Topics for Master Team Projects

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Interpretable Medical Mining (IMM)

- current state-of-the-art ML algorithms induce **opaque black-box models** that are difficult to understand for physicians

	Examples	Interpretable	Accurate
Simple model	linear regression, decision tree	✓	✗
Complex model	rand. forest, boosted model, DL	✗	✓

- models must be both **accurate *and* interpretable** to be deployed in real clinical settings, e.g., in ICUs
- explaining complex models helps to **increase acceptance** by medical experts and to uncover data problems
- current research focusses on **algorithm-agnostic** methods for model interpretation (LIME, SHAP, Reliance)

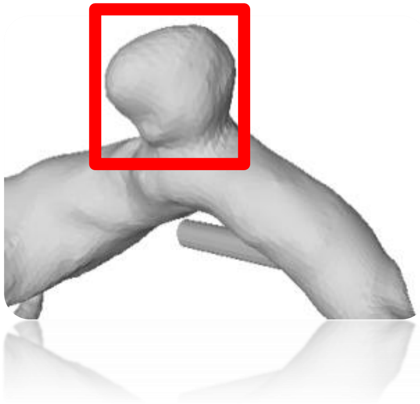
Relevant Literature

Marco T. Ribeiro, Sameer Singh, and Carlos Guestrin. "'Why Should I Trust You?' Explaining the Predictions of Any Classifier". In: Proc. of ACM SIGKDD Int. Conference on Knowledge Discovery and Data Mining, pp. 1135-1144, 2016.

Scott M. Lundberg, and Su-In Lee. "A unified approach to interpreting model predictions". Advances in Neural Information Processing Systems. 2017.

Aaron Fisher, Cynthia Rudin, and Francesca Dominici. "Model Class Reliance: Variable Importance Measures for any Machine Learning Model Class, from the 'Rashomon' Perspective". arXiv:1801.01489, 2018.

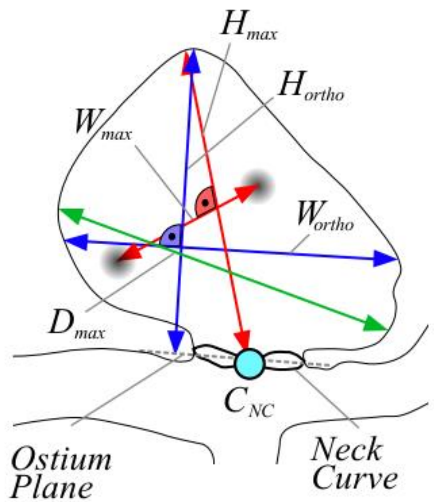
TP1: Interpretable Machine Learning for Rupture Risk Classification in Intracranial Aneurysms

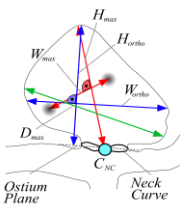


- early detection of high rupture risk aneurysms is crucial for effective treatment strategy planning
- clinicians need an accurate and reliable model ...which is explainable!

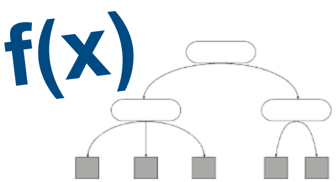
Task: design and implementation of a **prototypical GUI which comprises at least 4 model-agnostic *model explanation techniques**** for rupture status classification

* global/local feature importance, feature interaction, feature visualizations, surrogate models, representative instances

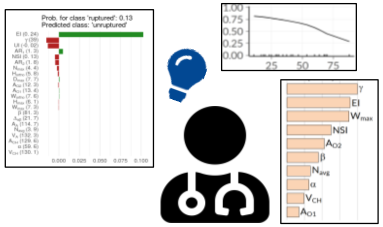




1. Extract morpho-logical parameters



2. Build classification models to objectively assess IA rupture risk



3. Explore models and study parameter relevance

TP2: Exploiting Participant Evolution for Classification in Longitudinal Cohort Study Data

- **Cohort study**: health survey where the participants are followed for a longer period of time

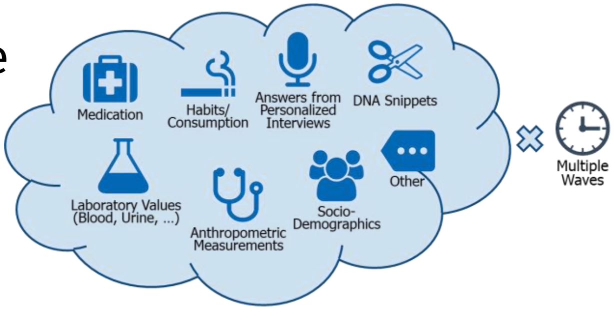
→ goal: identify **risk factors** for common diseases

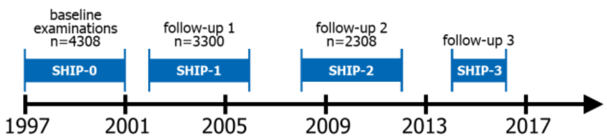
- What can we learn from ***the change* of a participant over time**?

Task: extend a framework that extracts ***evolution* features** by implementing explanation methods:

  - merit of an evo feature towards classification accuracy improvement
  - effect of evo feature value on predicted class
  - minimal change of a participant such that the predicted class label changes
  - minimal set of evolution features

- **Dataset**: Study of Health in Pomerania
- **Prerequisites**: experience in R is beneficial





Relevant Literature

Uli Niemann, Tommy Hielscher, Myra Spiliopoulou, Henry Völzke, and Jens-Peter Kühn. Can we classify the participants of a longitudinal epidemiological study from their previous evolution?. Proc. of IEEE CBMS, 121-126, 2015.

Tommy Hielscher, Myra Spiliopoulou, Henry Völzke, and Jens-Peter Kühn. Mining longitudinal epidemiological data to understand a reversible disorder. Proc. of IDA, 2014.

Timeline

- **Registration**:
    1. Apply for a topic until 04.04.2019
    2. Notification on topic assignment per mail by me on 09.04.2019 (or before)
    3. Fill the registration form and submit until 11.04.2019
- **Meetings**:
    - introductory meeting (to be scheduled)
    - kick-off meeting (to be scheduled)
    - further meetings on request
- **Submission deadline**: 01.09.2019
- **Final presentation**: September 2019

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