Module Description, available in: EN

Machine Learning in Computer Vision

General Information

Number of ECTS Credits

3

Module code

TSM_CompVis

Valid for academic year

2024-25

Last modification

2018-11-06

Coordinator of the module

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Explanations regarding the language definitions for each location:

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Lausanne			Lugano	Zurich		
Instruction					**X** E 100%		
Documentation					**X** E 100%		
Examination					**X** E 100%		

Module Category

TSM Technical scientific module

Lessons

2 lecture periods and 1 tutorial period per week

Entry level competences

Prerequisites, previous knowledge

Prerequisites:

- Basic knowledge of machine learning (e.g. Andrew Ng's ML course on Coursera)
- Good command of an imperative programming language, basic knowledge of Python (the module will use Python 3).
- http://www.scipy-lectures.org/index.html Sections 1.1, 1.2, 1.3, 3.6.1, 3.6.2
- Basic knowledge of probability, statistics, linear algebra (vectors, matrices)
- Students are expected to take their laptops for the Lab activities

Brief course description of module objectives and content

Analyzing images is a very complex task that has many important real-world applications. This module presents powerful techniques to extract information from images and 3D data, based on machine learning and deep learning methods. These methods are mostly used as "black boxes" and their inner workings are not discussed in much detail. The module provides an overview of many image analysis applications such as document

analysis, medical imaging and autonomous driving; examples of advanced uses of deep learning on images (generative networks for image synthesis, adversarial networks, neural style transfer) are also discussed.

Aims, content, methods

Learning objectives and competencies to be acquired

- Students know how images and 3D data are represented and manipulated by software
- Students know the most important problems related to image analysis: e.g. image classification, segmentation and object detection and tracking
- Students can apply machine learning and deep learning techniques to solve image-related problems, and deal with practical issues arising in the field (dataset engineering, data augmentation, data normalization)
- Students have seen different examples of image analysis problems and common solution techniques, and are able to acquire additional expert knowledge from the scientific literature and online resources

Module content with weighting of different components

- Introduction
- Basic image processing methods applied to document processing: binarization; segmentation of text into lines, words and characters; connected component analysis.
- Image classification
    - applications to OCR: handcrafted features; convolutional neural networks.
    - Image classification with small datasets: data augmentation techniques; one-shot learning; transfer learning and pre-trained models.
- Segmentation
    - applications to medical images (2D, 3D)
    - fully convolutional networks for semantic segmentation.
- Object detection
    - face detection with cascading classifiers
    - pedestrian detection for autonomous driving
    - object tracking in videos.
- Generative models and Image Synthesis
    - Applications to Image Inpainting;
    - Generative Adversarial Networks;
    - Neural style transfer.

Teaching and learning methods

Classroom teaching; programming exercises using python and frameworks in python

Literature

- Computer Vision: Algorithms and Applications, Richard Szeliski, 2010
- Deep Learning with Python, Francois Chollet, early 2018, Sections 5, 8.3, 8.5

Assessment

Certification requirements

Module uses certification requirements

Certification requirements for final examinations (conditions for attestation)

75% of homework passed

Basic principle for exams

As a rule, all standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.

Standard final exam for a module and written resit exam

Kind of exam

Written exam

Duration of exam

120 minutes

Permissible aids

Aids permitted as specified below:

Permissible electronic aids

No electronic aids permitted

Other permissible aids

10 A4 pages (2 sided)

Special case: Resit exam as oral exam

Kind of exam

Oral exam

Duration of exam

30 minutes

Permissible aids

No aids permitted