# Summary

Embedded Vision Design 3 is a workshop that is concerned with machine learning and deep learning as applied in computer vision. Both types of learning perform a specific task without using explicit instructions, so that a (embedded) system can adapt to uncertain or changing conditions. These algorithms model part of reality by using a mathematical function that the algorithm doesn’t know in advance, but which it can estimate after seeing data. Machines can only simulate certain types of human learning, and there is no single algorithm that works best on every problem. Because of that, you will be introduced to many different algorithms, each having its specialty. For example, a relatively young subset of machine learning is deep learning, which more closely tries to mimic human brain functioning, especially inspired on the visual cortex. The basic paradigm assumes artificial neurons as building blocks, ordered in multiple layers to form neural networks.

In EVD3 you will learn about the various approaches that can be taken towards machine learning, such as supervised and unsupervised learning. You will learn about the application of neural networks, their training, finetuning and performance analysis. Furthermore, you will learn about methods to prepare data, train algorithms and assess their performance. The ultimate goal of the workshop is to provide you with the tools to design, implement, and evaluate machine learning and deep learning applied to image processing, in particular object classification. We take a hands-on approach here, and you will start working on a machine learning project right from the start of the semester. We will be using publicly available Python packages, such as OpenCV, Scikit-learn, Tensorflow, and Keras. The assessment of EVD3 takes place through a report on your machine learning and deep learning project, arguing the choices you have made and evaluating your model’s performance.

# Samenvatting

Embedded Vision Design 3 is gericht op machine learning en deep learning zoals toegepast in computer vision. Beide methodes voeren een specifieke taak uit zonder expliciete instructies te gebruiken, zodat een (embedded) systeem zich kan aanpassen aan onzekere of veranderende omstandigheden. Ze modelleren een deel van de werkelijkheid door een wiskundige functie te gebruiken die het algoritme niet van tevoren weet, maar die het kan schatten na het zien van gegevens. Machines kunnen alleen bepaalde soorten menselijk leren simuleren, en er is geen enkel algoritme dat bij elk probleem optimaal werkt, dus zijn er veel verschillende algoritmen, elk met zijn specialiteit. Deep-learning is een relatief jonge tak van machine learning, die het functioneren van het menselijk brein beter probeert na te bootsen, vooral geïnspireerd op de visuele cortex. Het basisparadigma veronderstelt kunstmatige neuronen als bouwstenen, geordend in meerdere lagen om neurale netwerken te vormen.

In EVD3 leer je over de verschillende benaderingen die kunnen worden gebruikt voor machine learning. Je leert over de toepassing van neurale netwerken, hun training, fijnafstemming en prestatieanalyse. Verder leer je je data voor te bereiden, algoritmen te trainen en hun prestaties te beoordelen. Het uiteindelijke doel van de workshop is om je de tools te bieden voor het ontwerpen, implementeren en evalueren van machine learning toegepast op beeldverwerking, in het bijzonder objectclassificatie. We hanteren hier een hands-on aanpak en je begint vanaf het begin van het semester aan een project te werken. De beoordeling van EVD3 vindt plaats op basis van een rapport over je machine learning en deep learning-project, waarin de gemaakte keuze wordt beargumenteerd en de algoritmeprestaties worden geëvalueerd.

# Links

* You are invited to contribute to our collection of applications: <https://padlet.com/jeroen_veen/zul8z8tbvhqpvb8t>
* Online Quizzes: [http://www.socrative.com](http://www.socrative.com/) room 1PTGB6PY, register using your student number

# Literature

A. Géron, Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, O'Reilly Media; 2nd ed. edition, ISBN-13: 978-1492032649

A. Kahler and G. Bradski, Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library, O'Reilly Media (1 februari 2017), ISBN-13: 978-1491937990

# Learning objectives

|  |  |
| --- | --- |
| LO | Description, the student is expected to: |
| 1 | explains ML basic principles and reflect on its applications. |
| 2 | apply SML in practice by selecting and training an algorithm, and preparing  data. |
| 3 | analyze an SML pipeline by validating and testing; and evaluating quality measures. |
| 4 | understand DL basic principles and reflect on its application. |
| 5 | apply a CNN in practice by selecting and training a network. |
| 6 | analyze a CNN and evaluates its performance. |

# Organization

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## Theory with integrated quizzes

• Individual, multiple choice questions

• Online: [http://www.socrative.com](http://www.socrative.com/) room 1PTGB6PY

• Open book quiz, so books and slides can be consulted

• HAN student number, so NOT your name, nickname or anything else.

• Quiz starts exactly at class hour and takes 10 minutes.

• Be on time and have your equipment prepared.

• During the quiz: no entering or leaving the classroom, and silence

## Hands-on with 2 mini-projects

• A project team will consist of 2-3 students.

• Portfolio building using template

• Deliver intermediate results via InleverAPP as indicated in the schedule.

## **Final mark: 80% ML + DL report, 20% quiz results**