DATA DRIVEN DECISION SUPPORT FOR HEALTH AND CARE

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The largest applied research institute in **Austria**

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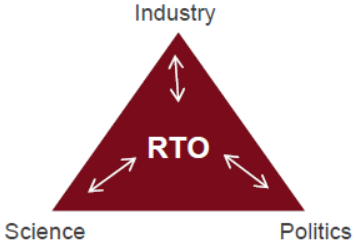
Research and Technology Organisation



Owner structure

50.46%
Republic of Austria

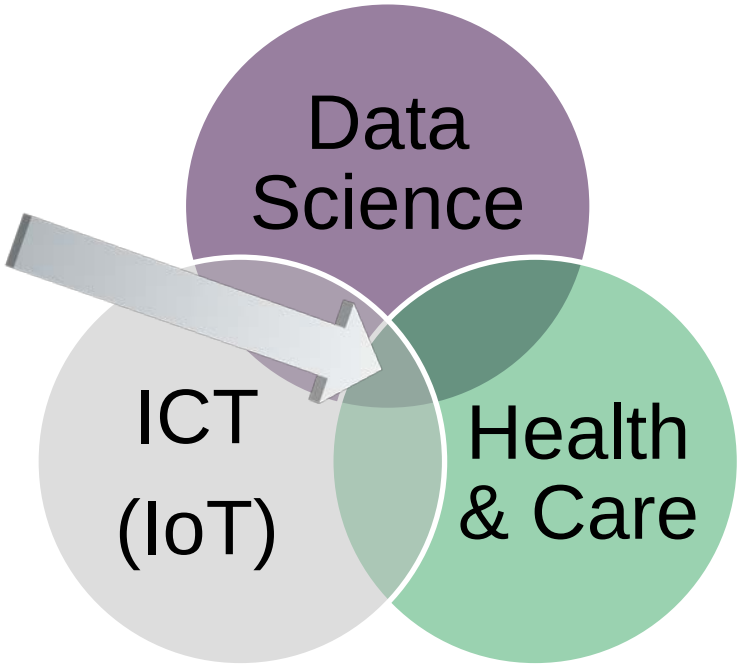
49.54%
Federation of Austrian Industries

1300
Employees

Health & Bioresources	Digital Safety & Security	Vision, Automation & Control
Low-Emission Transport	Technology Experience	Innovation Systems & Policy
Energy	Mobility Systems	

PREDICTIVE HEALTHCARE INFORMATION SYSTEMS @ AIT

Information-driven Health & Care



CONTENT

- Introduction – What is special in Health & Care?
- Methods
  - Predictive Modelling Pipeline
  - Prediction of Re-Admissions, Delirium, Blood Transfusion
  - Feature Importance
  - Individual Feature Influence
- Results
  - Application at the KAGes
  - The controller‘s view
  - The physician‘s view
- Discussion

PROPERTIES OF HEALTH AND CARE DATA

- Complex
- Distributed within single institutions
- Distributed across different institutions
- Hard to overview by physicians
- Personalized
- Sensitive

- Healthcare sector is slowly changing
- Guidelines – Evidence Based Medicine
- Decisions might have severe consequences
  - For patients
  - For physicians and caregivers

DATA DRIVEN DECISION SUPPORT PROCESS IN HEALTH & CARE

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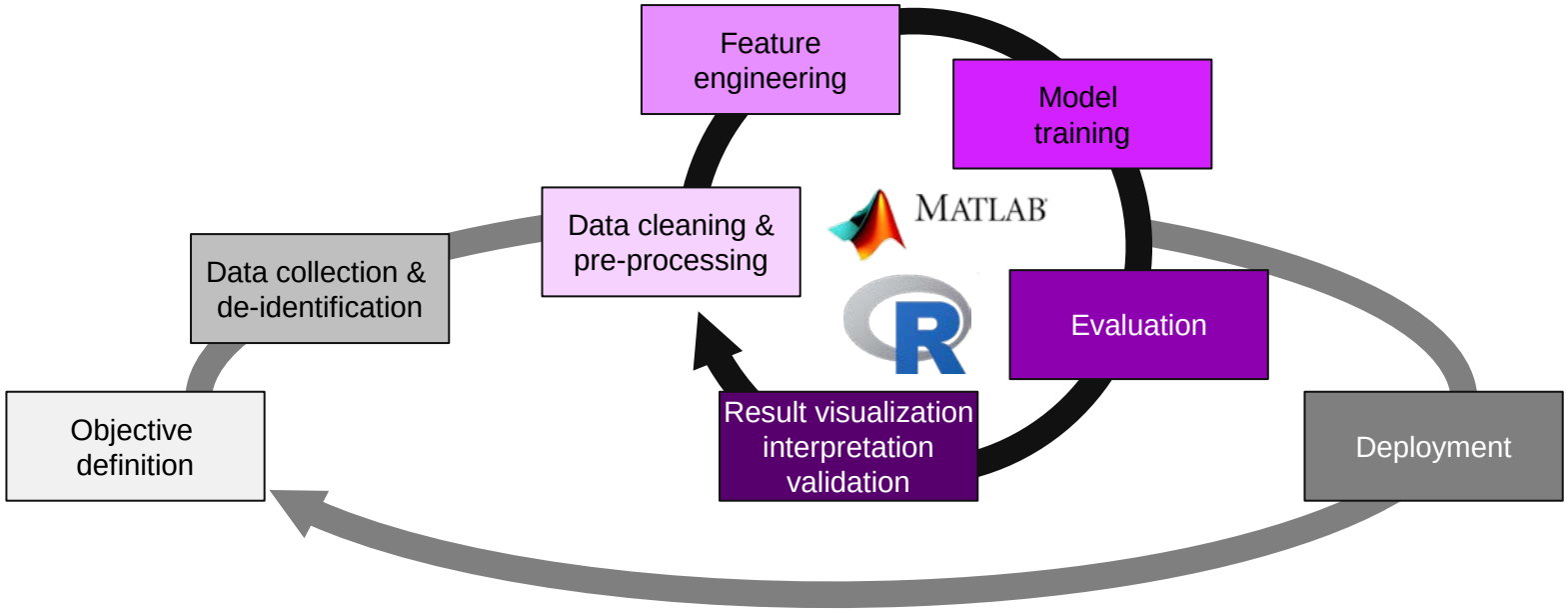


APPLICATION SELECTION

- Which topics are interesting?
- Which data are available?
- Which data are available at the right time?

METHODS – PREDICTION OF RE-ADMISSIONS

- Patient is treated in a hospital
- At discharge, a prediction is made
  - Will the patient be re-admitted to hospital within the subsequent 30 days?
- This might influence further treatment (rehabilitation, monitoring, etc.)

- Expensive for hospitals and healthcare systems
- Painful for patients

METHODS – PREDICTION OF DELIR

- Especially old patients admitted to hospital have a high risk to develop delir at hospital
- Even higher risk in case of surgery
- Expensive and cumbersome for the hospital
- Painful for patients

- Patient is admitted to hospital
- Risk of delir is predicted
- Warning is shown to physicians (in case of high risk)
- Special treatment (e.g. special delir room, high care level)

PREDICTION OF BLOOD TRANSFUSIONS DURING ELECTIVE SURGERY

- Common elective surgery
  - Total hip replacement
  - Total knee replacement
  - Coronary Artery Bypass Graft (CABG)

VALIDATION / INTERPRETATION

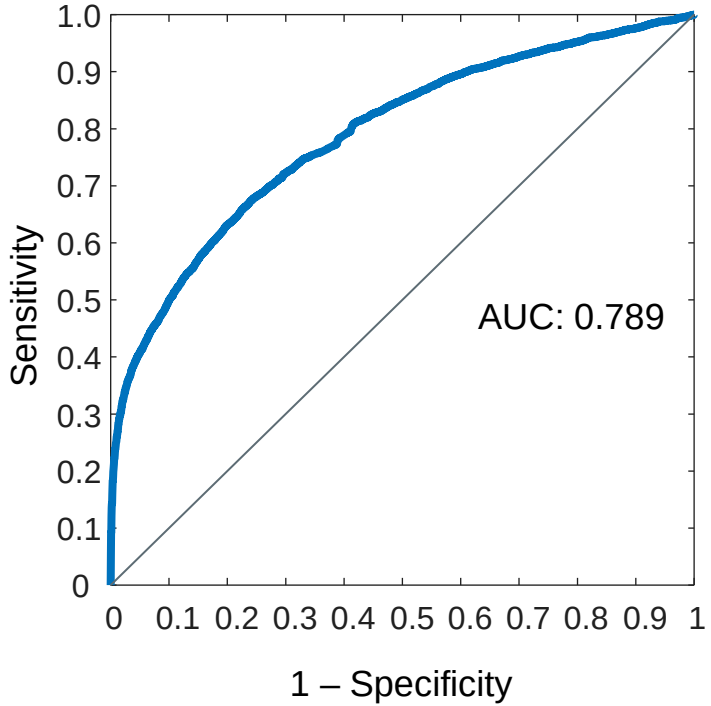
How to understand the „black box“ predictive model?

- “Explainability”

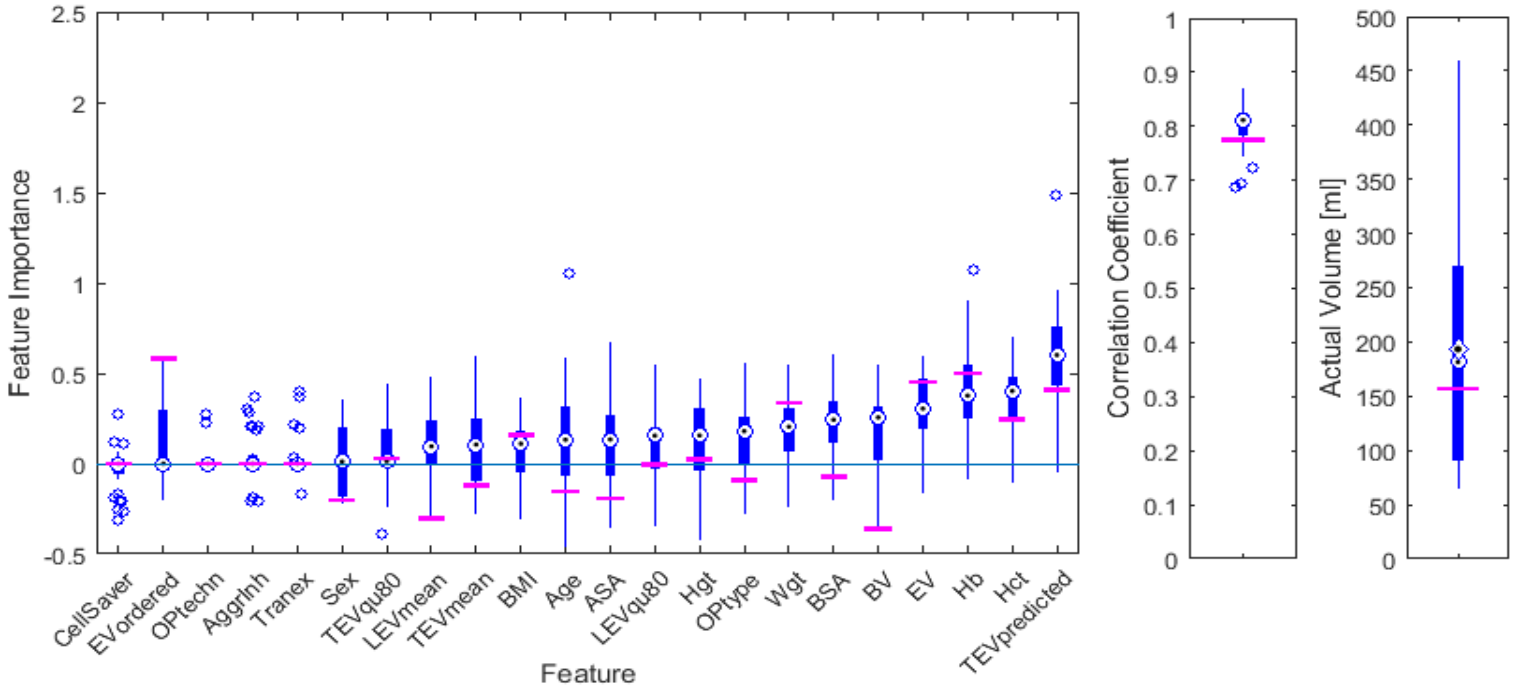
- Feature Importance
  - If all values of a specific feature are replaced by random values
    ➔ How much worse would results be?
  - Information on the importance of a feature **within the whole study population**

- Individual Feature Influence
  - Which features were responsible for a specific decision **for an individual patient**
    - Analysis of the specific path within each decision tree of a random forest
    - Analysis of the gradient of the outcome in the multidimensional region close to the specific patient

RECEIVER OPERATING CURVE
30 DAYS RE-ADMISSIONS



RESULTS –
THE CONTROLLER‘S VIEW



Development of Multivariable Models to Predict and Benchmark Transfusion in Elective Surgery Supporting Patient Blood Management.
Hayn D, Kreiner K, Ebner H, Kastner P, Breznik N, Rzepka A, Hofmann A, Gombotz H, Schreier G.
Appl Clin Inform. 2017 Jun 14;8(2):617-631. doi: 10.4338/ACI-2016-11-RA-0195.
PMID: 28850152

RESULTS –
THE PHYSICIAN‘S VIEW

Individual risk for a delirium: 22 %

These observations were most important for the current patient’s risk:

1. ICD-10 Chapter Cancer (no)
2. Age (84 y)
3. Time since previous admission (43 d)
4. Length of stay (12 d)

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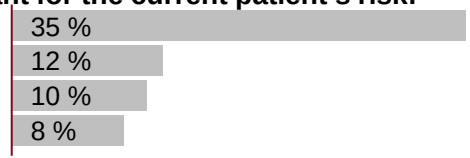

These observations were more important for the current patient than for other patients:

1. Length of stay (12 d)
2. Charlson index (4)
3. Hematocrit (38 %)
4. Time since previous admission (43 d)

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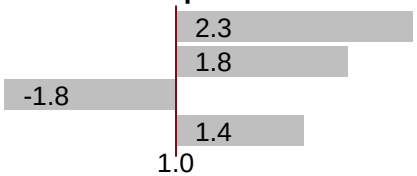

Plausibility of Individual Decisions from Random Forests in Clinical Predictive Modelling Applications.
Hayn D, Walch H, Stieg J, Kreiner K, Ebner H, Schreier G.
Stud Health Technol Inform. 2017;236:328-335.
PMID: 28508814

PAPER CONTENT

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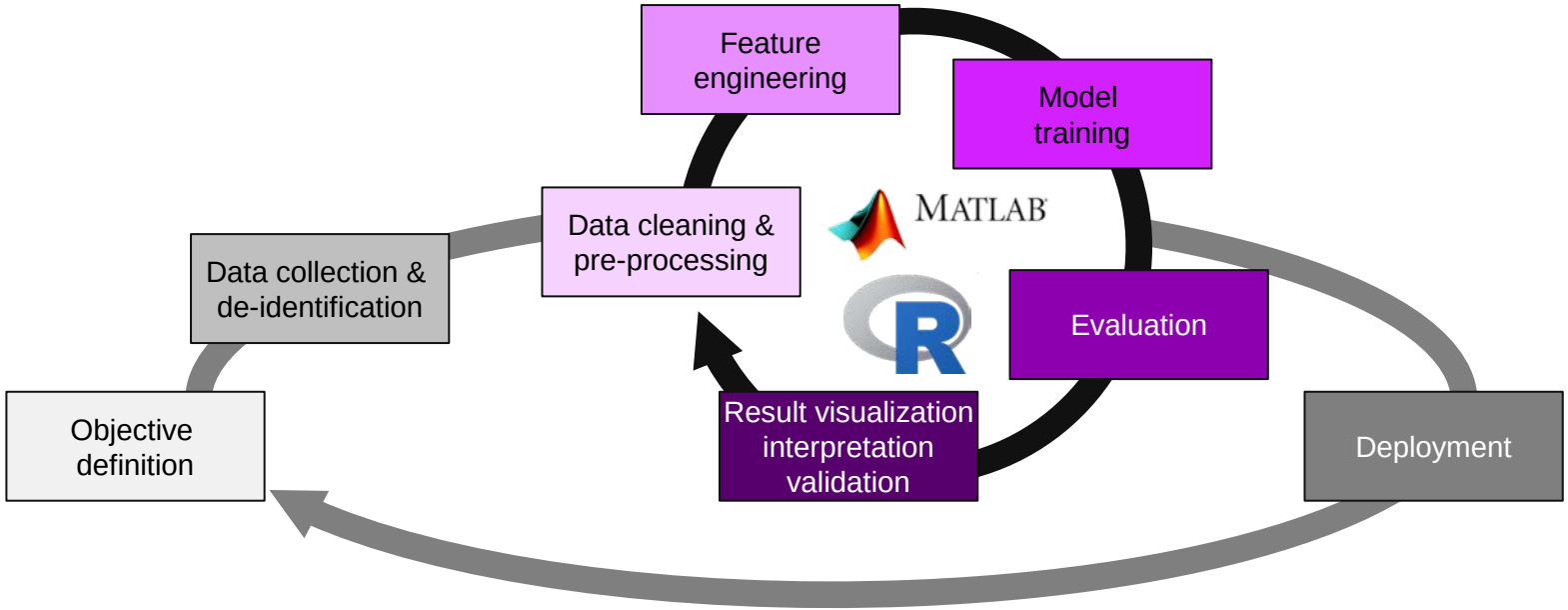

DISCUSSION

- There are a lot of health and care data that might improve treatment
- Data driven decision support has specific requirements in health and care
- Applications
  - Controllers, Managers, Benchmarking
  - Individual decision
- Explainability!
  - Global feature importance
  - Feature influence on individual decisions
- Next steps
  - Implementation in routine care
  - Prove that data driven health and care can improve the outcome for the patient

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THANK YOU!

Dieter Hayn, 11/29/2017