

Course of study/ focus of study: M.Sc. Berechnung und Simulation im Maschinenbau	
Module name / title	Machine Learning Methods (engl.)
Module number	MLM
Module coordinator/ person responsible	Frau Prof. Dr. Sarah Hallerberg
Duration of the module/ semester/ frequency	1 Semester/ 1. or 2. semester/ annually
Credits (CP)/ semester hours per week (SHW)	5 LP/ 3.00 SWS
Type of module , Applicability of the module	Wahlpflichtmodul im studiengangsspezifischen Angebot
Workload	Contact hours: 54 h and Self-study: 96 h (Basis: 18 semester weeks (incl. exam time), 1 SHW = 60 minutes)
Module prerequisites Requirements for participation/ previous knowledge	Empfohlen: Programmierkenntnisse, Mathematik
Teaching language	Teaching language: English Alternate teaching language: German If there is more than one teaching language, the used teaching language will be announced by the lecturer.
Competencies gained/ Learning Outcome	The students acquire an understanding of several common methods of machine learning and automated decision making. They can apply these methods to different data sets and are able to quantify the success of each method. The students can also quantify, understand and assess the limitations of each method.
Content of the module	<ol style="list-style-type: none"> 1. Introduction to machine learning, distribution of data sets for group projects and programing assignments, 2. Introduction to required programming language(s) and software 3. Regression, bias, overfitting, No-Free-Lunch-Theorems 4. Introduction to Markov processes and information theory 5. Maximum Likelihood, Bayes' Theorem and probabilistic supervised learning, contingency tables and receiver operator characteristic curves, cross-validation 6. Support vector machines, the curse of dimensionality, principal component analysis 7. Decision trees, random forests and boosting 8. Introduction to artificial neural networks 8. Learning and training strategies for artificial neural networks 9. Overview on recent developments, open questions and challenges in supervised machine learning 10. Introduction to unsupervised learning 11. Overview on recent developments, open questions and challenges in unsupervised machine learning

Requirements for the award of credit points (Study and exam requirements)	Seminar: Regular examination type for module testing: Portfolio (PL) Further possible examination types: oral presentation, written report laboratory internship: Laboratory degree (SL) Where more than one possible examination type is used in the module, the examination type to be used is to be made known by the responsible lecturer at the start of the course.
Learning and teaching types/ methods/ media types	lectures, programming exercises, group projects black board, projector, computer pool or laptops
Literature	<ol style="list-style-type: none"> 1. T. Hastie, R. Tibshirani and J. Friedman, The Elements of Statistical Learning, Springer Series in Statistics, 2009. free web book: https://web.stanford.edu/~hastie/ElemStatLearn/ 2. I. Goodfellow, Y. Bengio and A. Courville, Deep Learning, MIT Press, 2016, free web book: http://www.deeplearningbook.org 3. http://neuralnetworksanddeeplearning.com 4. Nikhil Ketkar, Deep Learning with Python, Apress, 2017 5. Danish Haroon, Python Machine Learning Case Studies, Apress, 2017 6. Jose Unoingco, Python for Probability, Statistics and Machine Learning, Springer, 2016 7. D. Sarkar, R. Bali, T. Sharma, Practical Machine Learning with Python, Apress, 2018