Digital Health Center
by Hasso-Plattner-Institut

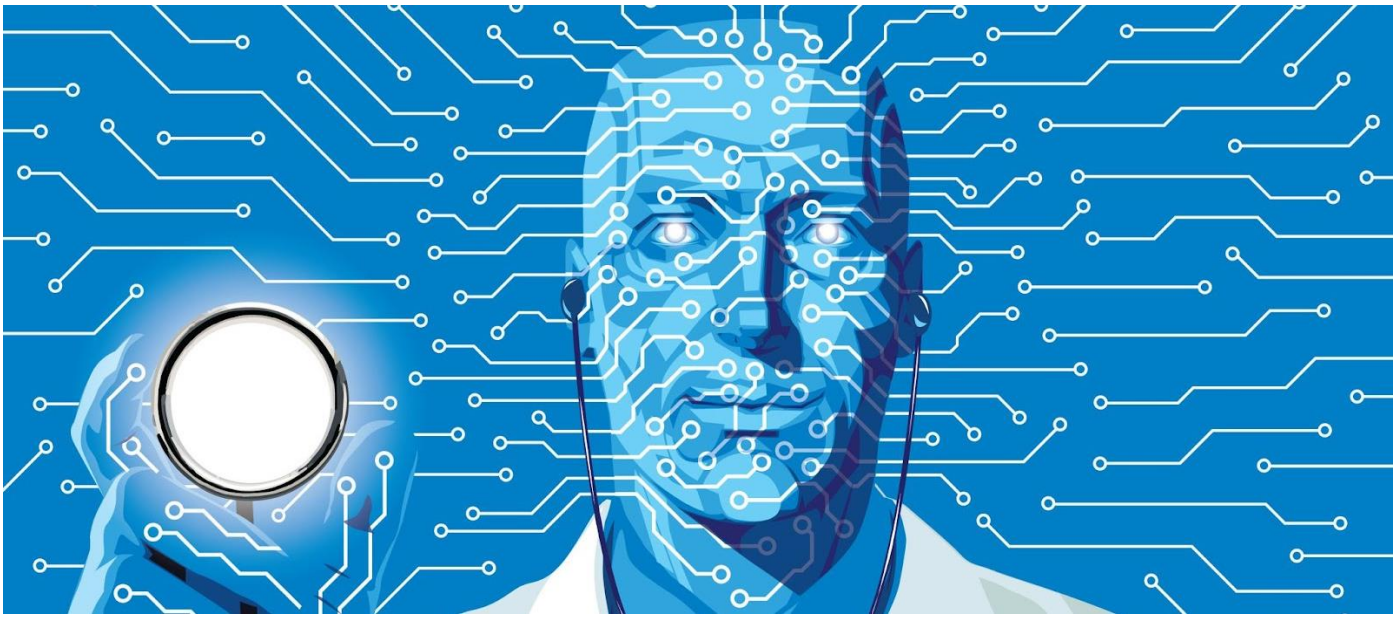
Digital Health and Connected Healthcare
Master Project Summer 2022

CHARITÉ
UNIVERSITÄTSMEDIZIN BERLIN

In cooperation with the surgery department of the Charité in Berlin

Dr. AI - The Model Will See You Now!

Using multimodal, heterogeneous medical data to solve real-world problems



Imagine: you have just had your first ever open-heart surgery. You have regained conscience and look around on the ward. You see someone in a white coat walk in, it's your surgeon, Doctor Mensch! He tells you that your surgery went well, and every sign seemed to indicate a quick recovery. But then he was alerted by his newest colleague, Doctor AI, that something was amiss. You were put under extra supervision, and, indeed, you had a post-surgery heart attack. Luckily, the staff rushed in and quickly managed to make it pass. Soon, all the doctors agree, you can go home safely.

It's becoming more and more clear that **AI systems** can improve healthcare in numerous ways. For example, a Machine Learning model was developed that can outperform doctors in recognizing breast cancer.[1] Researchers have also created an AI that performs better than 72% of general practitioners when diagnosing test cases of illnesses.[2] Moreover, multiple studies with Convolutional Neural Networks in medical care have shown promising results.[3]

It is safe to say that the digital revolution provides many opportunities: with large amounts of vital data, we might be able to create a Machine Learning tool which would provide the doctor with information to make better decisions; we can potentially **save years of life** this way.

At the chair of Connected Healthcare, we have the exciting opportunity to offer students a huge dataset of **thousands real patients** with up to **100 dynamic and static data inputs**. The data is collected before, during, and after a surgery procedure. Additionally, you can **consult with surgeons** (from the renowned Charité hospital) that have a technical background and are excited to bring **new technologies into practice**.

[1] McKinney, S.M., Sieniek, M., Godbole, V. et al. International evaluation of an AI system for breast cancer screening. Nature 577, 89-94 (2020).
[2] Richens, J.G., Lee, C.M. & Johri, S. Improving the accuracy of medical diagnosis with causal machine learning. *Nat Commun* **11,** 3923 (2020).
[3] Nagendran M., Chen Y, Lovejoy C A, Gordon A C, Komorowski M, Harvey H et al. Artificial intelligence versus clinicians: systematic review of design, reporting standards, and claims of deep learning studies BMJ 2020;

We offer you the chance to make **creative use** of the datasets. You could think of:

- Creating and deploying state-of-the-art data-oriented medical systems: a well-engineered, extendable, and transparent system is essential for deployment in practice, especially in the essential infrastructure deployed in the medical field.
- Detailed pre-operative risk analyses: you can give patients a detailed overview of the risks associated with certain procedures by creating a sophisticated time aware LSTM network[4], for example.
- Predicting complications or the stay of patients in the ICU: automated AI-systems make careful monitoring of patients possible in the case of a personnel shortage. Additionally, during the COVID-19 pandemic, we learned that capacity in ICUs is scarce and should be managed carefully.

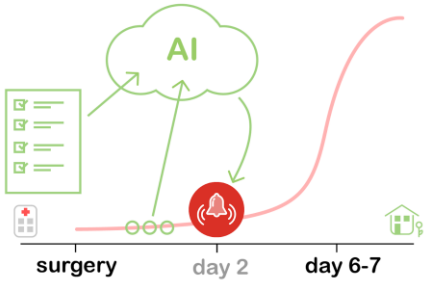


Figure 1: A system that alerts doctors of complications before they are likely to happen

Figure 2: Calculating the risk of complication before an operation

The use cases above are just examples, you can also come up with your own. We are interested in exciting **new, practical, innovative ideas for improving current health practices**. You will be building different types of **Machine Learning models** and implement them **with scalable software systems** to create a well-performing, accurate tool, which can be of real use to medical professionals. We also offer and encourage contributing to current medical research by **publishing your results**.

Requirements and Expectations

This is an interdisciplinary project at the intersection between computer science and medicine. Ideally, you have some data science or computer science background and are motivated and **excited to learn** about putting this to use to **make real, helpful solutions**. Specifically, a broad and diverse field of expertise is very welcome. The following topics will be relevant for this project, and we expect prior knowledge of one or more of the following:

- **Creating a reliable, extensible, and explainable software system**
  ➔ Experience with software engineering and modelling
- **Processing static, textual, and time-series data in a well-engineered data pipeline**
  ➔ The use of different techniques to enhance data quality
- **Machine learning and deep learning**
  ➔ Experience with frameworks like Sklearn, TensorFlow, and Keras or equivalents
- **Combining science and engineering**
  ➔ Making your findings known to the medical world and advancing the status quo of research

Contact

If you have any questions about the project, want to see what is possible, or you're curious about the skills involved, do not hesitate to contact us.

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[4] Baytas, I. M., Xiao, C., Zhang, X., Wang, F., Jain, A. K., & Zhou, J. (2017). Patient subtyping via time-aware LSTM networks. *Proceedings of the ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, Part F129685*, 65–74. https://doi.org/10.1145/3097983.3097997