMÁTICA

2024/25 YEAR

FUNDAMENTOS DE SISTEMAS INTELIGENTES EN VISIÓN

Course details

Course name: FUNDAMENTOS DE SISTEMAS INTELIGENTES EN VISIÓN
Code: 101421
Degree/Master: GRADO DE INGENIERÍA INFORMÁTICA **Year:**
Field: FUNDAMENTOS DE SISTEMAS INTELIGENTES EN VISIÓN
Character: OBLIGATORIA **Duration:** FIRST TERM
ECTS Credits: 6.0 **Classroom hours:** 60
Face-to-face classroom percentage: 40.0% **Study hours:** 90
Online platform: https://moodle.uco.es/

Coordinating teacher

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Brief description of the contents

The main goal of this course is to provide basic knowledge to analyze, design and implement intelligent systems based on computer vision.
This includes:
- Design of acquisition systems: selecting the appropriate sensors and configuring their parameters.
- Understanding the basis of digital images: projective geometry, camera calibration and correction of lens aberrations.
- Learning the main techniques of digital image processing: processing in space and frequency domains.
- Understanding the segmentation techniques and their uses.
- Grasp the principles of feature extraction and description and their utility.
- Becoming familiar with the fundamentals of 3D reconstruction from 2D images.

Prerequisites

Prerequisites established in the study plan

None.

Recommendations

It is more than recommended good skills in C++ programming (medium level).

Study programme

1. Theory contents

BLOCK 1: Digital image processing. Image acquisition. Pixelwise operations. Linear and non-linear filtering. Applications.

BLOCK 2: 3D scene reconstruction. Main stereo techniques, structured light and Shape-from-X. Applications.

BLOCK 3: Image understanding. Segmentation and feature extraction. Representation and description. Modern Computer Vision approaches.

2. Practical contents

Introduction to the use of the OpenCV software package and its application to the field of Computer Vision. To this end, several practical exercises will be carried out using this package, where the student will learn the following skills:

- Installation and optimised configuration of the OpenCV package in Linux/Windows environments.
- Basic loading and manipulation of monochrome/colour images.
- Video capture/recording with USB cameras.
- Point processing of images: histogram equalisation/enhancement.
- Camera calibration and application to camera distortion correction.
- Camera pose estimation and application to augmented reality.
- Reconstruction of the 3D scene from its 3D projections.
- Feature extraction such as gradients, lines, optical flow, texture.
- Application of machine learning for image classification: Nearest Neighbour and Support Vector Machine.
- Deep Learning applied to Computer Vision problems.

Bibliography

- Adrian Kaehler y Gary Bradski , "Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library", O'Reilly Media, 2016, ISBN: 978-1491937990
- Richard Szeliski, "Computer Vision: Algorithms and Applications", 2nd Edition, Springer, 2022 - Online: https://szeliski.org/Book/

Extra:

- Alberto Fernandez Villan, "Mastering OpenCV 4 with Python", Packt, 2019
- Aurelien Geron, "Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly, 2019
- Jeremy Howard y Sylvain Gugger, "Deep Learning for Coders with FastAI and PyTorch", O'Reilly, 2020.

Methodology

Methodological adaptations for part-time students and students with disabilities and special educational needs

At the beginning of the course, the student should contact the course instructor to handle each situation in a particular manner.

Face-to-face activities

Activity	Large group	Medium group	Total
Assessment activities	3	-	3
Practical experimentation activities	-	24	24
Projects based on the course contents	28.5	-	28.5
Tutorial action activities	4.5	-	4.5
Total hours:	***36.0***	***24***	***60.0***

Off-site activities

Activity	Total
Exercise and problem solving activities	40
Information processing activities	40
Information search activities	10
Total hours	***90***

Results of the training and learning process

Knowledge, competencies and skills

CB4 To make students able to share information, ideas, problems and solutions with an audience of specialists and non-specialists

CTEC4 Ability to know the fundamentals, paradigms and techniques of intelligent systems and analyze, design and build systems, services and computer applications that use these techniques in any field of application.

CTEC5 Ability to acquire, obtain, formalize and represent human knowledge in a computable way to solve problems through a computer system in any field of application, particularly those related to aspects of computing, perception and performance in intelligent environments.

Assessment methods and instruments

Intended learning outcomes	Examination	Means of practical execution	Students assignments
CB4	X	X	X
CTEC4	X	X	X
CTEC5	X	X	X
Total (100%)	***35%***	***45%***	***20%***
Minimum grade (*)	***5***	***5***	***0***

(*)Minimum mark (out of 10) needed for the assessment tool to be weighted in the course final mark. In any case, final mark must be 5,0 or higher to pass the course.

General clarifications on instruments for evaluation:

In January and February, the students must do a final exam both theoretical (Examination) and practical (Means of practical execution). The final mark will be the weighted average of the exams and the laboratory practicals (Students assignments). The exercises of the laboratory practicals must be handed in before the exam in January.

After the February exam (extraordinary ones), the evaluation criteria are based exclusively on the final exams (theoretical and practical).

Grades for instruments passed will only be valid for the current academic course.

NOTE: plagiarism is a very serious issue in the educational field in general, and in the university setting in particular. Therefore, the detection of **plagiarism** (e.g., similarities with other students' work, content obtained from the Internet, or generated with LLMs) in "Students assignments" or any other activity will automatically result in a grade of zero for that assessment tool, and there will be **no option to recover** this percentage during the current course.

NOTE-2: During evaluation tests (e.g., exams), the entry into the classroom with electronic devices (e.g., smartphone, smartwatch, etc.) **will not be allowed**.

Clarifications on the methodology for part-time students and students with disabilities and special educational needs:

At the beginning of the course, the student should contact the course instructor to handle each situation in a particular manner.

Clarifications on the evaluation of the extraordinary call and extra-ordinary call for completion studies:

After February, the evaluation criteria are based only on the final exams.

Qualifying criteria for obtaining honors:

The current regulations will be applied.

Sustainable development goals

Quality education
Industry, innovation and infrastructure

Other Faculty

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The methodological strategies and the evaluation system contemplated in this Teaching Guide will respond to the principles of equality and non-discrimination and must be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are required. Students must be informed of the risks and measures that affect them, especially those that may have serious or very serious consequences (article 6 of the Safety, Health and Welfare Policy; BOUCO 23-02-23).