



HNO-Klinik Abteilung Phoniatrie und Pädaudiologie  
Waldstr. 1 91054 Erlangen

Master thesis for students in:  
Medical Engineering, Integrated Life Science,  
Computer Science, ...

**Hals-Nasen-Ohren-Klinik  
Kopf- und Halschirurgie**  
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## Machine learning based analysis of peripheral blood immune phenotype in immunotherapy and combined radio-immunotherapy of squamous head and neck cancer.

**Background:** This is a joint research project by the clinic of radiation oncology, institute of pathology and the ENT department of the University Hospital Erlangen. The inhibition of the immune-checkpoints has revolutionized cancer treatment and has been awarded the Nobel Prize in 2018. Despite major improvements in cancer treatment, the majority of cancer patients do not respond to immunotherapy. Therefore, the development of biomarkers for the identification and selection of patients that benefit from immunotherapy is one of the key tasks of precision-oncology. Currently, the only available biomarker is PDL-1 that is known to have a low validity. Consequently, there is a great demand to develop new biomarkers and to evaluate the value of combined scores of various potential biomarkers. The **goal of this MS thesis** is to develop the value of multiple biomarkers using methods of **machine learning** based on the available clinical and pathologic patients' data to allow for a more precise prediction of treatment outcome and thus improve cancer treatment.

**Work packages:** Different machine learning (ML) methods will be investigated and compared regarding their potential for classification (response to treatment; recurrence/ non recurrence), prediction of treatment response, recurrence and feature selection. All necessary patient data and biomarkers are already available and provided by the clinic of radiation oncology and the institute of pathology. The thesis contains:

(1) Data preparation: Collected data and parameters have to be arranged for further analysis. If necessary, appropriate strategies to deal with incomplete data, such as replacing non available data with the median of the same group to maximize the available data for subsequent analyses have to be performed. (2) Classification: Investigate different machine learning approaches on their performance for prediction of treatment response, treatment efficacy and recurrence rate using biomarkers. (3) Biomarkers have been determined at different time points during immunotherapy. Hence, we want to identify the best time of diagnosis for prediction of the surveyed outcome parameter. (4) Perform feature selection to identify biomarkers with the most significant impact.

The **hypothesis** of the study is that there is a combination of optimal time point and biomarker set for prediction of therapy response and efficacy.

### Requirements/Nice to have:

- Profound knowledge in machine learning methods
- Experience with Python
- Interest in interdisciplinary work and research
- Thesis can be written in German or English

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