2024

Biomedizinische Informatik

❖ Teaching offers 2024
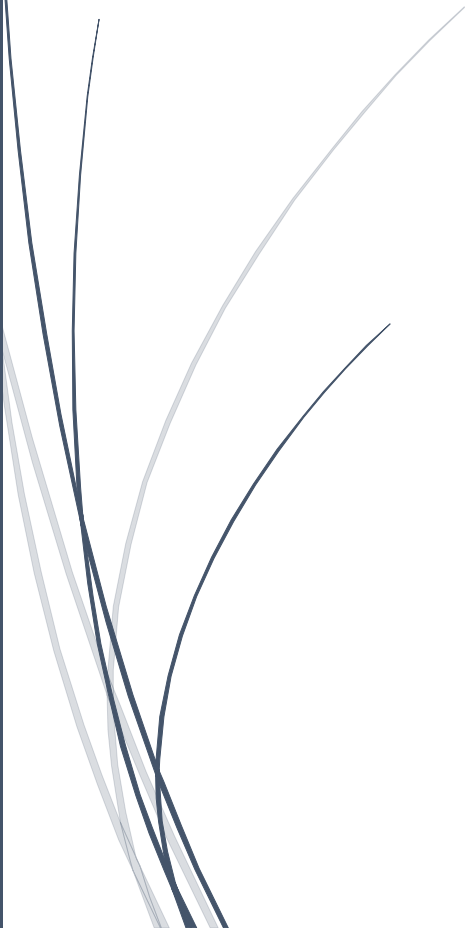
Contents

1. Vorbemerkung/Preliminary remarks

Dieses Dokument gibt einen inhaltlichen Überblick über die Lehrangebote unseres Instituts. Bis auf die wissenschaftlichen Projekte der Vorklinik sind unsere Kurse auch für ärztliches Personal der Uniklinik Köln und Mitarbeitende aus der Forschung an der Universität zu Köln geöffnet. Die Termine und Uhrzeiten der Veranstaltungen sind in KLIPS zu finden. Falls Sie keinen KLIPS-Zugang haben oder unsere Angebote nicht einsehen können, schreiben Sie bitte eine Mail an BI-K-INFORM@uk-koeln.de.

Auch bei weiteren inhaltlichen oder formalen Fragen können Sie sich gerne an BI-K-INFORM@uk-koeln.de wenden.

This document provides an overview of the courses offered by our institute. With the exception of the preclinical scientific projects, our courses are also open to medical staff at the University Hospital of Cologne and research staff at the University of Cologne. The dates and times of the courses can be found in KLIPS. If you do not have KLIPS access or are unable to view our programmes, please send an email to BI-K-INFORM@uk-koeln.de .

You are also welcome to contact BI-K-INFORM@uk-koeln.de if you have any further questions regarding content or form.

2. Wahlblöcke

2.1. AI Ethics in Medicine

2.1.1. Ethical aspects of Medical AI applications

Titel	**Ethical aspects of Medical AI applications**
Description	This course offers an insightful overview into the ethical considerations of using Artificial Intelligence in healthcare, requiring no prior knowledge of

	AI. It covers an introduction to AI, its medical uses, and delves into critical ethical issues as outlined by the WHO, including the justification of AI use, data privacy, risks to safety and cybersecurity, bias, accountability, and the impact on labor and commercialization in healthcare. Through real-world examples and comprehensive references, the course prepares participants to critically evaluate and navigate the ethical landscape of medical AI technologies.

2.2. Medical Informatics Technologies

2.2.1. Deep Learning Basics

Titel	**Deep Learning Basics**
Description	This course offers an introduction to deep learning, covering neural networks, backpropagation, and optimization techniques, progressing to CNNs and RNNs with TensorFlow and PyTorch implementations. It addresses training practices, model evaluation, and hyperparameter tuning. No prior Python or data science knowledge is required, preparing students for advanced topics such as medical imaging processing.

2.2.2. Medical Image processing

Titel	**Medical Image processing**
Description	This course explores imaging technologies (x-ray, CT, MRI) and their integration with AI to improve image interpretation and evaluation. It focuses on machine learning, especially deep neural networks, for image analysis tasks like classification and segmentation. Participants learn about neural network architectures (CNNs, U-Net) through hands-on coding, and assess deep learning performance in medical imaging.

2.2.3. Machine Learning and Trust in Medical Applications: Determining the tradeoffs

Titel	**Machine Learning and Trust in Medical Applications: Determining the tradeoffs**
Description	This seminar examines the shift from traditional statistics to machine learning in medicine, highlighting the balance between AI expectations and healthcare realities. It discusses the move to using large datasets for improved ML model accuracy and efficiency, while stressing that AI is not a one-size-fits-all solution. The importance of knowing when and why ML works or doesn't is emphasized, addressing misconceptions about AI's complexity. The goal is to promote a nuanced understanding of AI's application in healthcare to reduce risks of misuse.

2.2.4. Data Analytics with Python for Medical Doctors

Titel	**Data Analytics with Python for Medical Doctors**
Description	This course introduces medical professionals to data analysis with Python, covering exploratory techniques, pattern identification, and outlier detection using tools like NumPy, Pandas, and Matplotlib. Participants will learn to process, analyze, and visualize medical data, including basic statistical methods and data normalization, to effectively interpret healthcare information.

2.2.5. Coding Basics in Python

Titel	**Coding Basics in Python**
Description	This introductory course for medical students and residents with no programming background focuses on Python concepts applicable to medical research and software development. Through interactive seminars and coding assignments, it builds foundational programming skills and serves as a primer for advanced medical informatics topics. Offered by the Institute for Biomedical Informatics at Uniklinik Köln, participants can earn a

	completion certificate, preparing them to apply coding in their medical careers.

2.2.6. Biomedical semantics for advanced search technologies

Titel	Biomedical semantics for advanced search technologies
Description	This seminar provides an introduction to Semantic Web technologies, Linked Data, and Knowledge Discovery, focusing on their application in biomedicine. It is designed for beginners and covers how semantic enhancement of data facilitates information retrieval and knowledge discovery. Participants will learn the use of semantics in life sciences IT solutions through examples like controlled vocabularies and ontologies. The hands-on approach aims to enhance understanding of terminology use in data analysis and its impact on AI and machine learning advancements in healthcare.

2.2.7. Introduction to Medical Data Science (DDM1)

Titel	Introduction to Medical Data Science (DDM1) (nur im Wi/Se)
Description	This course aims to introduce medical students to the basics of data science, aspects of data reusability and how best to prepare data for data mining. The first session will be a 180-minutes online session which starts with a 90-minutes lecture providing practical information on how Biomedical Data can be preprocessed in order to prepare data mining processes, i.e. to make the data (re-)usable for Data Driven Medicine (DDM). This first session will finish with an optional but recommended 90-minute introduction to the programming language python. This introduction is the same for all DDM courses.

2.2.8. Teaching machines how to make a decision: Supervised Machine Learning (DDM2)

Titel	Teaching machines how to make a decision: Supervised Machine Learning (DDM2) (nur im Wi/Se)

Description	This course provides both theoretical and practical information on how knowledge can be generated from Biomedical Data using Supervised Machine Learning (ML) methods in the field of Data Driven Medicine (DDM). The first session will be a 180-minutes online session which starts with a 90-minutes lecture on Supervised ML approaches. This first session will finish with an optional but recommended 90-minute introduction to the programming language python.

2.2.9. How machines can self learn: Unsupervised Machine Learning (DDM3)

Titel	**How machines can self learn: Unsupervised Machine Learning (DDM3) (nur im Wi/Se)**
Description	This course provides both theoretical and practical information on how knowledge can be generated from Biomedical Data using Unsupervised Machine Learning (ML) methods in the field of Data Driven Medicine (DDM). The first session will be a 180-minutes online session which starts with a 90-minutes lecture on Unsupervised ML approaches. This first session will finish with an optional but recommended 90-minute introduction to the programming language python.

2.2.10. Diagnosing AI algorithms: Visualisation and Evaluation (DDM4)

Titel	**Diagnosing AI algorithms: Visualisation and Evaluation (DDM4) (nur im Wi/Se)**
Description	In two sessions this course theoretically and practically shows how the results of data mining in the field of Data Driven Medicine (DDM) can be evaluated and visualised. The first session will be a 180-minutes online session which starts with a 90-minutes lecture on evaluation approaches and visualisation techniques. This first session will finish with an optional but recommended 90-minute introduction to the programming language python.

3. Seminars

3.1. Medical Data Science

3.1.1. Advances in Biomedical Informatics Research: Graduate Students Colloquium

Titel	**Advances in Biomedical Informatics Research: Graduate Students Colloquium**
Description	This seminar caters to master's and doctoral students, researchers, and scientific staff in the field of medical informatics. Open also to participants from associated clinics and research bodies, it offers a venue for presenting research progress or reviewing academic articles. This initiative aims to foster academic growth, encourage the exchange of ideas, and enhance collaboration within the biomedical informatics and medical data science community.

3.1.2. Medical Data Science Colloquium

Titel	**Medical Data Science Colloquium**
Description	This seminar features scientists from UKK and global universities discussing the latest in medical data science and AI. It aims to highlight innovative research, facilitate discussions, and lay the groundwork for future collaborations in these dynamic fields.

3.2. AI Ethics in Medicine

3.2.1. Paradigm shifts in medical reasoning: Revisiting basics of the Scientific Methodology in Clinical Medicine

Titel	**Paradigm shifts in medical reasoning: Revisiting basics of the Scientific Methodology in Clinical Medicine**
Description	This course offers a fresh look at A.R. Feinstein's seminal 1964 work on 'Scientific Methodology in Clinical Medicine,' which significantly influenced clinical epidemiology. Students will explore the historical foundations of clinical medicine methodology through Feinstein's papers,

	examining principles, disease classification, therapeutic response evaluation, and clinical data acquisition. The course also connects these concepts to the contemporary advancements in machine learning and artificial intelligence, providing a bridge between past methodologies and future technologies in medicine.

3.2.2. Paradigm shifts in medical reasoning: Human vs Machine thinking

Titel	**Paradigm shifts in medical reasoning: Human vs Machine thinking**
Description	This course examines the impact of AI and Machine Learning on traditional medical reasoning and decision-making. It explores the shift towards personalized and data-driven medicine, challenging established medical paradigms with specific examples. This course aims to highlight the evolving interplay between human and machine thinking in the medical field, fostering a critical understanding of how technology is reshaping healthcare practices.

3.2.3. Paradigm shifts in medical reasoning: Reproducibility

Titel	**Paradigm shifts in medical reasoning: Reproducibility**
Description	This seminar delves into the critical role of reproducibility in scientific research, guided by Prof. Gundersen's studies on its various aspects within the scientific method. By examining outcomes, analysis, and interpretations of experiments through medical examples, students learn to appreciate and apply reproducibility principles in medical practice, fostering a deeper understanding of its significance in ensuring reliable and valid scientific inquiry.

3.3. Medical Informatics Technologies

3.3.1. Semantic Interoperability in Health: Data management and Interoperability

Titel	**Semantic Interoperability in Health: Data management and Interoperability**

Description	This module offers an introduction to the key concepts of interoperability and semantics in healthcare data, emphasizing the FAIR Data principles for improving data management. It addresses the necessity for automation in handling the increasing data complexity and variety, focusing on interoperability. The course covers topics like conceptual models and ontologies applied to medical cases and includes a practical session on FHIR (Fast Healthcare Interoperability Resources) to illustrate its significance in medical data exchange. This introductory module aims to prepare students for effectively dealing with interoperability challenges in healthcare data.

3.3.2. Semantic Interoperability in Health: Data Stewardship

Titel	Semantic Interoperability in Health: Data Stewardship
Description	This session offers an in-depth look at managing healthcare data effectively, emphasizing data stewardship's principles and practices. It covers the essentials of handling medical data, including data quality, privacy, security, and compliance, alongside practical insights into data interoperability. Through interactive discussions and a demo on data provisioning, participants will deepen their understanding of how to safeguard and optimize healthcare data for better decision-making and patient care.

3.3.3. Semantic Interoperability in Health: Experience session - Medical interopera

Titel	Semantic Interoperability in Health: Experience session - Medical interopera
Description	This course is dedicated to exploring HL7 FHIR, the standard for healthcare data exchange. This session offers insights into FHIR's structure, how it facilitates secure patient data sharing, and its impact on healthcare. Through discussions, demos, and hands-on exercises, participants will learn about FHIR resources, data types, and profiles, gaining practical skills in data

	exchange and search functionalities. Tools like VS Code and API platforms such as Postman or Insomnia are recommended for practice, highlighting FHIR's role in enhancing clinical workflows and decision-making.

3.3.4. Semantic Interoperability in Health: Experience session – Visualisation

Titel	**Semantic Interoperability in Health: Experience session – Visualisation**
Description	The "Semantic Interoperability in Health: Experience Session - Visualization Part 4" emphasizes the importance of data analysis and visualization in making complex information accessible. It offers foundational training in data visualization techniques over two 45-minute sessions, targeting both beginners and intermediate learners. Participants will learn how to transform complex data into clear visuals and develop skills for effectively presenting data insights. The goal is to enhance decision-making and communication abilities using standard data visualization methods.

3.4. Innovation and Entrepreneurship

3.4.1. MedTechs: Medical Technology-based entrepreneurship and innovation

Titel	**MedTechs: Medical Technology-based entrepreneurship and innovation**
Description	This course offers experiential learning on starting and growing MedTech startups. It teaches students about the challenges and opportunities in the MedTech sector, including case study exploration and strategy development. With support for group and individual projects, the course provides practical experience in launching MedTech ventures and turning ideas into viable business opportunities, preparing students for entrepreneurial success in the medical technology field.

4. Wissenschaftliche Projekte für Studierende der Vorklinik

4.1. Wissenschaftliches Projekt im Rahmen einer Literaturrecherche mit begleitendem Seminar

Titel	**Wissenschaftliches Projekt im Rahmen einer Literaturrecherche mit begleitendem Seminar (nur im SoSe)**
Description	The course involves conducting a literature search with a specific focus on the field of Medical Informatics/Data Analysis. During the period of this project, a voluntary weekly seminar or a set consultation time at the institute is offered to support participants.

4.2. Wissenschaftliches Projekt im Rahmen eines Programmierpraktikums mit begleitendem Seminar

Titel	**Wissenschaftliches Projekt im Rahmen eines Programmierpraktikums mit begleitendem Seminar (nur im SoSe)**
Description	In this course, students tackle a project focused on medical data analysis. They begin with an introductory seminar to learn basic Python skills. Following this, they are assigned a specific task to complete within six weeks. An optional weekly seminar is available for addressing any questions. The course concludes with the students presenting their findings in a lecture and simultaneously preparing a project report according to the Dean's office guidelines.

5. Courses offered jointly with other Faculties

5.1. Innovation and Entrepreneurship

5.1.1. Innovation Ecosystems in Health and Medical Technologies

Titel	**Innovation Ecosystems in Health and Medical Technologies**

Description	This course delves into the impact of AI and Big Data on healthcare, highlighting the challenges in adopting such technologies due to stakeholder readiness. Utilizing open innovation methodologies, the course examines specific ecosystems and their constraints, informed by the Horizon Europe SHIFT-HUB project, which advocates for a patient-driven approach to smart health solutions adoption.