Module Medical Deep Learning

Module Name: Medical Deep Learning

Module Number		Level Master	Short Name MDL
Responsible Lecturers	Prof. Dr. Mattias Heinrich		
Department, Facility	UzL, Institute for Medical Mathematics		
Course of Studies	Biomedical Engineering, Master		
Compulsory/elective	Elective	ECTS Credit Points	6
Semester of Studies	2	Semester Hours per Week	4
Length (semesters)	1	Workload (hours)	120
Frequency	SuSe	Presence Hours	50
Teaching Language	English	Self-Study Hours	70
Consideration of Gender and Diversity Issues	☒ Use of gender-neutral language (THL standard) ☐ Target group specific adjustment of didactic methods ☐ Making subject diversity visible (female researchers, cultures etc.)		
Applicability	Biomedical Engineering		
Remarks	None		

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Course 1: Medical Deep Learning Lecture

Course Number		Short Name	MDL
Course Type	Lecture and exercise	Form of Learning	Presence
Mandatory Attendance	X	ECTS Credit Points	6
Participation Limit	16	Semester Hours per Week	4
Group Size (practical training, exercises, …)	None	Workload (hours)	120
Teaching Language	English	Presence Hours	50
Study Achievements („Studienleistung“, SL)	None	Self-Study Hours	70
SL Length (minutes)	n. a.	SL Grading System	n. a.
Exam Type	Written Exam or oral exam	Exam Language	English
Exam Length (minutes)	90 or 20	Exam Grading System	One-third Grades
Learning Outcomes	The students know the importance of data security, patient anonymization and ethics for clinical studies with sensitive data. They know methods and tools for collecting, preprocessing, storing and annotating large data sets for deep learning from medical data. You have a good understanding of deep / convolutional neural networks for general data processing (signals / text / images), their learning process and the assessment of their quality for new data. They understand the principles of weakly supervised learning, transfer learning, concept development and generative adversarial networks. You will know how to examine learned feature representations for the interpretation and visualization of high-dimensional abstract data. You can implement modern network architectures in DL frameworks and adapt and expand them to given problems in medicine. They have a broad overview of current applications of deep learning in medicine in research and clinical practice and can transfer their knowledge to future topics.		
Participation Prerequisites	None		
Contents	Heart disease health care: ECG signal analysis for arrhythmia detection or sleep apnea and for mobile low-cost devices		

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	MRI sequence analysis for anatomical segmentation and temporal modeling Multimodal clinical case retrieval and prediction: Pathology and semantic image capture and localization Analysis of text / natural language (radiology reports / study articles) for multimodal data mining in Electronic Health Records (EHR) Computer-aided detection and classification of diseases: CT lung nodule detection for cancer screening with transfer learning Poorly monitored anomaly detection and biomarker detection Interpretable and reliable deep learning systems Human interaction and correction within deep learning models Visualization of uncertainties and internally learned representations Deep learning concepts, architectures and hardware Convolutional Networks, Residual Learning, Deep Networks Loss functions, derivatives, stochastic optimization Acyclic graph networks, generative adversarial networks Cloud Computing, GPUs, Low Precision Computing, DL Frameworks
Literature	Ian Goodfellow, Yoshua Bengio und Aaron Courville: *Deep Learning* - The MIT Press
Remarks	None