03-IMAP-MIA	Medical Image Analysis

Lehrform *(teaching format)* / **SWS** *(hours per week)*: 2VL + 2UE

Kreditpunkte *(credit points)*: 6

Turnus *(frequency)*: usually, every secend summer term (even-numbered years: 2026, 2028, ff.)

Inhaltliche Voraussetzungen *(content-related prior knowledge/skills)*: basic knowledge of image processing and machine learning is helpful

Sprache *(language)*: English

Lehrende *(teaching staff)*: AG Digitale Medizin (Prof. Dr. Horst Hahn, et al.)

Studiengang *(degree program)*	Module	Semester
Informatik (Master)	IMAP, IMAP-VMC, IMVP-AI, IMVP-DMI	from 1st sem.
AI and Intelligent Systems (Master)	AI-M-MLCS	from 2nd sem.
Digital Media (Master)	DMM-MI	from 2nd sem.
Management Information Systems (Master)	MIS-INF3	from 2nd sem.
Informatik (Bachelor VF)	(nur *Freie Wahl*)	

Lernergebnisse / *Learning Outcome*:

Students will gain an understanding of the principles and methods of medical image analysis, combining classical and deep-learning approaches. They will be able to classify, segment, and quantify medical images and to design and evaluate analysis pipelines using standard tools such as Keras, PyTorch, MONAI, or SimpleITK. Participants will learn to interpret medical imaging data in clinical contexts, particularly in cancer imaging, and to critically assess algorithmic reliability, data bias, and ethical implications of medical AI.

Inhalte / *Contents*:

Lecture and exercise on methods and applications of medical image analysis.

Topics include:

- Medical imaging modalities (MRI, CT, PET, Ultrasound)
- Image preprocessing, filtering, and feature extraction
- Registration and image fusion (classical + deep methods)
- Object detection, segmentation, and classification
- Deep learning architectures: U-Net, 3D CNNs, transformers
- Evaluation metrics, data handling, and validation
- Ethics, bias, and reproducibility in medical AI
- Clinical applications with a focus on oncology (tumor detection, therapy response assessment, etc.)

The exercises comprise hands-on implementation, experiments with open datasets, and homework assignments focusing on real-world problems.

Hinweise *(remarks)*: The table lists only the primary / most specific modules to which this course is assigned.

This module focuses on domain-specific methods and applications in medical imaging and thereby complements other courses such as Advanced Machine Learning, Deep Learning and 3D Computer Vision, or Deep Generative Mode