Introduction to Deep Learning (5173030)

Module name english	Introduction to Deep Learning				
Type of module	Pflichtmodul		**Responsible for module**	Prof. Dr. Magda Gregorová	
Lecturer	Prof. Dr. Magda Gregorová				
Language of instruction, L. of examination	Englisch		**Semester**	1	
SWS	4		**Teaching and learning formats**	Seminaristischer Unterricht	
ECTS-Credits	5		**Type of examination**	Portfolio	
Bonus benefits					
Workload	**Workload (Total)**	150	**Attendance time**	60	**Self-Study time (incl. exam preparation)**	90
Duration of module	1 Semester		**Frequency**	ME/OE	
Type of grading	Differenzierte Note		**Verwendbarkeit**	Artificial Intelligence	
Conditions for participation	None				
Recommended prerequisites					
Module's learning outcomes	Upon completion of the module students: • can place artificial neural networks within the broader area of machine learning, understand their major advantages and disadvantages, and are aware of major applications of ANN as well as selected advanced models under research and their fundamental ideas • understand and assess the critical differences between the basic ANN architectures (MLP, CNN, RNN), can implement them in standard deep learning software packages, and can train, test, and evaluate the ANN models over real data • building on the experience of working with their own ANN implementations, can reuse publicly available implementations of more complex models to carry out experiments over real datasets, can compare the performance of these across various models and their hyperparameter setups • understand the importance of transparency and reproducibility in deep learning experimentation and can present in written as well as oral their learning and evaluation pipeline including relevant description of the selected software and hardware configuration • are aware of the ethical and societal impacts of machine learning and deep learning and can critically assess deep learning reports along these lines				
Module content	• Artificial neural networks (ANN) in machine learning (ML) - Basic concepts of learning algorithms and typical tasks - Model development workflow, hyperparameter tunning, performance measures and model selection - Ethical and societal aspects (open access, data governance, fairness, transparency, reproducibility, safety and robustness, interpretability and human oversight/trust, ecological footprint) • Basic ANN architectures - Multilayer perceptron (feed forward) - Convolutional neural networks - Recurrent neural networks • ANN model regularization - Norm penalties - Data augmentation - Early stopping - Dropout • ANN model optimization - (Stochastic) gradient descent - Backpropagation - Momentum methods - Learning rate scheduling • Major ANN applications and selected advanced models - Computer vision (object detection, image classification, style transfer) - Natural language processing (word2vec, BERT) - Autoencoders - Generative models • Deep learning software packages (one of these) - PyTorch - Tensorflow				
Literature	1. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, 2016 2. Zhang, Aston, Zachary C. Lipton, Mu Li, and Alexander J. Smola. Dive into Deep Learning. https://d2l.ai/, 2021				