HALMSTAD UNIVERSITY
Phone +46 35 16 71 00 - www.hh.se
School of Information Technology

Fundamentals of Computer Vision with Deep Learning 5 credits

Grundläggande datorseende med djupinlärning 5 hp

Second cycle
Main field: Computer Science and Engineering, Second cycle, has only first-cycle course/s as entry requirements (A1N)
Syllabus is adopted by the Research and Education Board (2021-10-13) and is valid for students admitted for the spring semester 2022.

Placement in the Academic System

The course is given as a single subject course.

Prerequisites and Conditions of Admission

Degree of Bachelor of Science in Computer Science and Engineering 180 credits. Programming 7.5 credits and Mathematics (Linear Algebra, Multi-variable Calculus) 7.5 credits.

Course Objectives

This course covers the basic concepts and algorithms of computer vision and deep learning, both from a theoretical and practical perspective. Via practical examples and assignments, students will assess how the presented concepts can be put into practice.

Following successful completion of the course the student should be able to:

Knowledge and understanding

- describe basic computer vision and deep learning concepts and algorithms in joint applications, including an informal explanation of the mathematical theory behind
- explain the strengths and limitations of the different methods of computer vision and deep learning

Skills and ability

- identify challenges that can be solved with computer vision methods including deep learning, and choose an appropriate method
- apply basic computer vision methods to solve challenges that are relevant in industrial applications or research
- explain, with proper terminology and in a well-structured way, the solution to the identified problems of computer vision and deep learning

Judgement and approach

- choose between different computer vision methods comprising deep learning for a particular application and motivate the choice
- design a computer vision system (at high-level) based on a set of given requirements for a particular application, deciding between available options and motivating the choice

Primary Contents

Image acquisition, sampling (pixels) and representation (histogram, color spaces, Fourier Transform)
Image transformations: local & global operators, convolution, filtering (smoothing, sharpening)
Low-level Vision: edges, corners, lines and circles detection, scalar product

Feature extraction and classification:

- Feature Extraction
- Deep Learning and Transfer Learning
- Image Pattern Classification

Computer Vision applications:

- Facial analysis: detection and recognition
- In-vehicle vision system: driver drowsiness
- Robot vision systems: human emotion and intention detection

Teaching Formats

Distance (on-line) lectures, followed by practical assignments in Matlab/Python, which allows the participants to implement concepts presented in lectures and solve concrete problems. Videos of the lectures will also be put online for self-paced learning.
Laboratory exercises will be supported by online guidance, in addition to written instructions, to facilitate self-paced learning.

Teaching is in English.

Examination

The overall grades of Fail or Pass will be awarded for the course.
Grade based on three practical assignments, demanding submission of report and associated programming code before a specific deadline.

Name of the test		Grading
Practical Assignment I - Image Acquisition and Analysis	1 credits	U/G
Practical Assignment II - Feature Extraction and Classification	2 credits	U/G
Practical Assignment III - Computer Vision Applications	2 credits	U/G

If a disabled student has been granted learning support through a decision by Halmstad University, the examiner may decide on an adapted or alternative form of assessement for this student.

Course Evaluation

Course evaluation is part of the course. This evaluation should offer guidance in the future development and planning of the course. Course evaluations should be documented and made available to the students.

Course Literature

Rafael C. Gonzalez, Richard E. Woods. *Digital Image Processing.* Global Edition, 4th Edition, Pearson 2018. ISBN 9780133356724

R. Szeliski. *"Computer Vision: Algorithms and Applications*". 2nd ed., Springer 2021 (available online: `http://szeliski.org/Book`)

Ian Goodfellow,Yoshua Bengio, Aaron Courville. *Deep Learning*. MIT Press 2016. `https://www.deeplearningbook.org/`

PyImageSearch. `https://www.pyimagesearch.com/`