Bundesrechnungshof

ECA conference on Big and Open Data
for European supreme audit institutions

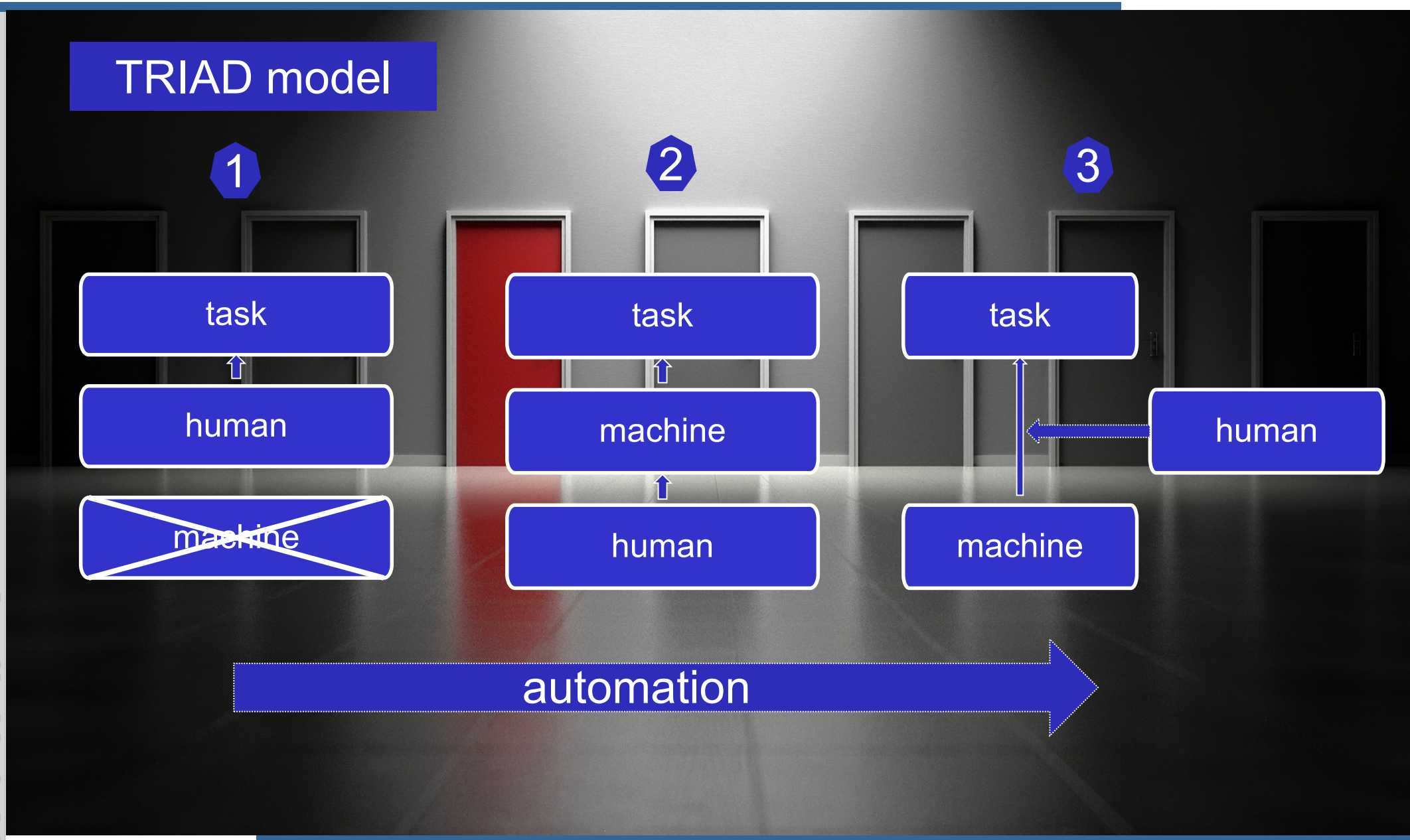
Luxembourg, 27-28 November 2019

# Auditing of automated decision-making

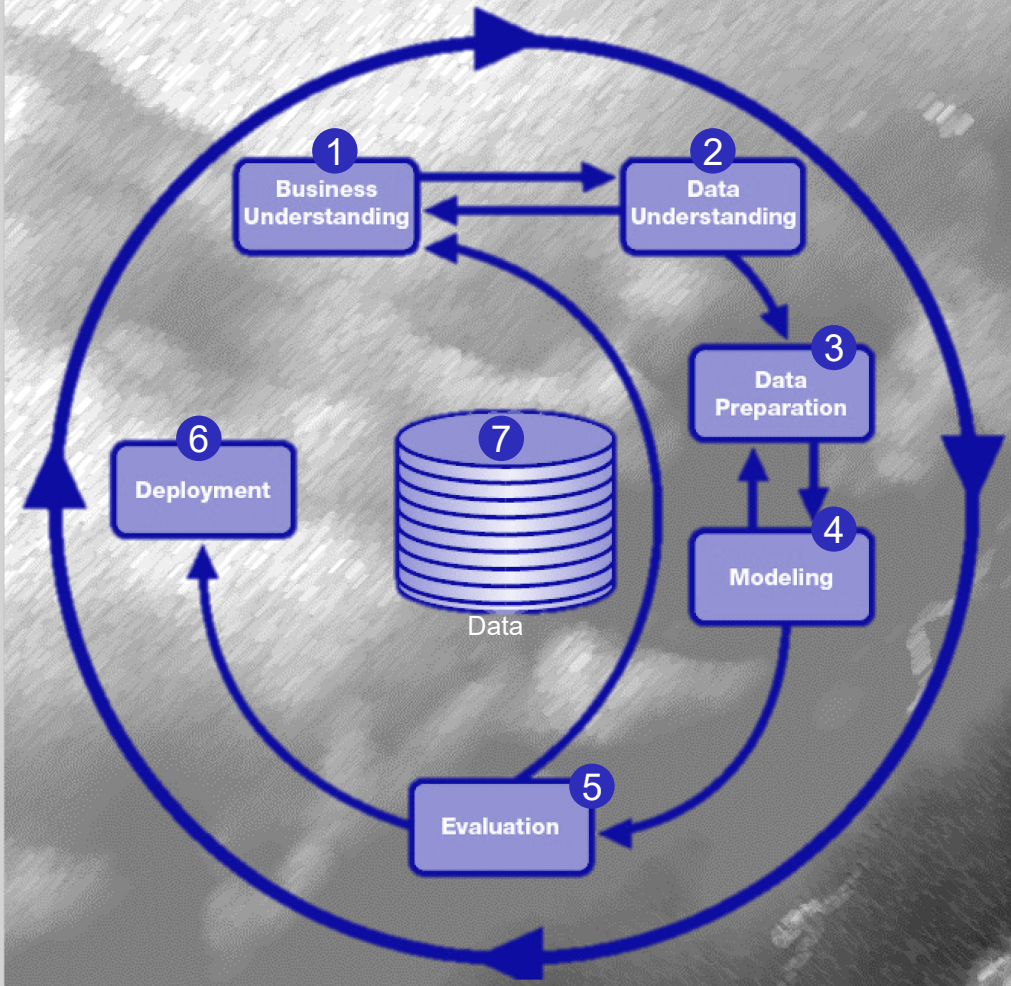
## Challenges of deep learning and data analytics from the auditor‘s point of view

(Peter Koß, audit manager, German SAI)

# Decision-making as the goal of data analytics



# CRISP-DM - a guideline for the audit process




Each phase of the data analytics process as described by CRISP-DM is well-suited for stepping in with audit work

Prepare audit goals and activities for:

- Business understanding
- Data understanding
- Data preparation
- Modeling
- Evaluation
- Deployment
- Data provision



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# CRISP-DM - phases and the auditor's capabilities

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Each CRISP-DM phase requires different auditing abilities and audit knowledge:

Level of complexity increases

| | |
|---|---|
| (1-2) | • be familiar with the field of business |
| (3,7) | • have an understanding of database technologies, data and quality management |
| (4-5) | • have a track record in data analytics, statistics, and quality measures |
| (6) | • be familiar with software architectures, deployment, and data procurement |

# A look into the black box

- Machine learning models are “black boxes”
  - Coherencies learnt are complex and abstract
  - Models depend on data used
  - Model evaluation
    - Statistical evaluation
    - Semantical evaluation
  - Model performance is evaluated by means of standard metrics
  - Metrics may lead to erroneous conclusions about model quality
- Humans do not understand the decision-making process

# A look into the black box - model evaluation

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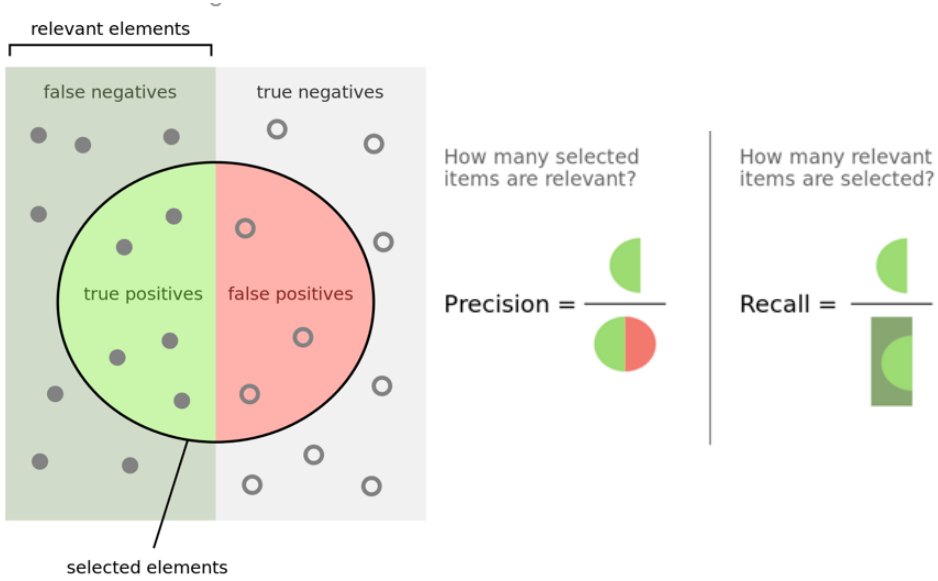
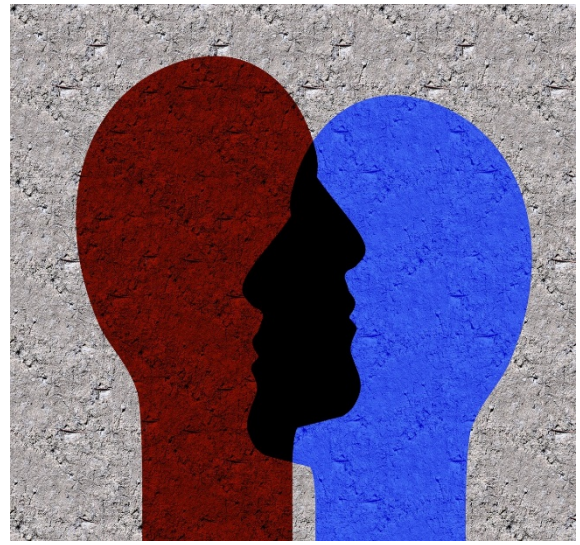
## Statistical evaluation

- Evaluate blind tests
- Evaluate statistical tests
  - Classification
  - Regression
  - Clustering

## Semantical evaluation

- Understanding of the results
- Alignment with business goals
- Plausibility of assumed correlations
- Implications of bias, variance and random noise
- Means for prevention of overfitting



# Audit catalogue for data mining and AI systems

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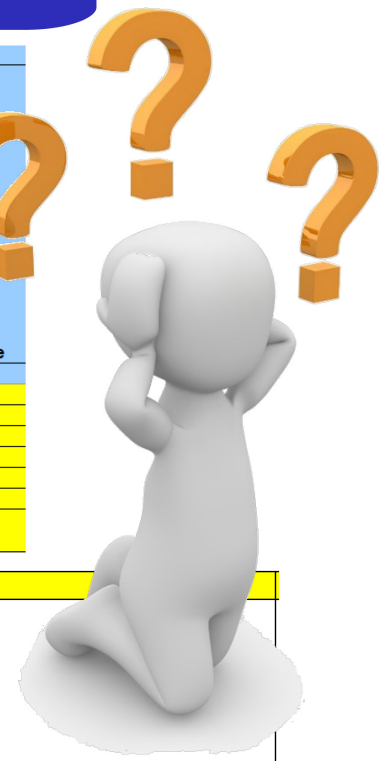
Audit catalogue derived from CRISP-DM containing a total of 71 audit questions

| No. | Relevance | Priority | Type | Questions based on the process model: Cross Industry Standard Process Data Mining (CRISP-DM) | Purpose of the question | Document needed as audit evidence (if appropriate and available) | Sys Roles concerned: Autonomy and control | Sys Roles concerned: Requisitioning unit | Done (yes="X", no=empty case) | Response |
|---|---|---|---|---|---|---|---|---|---|---|
| 71 | | | | | | | | | | |
| A1 | | | | Microeconomic questions | | | x | x | 0% | |
| A2 | | | | Understanding of data | | | | x | 0% | |
| A3 | | | | Data preparation | | | x | x | 0% | |
| A4 | | | | Modelling | | | x | x | 0% | |
| A5 | | | | Evaluation | | | x | x | 0% | |
| A6 | | | | Deployment and operation | | | x | x | 0% | |
| A7 | | | | Management processes during development, rollout and operation | | | | x | 0% | |

| | | | | | | |
|---|---|---|---|---|---|---|
| A5 | | | | Evaluation | | |
| A5.001 | | | | Specify the validation methods you applied and state the underlying criteria. | - Identify,<br>--- how the model quality has been checked,<br>--- how the system decisions/forecasts have been tracked,<br>--- how the influence of individual criteria on the decisions has been analysed,<br>--- how it has been checked whether criteria not taken into account might have led to better decisions, and<br>--- how the fairness of the model has been checked. | - description of validation methodology used |



For audit work on development, rollout, and operation of AI and data mining systems

We are currently piloting the catalogue in close cooperation with the Federal Employment Agency



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# Key takeaways

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- Automated decision-making presents new challenges for our audit work
- The CRISP-DM standard offers audit intervention points at each phase
- Auditors need specific skills and tools to audit automated decision-making
- Statistical or semantical evaluation may be applied to “black box” models
- Our new audit catalogue covers a broad range of audit questions and topics

**Thank you for your attention.**



Peter Koß, audit manager, German SAI