Course Specifications
Valid as from the academic year 2019-2020

Machine Learning (C003758)

Course

Lecturers in academic year 2019-2020
Saeys, Yvan

Course offerings and teaching methods in academic year 2019-2020
A (semester 1)
English

Offered in the following programmes in 2019-2020

<table>
<thead>
<tr>
<th>Programmes</th>
<th>Credits</th>
<th>Offering</th>
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<tbody>
<tr>
<td>Master of Science in Teaching in Science and Technology (main subject Computer Science)</td>
<td>6</td>
<td>A</td>
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<tr>
<td>Master of Science in Teaching in Science and Technology (main subject Mathematics)</td>
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<td>A</td>
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<tr>
<td>Master of Science in Teaching in Science and Technology (main subject Physics and Astronomy)</td>
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<tr>
<td>Exchange Programme in Physics and Astronomy (Master's Level)</td>
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<td>A</td>
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<tr>
<td>Exchange Programme in Computer Science (master's level)</td>
<td>6</td>
<td>A</td>
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<tr>
<td>Exchange Programme in Mathematics (master's level)</td>
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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 gebruik 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

Credits 6.0 
Study time 180 h 
Contact hrs 60.0 h 

(Approved)
• 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
Lecture, project, seminar: coached exercises, seminar: practical PC room classes

Learning materials and price
Slides, tutorials en papers die dienen als cursusmateriaal worden beschikbaar gemaakt via Ufora.

References
The Elements of Statistical Learning: Data Mining, Inference and Prediction (2nd edition)
Trevor Hastie, Robert Tibshirani and Jerome Friedman

Course content-related study coaching
Persoonlijk contact met de lesgever, via e-mail of op afspraak.

Evaluation methods
end-of-term evaluation and continuous assessment

Examination methods in case of periodic evaluation during the first examination period
Written examination with open questions

Examination methods in case of periodic evaluation during the second examination period
Written examination with open questions

Examination methods in case of permanent evaluation
Oral examination, skills test, report

Possibilities of retake in case of permanent evaluation
examination during the second examination period is possible

(Approved)
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.

Calculation of the examination mark

(Approved)