EASL School of Artificial Intelligence in Hepatology

Course Organisers: **Prof. Julien Calderaro (Creteil, France), Prof. Jakob Kather (Dresden/Heidelberg, Germany), Dr. med. Jan Clusmann (Dresden, Germany), Prof. Carolin V. Schneider (Aachen/Dresden, Germany)**

Institution: *** Technical University Dresden**

Programme Overview/Summary:

Methods of artificial intelligence have emerged in various disciplines associated with hepatology. Firstly, in pathology, the gold standard for diagnosing most liver diseases, diagnostic algorithms increasingly incorporate artificial-intelligence based prediction models, as pathologists' subjective assessment of tissue sections is not perfectly reproducible and not standardised. Secondly, increasing amounts of clinical data including genomics, metabolomics, proteomics and better availability of fine-granular EHR information challenge the integration of available data per patient, highlighting the necessity for clinical decision support systems based on machine learning approaches. And thirdly, the rapid rise of large language models is influencing medicine on all levels, contributing to patient empowerment, but also misinformation, thereby causing multiple unprecedented challenges for the next generation of clinicians.

Liver medicine is complex and both clinician scientists and computer scientists are required to gain a working knowledge of each other's domains. In the past four years, the applicants have jointly initiated and performed several virtual, hybrid and physical courses conducted to 1) teach artificial intelligence techniques to young clinicians and pathologists, and 2) teach clinical reasoning to young data scientists. These courses were sponsored by the French Society of Pathology and the University of Paris Est, among others. More information is available on https://www.artificialintelligence-pathology.com/. The courses were a great success and the participants were able to work in interdisciplinary teams and solve clinically relevant questions in a matter of weeks. The successful completion of these courses in 2021, 2022 and 2023 shows that the organisers can effectively collaborate and deliver a comprehensive educational programme for a diverse audience.
Here, we propose an EASL school on artificial intelligence in hepatology, which is aimed at an interdisciplinary audience of hepatologists and pathologists in training, but also at biomedical and data science researchers working in the field of hepatology. We are convinced that this school will be a hub to foster a new generation of digitally skilled scientists who will build artificial intelligence solutions for better diagnosis and assessment of liver diseases. Our school will have a ripple effect, massively boosting the digital literacy of young researchers in EASL and preparing the EASL community for the challenges of our digital era.

Programme proposal:

Faculty

Experts from the host institution (TU Dresden, Dresden, Germany)

1. Prof. Jakob Kather (Professor for Clinical Artificial Intelligence, Clinician)
2. Dr. Narmin Ghaffari Laleh (AI engineer)
3. Dr. Jan Clusmann (Clinician, Data Scientist)
4. Prof. Carolin V. Schneider (Professor for Metabolic liver diseases, Clinician)

Experts from collaborating institution (Henri Mondor Hospital, Créteil, France)

1. Prof. Julien Calderaro (Pathologist)
2. Prof Mamatha Bhat, Toronto - Hepatology

Online part

Part 1 self-study (materials provided by the course organizers)

- Good practice in data science (study setup including training, testing, validation)
- Basics of AI for image analysis
- Basic skills in programming and hepatology (respectively for clinicians, data scientists)

Part 2 consolidation of self study (virtual seminar with the whole group and break-out sessions)

- Online discussions with the whole group to make sure everyone is at the required level of understanding
- Breakout-sessions with separate discussions for technical and medical participants

In person session at TU Dresden, Germany

Day 1 (full day)

- 09:00 Welcome session and course introduction
- 09:15 Introductory lecture on AI literacy and discussion session 1
- 10:15 Participants receive clinical challenges *
- 10:45 - 12:00 / 13:00 - 14:30 Hands-on working time
- 15:00 Discussion session 2: how can we mitigate biases in AI systems?
- 16:30 Discussion about next steps
- 19:00 Networking dinner

* The actual project will be highly dependent on the development of the field over the next year (two years ago none of today's Large Language Models, vision-language models, foundation/generalist models were available). Some potential experimental ideas include:

- *Understanding Bias in ML: Participants will work with clinical data from both European, American and Asian patient populations, aiming to replicate machine learning models that have the goal of predicting future HCC diagnosis. The primary objective is for participants to actively explore how model performance and feature importance can vary across different demographic groups to develop a sense of how these work and what challenges there are. Participants will analyse the reasons behind these variations and discuss ways to mitigate bias in real-world clinical settings.*
- *Building a guideline-support app: Participants obtain a collection of EASL guidelines with the task to develop a ready-to-use mobile-app (with a template readily available) that can be chat-queried and provides individual guideline-based feedback, incorporating essential concepts such as "Retrieval-augmented generation" and evaluate*
- *Evaluating diagnostic accuracy of computational pathology vision-language models in on rare liver diseases: Participants will be provided with digitised histopathological slides of rare liver disease cases, and vision-language models as software that generate pathological reports. They will benchmark the performance of these models. The focus will be on replicating published benchmarks and comparing model performance on common vs. rare liver diseases, offering insights into where current models succeed or fail in handling rare pathologies.*

For all three projects, participants will be provided with readily available computing resources, data in structured format, and all necessary packages installed to minimise delay.

Day 2 (half day, split in two groups)

- 09:00 Presentation of results
- 10:15 The winners are announced
- 10:30 State-of-the-art lecture
- 11:15 Discussion session 3: How to implement AI in clinical practice of hepatology?
- 12:00 Debriefing, feedback/ open evaluation session and goodbye

Debriefing

- Possibility for anonymous evaluation (online)
- Networking (online)
- Group work debriefing (virtual seminar where the groups have the opportunity to meet again with their mentor after two weeks of reflection time for some final discussion, question, potential pursuit of their project for publication)