

Computer Vision (E900539)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0

Study time 180 h

Course offerings in academic year 2023-2024

A (semester 1)

English

Gent

Lecturers in academic year 2023-2024

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BARCELO3 lecturer-in-charge

Offered in the following programmes in 2023-2024

[International Master of Science in Fire Safety Engineering](#)

crdts

6

offering

A

Teaching languages

English

Keywords

Image processing, pattern recognition, virtual reality

Position of the course

During this course the students will learn the essential steps from an original image to its final representation by means of quantitative descriptors, to develop and implement computer codes to decide which algorithms perform better for each problem and to develop and publish VR apps using Unity 3D platform.

Contents

- Image processing
 - Image pre-processing: intensity transformations, spatial and statistical filters, filtering in the frequency domain
 - Image segmentation: Otsu, watershed, morphological operations
 - Feature extraction: geometrical descriptors, colour spaces, texture analysis
- Pattern recognition in images
 - Machine learning based on features: Linear discriminant analysis, Bayes classifier, principal component analysis, decision trees and support vector machines.
 - Deep learning: blocks of deep neural networks, convolutional filters, training, forward and backward propagation, parameters and hyperparameters.
 - Specialized architectures and codes for structured implementations.
- Virtual reality
 - Overview of virtual reality (VR) hardware and software to learn different ways to get started with this technology.
 - Practical cases of current applications.
- Applications
 - Applications of the methodologies to practical problems in areas like: Robotics, Medical images, Satellite images, Fire and smoke images, Virtual reality

Initial competences

Programming, basic statistics

Final competences

- 1 Recognize different image modalities and their applications
- 2 Perform advanced manipulations of digital images stored in different file formats.
- 3 Perform automatic segmentation and extraction of descriptors.
- 4 Develop and implement algorithms for the automatic recognition of special patterns in images based on machine and deep learning methods.
- 5 Getting an overview to VR development with Unity and introducing VR elements and user

input.

6 Introducing to different VR technologies and building an application.

7 Publishing apps in Unity and exporting to mobile devices.

8 Design and implement appropriate pipelines for specific real problems, including input datasets, decision on the most appropriate techniques and interpretation of the results.

9 Generate high level reports including developments, evaluations and conclusions

Conditions for credit contract

This course unit cannot be taken via a credit contract

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Group work, Seminar, Lecture, Practical, Independent work

Extra information on the teaching methods

The methodology of the course combines theory lessons, laboratory sessions and autonomous learning through the development of projects and the analysis of real applications.

Learning materials and price

All material needed can be found digitally on the course web (for free)

References

- Webb, Andrew R. Introduction to biomedical imaging. Hoboken (N.J.): Wiley, cop. 2003. ISBN 0471237663. - González, Rafael C.; Woods, Richard E. Digital image processing. 3rd ed., international ed. Upper Saddle River: Pearson Education Internacional, cop. 2010. ISBN 9780132345637.
- Raschka, Sebastian; Mirjalili, Vahid. Python machine learning : machine learning and deep learning with Python, scikit-learn, and TensorFlow [on line]. 2nd ed. Birmingham, UK: Packt Publishing, 2017 Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5050960>. ISBN 9781787126022].
- James, Gareth. An introduction to statistical learning : with applications in R. New York: Springer, 2013. ISBN 9781461471370.
- Géron, Aurélien. Hands-on machine learning with Scikit-Learn and TensorFlow : concepts, tools, and techniques to build intelligent systems [on line]. Sebastopol, CA: O'Reilly Media, 2017 [Consultation: 21/04/2020]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=4822582>. ISBN 9781491962299

Course content-related study coaching

Interactive support through the electronic learning environment, in person after agreement on date and immediately before and after classes.

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment with multiple-choice questions, Written assessment with open-ended questions, Written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment with multiple-choice questions, Written assessment with open-ended questions, Written assessment

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

The examination of the course consists of three parts: A written mid-term exam, a written final exam and the continuous assessment.

Calculation of the examination mark

30% mid-term exam, 30% final exam, 40% continuous assessment

Facilities for Working Students

There are no special facilities for working students

