Technology
Arts Sciences
TH Köln

Course
ML - Machine Learnig

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^ General information

Long name	Machine Learnig
Approving CModule	ML_BaTIN
Responsible	Prof. Dr. Lothar Thieling Professor Fakultät IME
Level	Bachelor
Semester in the year	winter semester
Duration	Semester
Hours in self-study	78
ECTS	5
Professors	Prof. Dr. Lothar Thieling Professor Fakultät IME
Requirements	basic skills in Java and/or C basic skills in analysis and linear algebra
Language	German
Separate final exam	Yes

Final exam

Details

The students should demonstrate the following competences in an oral exam: 1.) Safe handling of basic concepts and mechanisms. 2.) Analyze problems in the field of machine learning and solve them with suitable methods. 3.) Analyze existing solutions and explain the used algorithmic and theory.

Minimum standard

At least 50% of the total number of points

Exam Type

The students should demonstrate the following competences in an oral exam: 1.) Safe handling of basic concepts and mechanisms. 2.) Analyze problems in the field of machine learning and solve them with suitable methods. 3.) Analyze existing solutions and explain the used algorithmic and theory.

^ Lecture / Exercises

Learning goals

Knowledge

fundamentals
types of learning
simple classifiers
simple predictors (Equalizer alias Linear Regression)
challenges in learning
linear regression as the simple predictor
linear regression as the simple classifier
training data (handling, analysis, processing)
gradient descent
quality measures
learning curve
multi-class classifier based on binary classifiers
multi-label-classification
logistic regression

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simple neuronale Netze
the artificial neuron as a simple classifier
operation
activation function
bias
training a neuron
multi-layer-perceptron
operation
purposes of the layers
backpropagation training algorithm
tools for creating and training simple neural networks and handling training data
handling, analysis and preparation of training data
creating and configuring neural networks
training neural networks
verification of trained networks

Deep Neural Networks (DNNs)
basic problems
vanishing or exploding gradients
high training times
overfitting
solutions for the probblems mentioned above
appropriate initialization of the weights, non-saturating activation function, gradient clipping

accelerated optimization procedures, reuse of pre-trained layers

regularization to avoid overfitting

tools for creating and training DNNs

handling, analysis and preparation of training data

creating and configuring neural networks

training of neural networks

verification and validation trained networks

Convolutional Neural Networks (CNNs)

idea

architecture

convolutional layer

pooling layer

convolution as a basic operator for training and detection

architectures of CNNs for different problems

tools for implementation and training CNNs

Recurrent Neural Networks (RNNs)

idea

recurrent neurons

training of RNNs and Deep RNNs

Long Short Term Memory

architectures of RNNs for different problems

tools for implementation and training deep CNNs

Skills

the presented neural networks

specify

describe

evaluate the pros and cons

solving problems using tools

for handling, analysis and preparation of the training data

for implementationion, verification, validation and training of all neural presented networks

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Lecture	2
Exercises (whole course)	0
Exercises (shared course)	0
Tutorial (voluntary)	0

Separate exam

^ <u>Practical training</u>

Learning goals

Skills

purposeful handling of the tools

deal with complex tasks in a small team

derive complex solutions that can be implemented using neural networks

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Practical training	2
Tutorial (voluntary)	0

Separate exam