Technische Universität München – Faculty of Informatics
Chair for Computer Aided Medical Procedures (Prof. Nassir Navab)
Practical Course: Machine Learning in Medical Imaging

RetinoPath

1 General Info

Project Title: RetinoPath
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2 Project Abstract

RetinoPath is a project centered on developing a deep-learning based method for the longitudinal analysis and computational modeling of retinal disease progression. By utilizing state-of-the-art computational techniques and incorporating the expertise of eye care specialists, RetinoPath seeks to unveil the complex patterns and mechanisms underlying various retinal disorders. The project's main objective is to improve early detection, enhance treatment strategies, and predict disease progression trajectory [1], ultimately contributing to better patient outcomes and advancements in retinal disease management. In this project, we have also the chance that apart working on the theory and implementation of methodology, collaborate with ophthalmologists as well.

3 Background and Motivation

Disease progression trajectory prediction aims to forecast the future clinical course of patients with various conditions, based on patient longitudinal data, such as electronic health records (EHRs), clinical measurements, and biomarkers [3]. This prediction can assist healthcare providers in determining the best course of treatment, optimizing patient care, and improving clinical outcomes [4]. A wide range of machine learning models have been applied to disease progression trajectory prediction, including logistic regression, deep learning models , and ensemble models. Many of these models use longitudinal EHR data, which provide a comprehensive picture of patient health history [2]. There are several challenges in disease progression trajectory prediction, such as data heterogeneity, missing data, and high dimensionality. Recent research has focused on addressing these challenges through the development of advanced machine learning techniques, such as representation learning and data imputation. Future work should focus on refining these methods and developing more accurate and robust predictive models.

4 Technical Prerequisites

- Solid machine learning and deep learning background
- Experienced in PyTorch

- Experienced in Python
- If needed be able to implement in MONAI Framework

5 Benefits

- Weekly supervision and discussions
- Possible novelty of the research
- The results of this work are intended to be published in a conference or journal
- Collaboration with senior researchers and ophthalmologists

6 Work packages and Time-plan

* The dates are adopted from the previous year and are not finalized yet.

	Description	# Students	From	To
WP1	Familiarizing with the literature.	4	10.05	17.05
WP2	Implementing the baselines	4	17.05	31.05
WP3	Improving the baselines and validation on relevant datasets	4	31.05	14.06
	Midterm Presentation	4	14.06	23.06
WP4	Implementing the model	4	14.06	07.07
WP5	Finalizing the results and evaluation	4	07.07	21.07
	Final Presentation	4	21.07	28.07

Table 1: Project Timeline

References

[1] Bryan Lim and Mihaela van der Schaar. Disease-atlas: Navigating disease trajectories using deep learning. In *Machine Learning for Healthcare Conference*, pages 137–160. PMLR, 2018.

[2] Sarah Mullin, Jaroslaw Zola, Robert Lee, Jinwei Hu, Brianne MacKenzie, Arlen Brickman, Gabriel Anaya, Shyamashree Sinha, Angie Li, and Peter L Elkin. Longitudinal k-means approaches to clustering and analyzing ehr opioid use trajectories for clinical subtypes. *Journal of biomedical informatics*, 122:103889, 2021.

[3] Alvin Rajkomar, Eyal Oren, Kai Chen, Andrew M Dai, Nissan Hajaj, Michaela Hardt, Peter J Liu, Xiaobing Liu, Jake Marcus, Mimi Sun, et al. Scalable and accurate deep learning with electronic health records. *NPJ digital medicine*, 1(1):18, 2018.

[4] Benjamin Shickel, Patrick James Tighe, Azra Bihorac, and Parisa Rashidi. Deep ehr: a survey of recent advances in deep learning techniques for electronic health record (ehr) analysis. *IEEE journal of biomedical and health informatics*, 22(5):1589–1604, 2017.