

## Machine Learning (C003758)

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

**Credits 6.0**

**Study time 180 h**

**Course offerings and teaching methods in academic year 2025-2026**

A (semester 1)

English

Gent

seminar

lecture

**Lecturers in academic year 2025-2026**

Saeyns, Yvan

WE02

lecturer-in-charge

**Offered in the following programmes in 2025-2026**

Master of Science in Teaching in Science and Technology(main subject Computer Science)

**crdts**

**offering**

6

A

Master of Science in Teaching in Science and Technology(main subject Mathematics)

6

A

Master of Science in Teaching in Science and Technology(main subject Physics and Astronomy)

6

A

Master of Science in Computer Science

6

A

Master of Science in Mathematics

6

A

Master of Science in Physics and Astronomy

6

A

Master of Science in Physics and Astronomy

6

A

Exchange Programme in Computer Science (master's level)

6

A

Exchange Programme in Mathematics (master's level)

6

A

Exchange Programme in Physics and Astronomy (Master's Level)

6

A

### Teaching languages

English

### Keywords

Machine learning, gesuperviseerd leren (classificatie en regressie), ongesuperviseerd leren (clustering), dimensionaliteitsreductietechnieken

### Position of the course

Machine learning technieken stellen ons in staat om automatisch modellen op te stellen op basis van voorbeelddata. Deze technieken worden in onze huidige samenleving succesvol gebruikt om allerlei taken op te lossen, en zijn een essentiële basisvaardigheid van de moderne data-wetenschapper.

### Contents

- Types machine learning technieken
- De bias-variance tradeoff
- Performantie-evaluatie (cross-validatie, area under ROC curve)
- Gesuperviseerd leren
  - Fisher LDA
  - Support Vector machines
  - Neurale netwerken en deep learning
  - Probabilistische modellen
  - K-Nearest Neighbours
- Ongesuperviseerd leren
  - Hierarchische clustering
  - K-Means
  - Density-gebaseerd clusteren
  - Self-Organizing maps
  - Gaussian mixture models en EM

- Bayesiaanse netwerken en Hidden Markov models
- Semi-supervised learning
- Dimensionaliteitsreductietechnieken
  - Het probleem van overfitting, the curse of dimensionality
  - Feature selectie
  - Feature transformatie
- Toepassingen van Machine Learning

### Initial competences

Een goed begrip van datastructuren en algoritmen, een goede kennis van de basis van probabiliteitstheorie en basisprogrammeervaardigheden.

### Final competences

- 1 Explain the differences among the three main styles of learning: supervised, reinforcement, and unsupervised. [Familiarity]
- 2 Implement simple algorithms for supervised learning, reinforcement learning, and unsupervised learning. [Usage]
- 3 Determine which of the three learning styles is appropriate to a particular problem domain. [Usage]
- 4 Compare and contrast each of the following techniques, providing examples of when each strategy is superior: decision trees, neural networks, and belief networks. [Assessment]
- 5 Evaluate the performance of a simple learning system on a real-world dataset. [Assessment]
- 6 Characterize the state of the art in learning theory, including its achievements and its shortcomings. [Familiarity]
- 7 Explain the problem of overfitting, along with techniques for detecting and managing the problem. [Usage]

### Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

### Conditions for exam contract

This course unit cannot be taken via an exam contract

### Teaching methods

Seminar, Lecture

### Study material

Type: Slides

Name: Course slides, tutorials and papers'

Indicative price: Free or paid by faculty

Optional: no

### References

Pattern Classification, 2nd Edition Richard O. Duda, Peter E. Hart, David G. Stork

ISBN: 978-0-471-05669-0

The Elements of Statistical Learning: Data Mining, Inference and Prediction (2nd edition)

Trevoer Hastie, Robert Tibshirani and Jerome Friedman

### Course content-related study coaching

Persoonlijk contact met de lesgever, via e-mail of op afspraak.

### Assessment moments

end-of-term and continuous assessment

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

Written assessment with open-ended questions

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

Written assessment with open-ended questions

### Examination methods in case of permanent assessment

Oral assessment, Assignment

### Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

### Calculation of the examination mark

Niet-periodegebonden evaluatie: groepswerk (project) (40%) + periodegebonden: examen (60%). Om te kunnen slagen voor het opleidingsonderdeel moet een student minstens 10/20 behalen voor de niet-periodegebonden evaluatie. Is aan deze voorwaarde niet voldaan, dan kan een student niet meer dan 8/20 halen voor dit vak.

Indien niet geslaagd voor de niet-periodegebonden evaluatie, kan de student het project verder afwerken voor de 2e zitting.