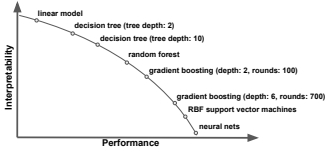
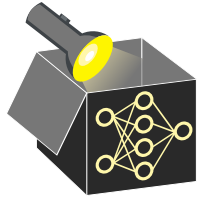
Interpretable Machine Learning

Introduction, Motivation, and History

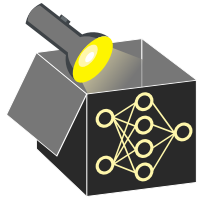


Learning goals

- Why interpretability?
- Developments until now?
- Use cases for interpretability



WHY INTERPRETABILITY?



- ML: huge potential to aid decision-making process due to its predictive performance
- ML models are black boxes, e.g., XGBoost, RBF SVM or DNNs
  $\rightsquigarrow$ too complex to be understood by humans
- Some applications are "learn to understand"
- When deploying ML models, lack of explanations
  1. hurts trust
  2. creates barriers

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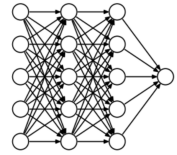
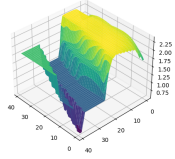
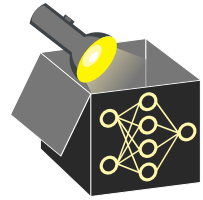
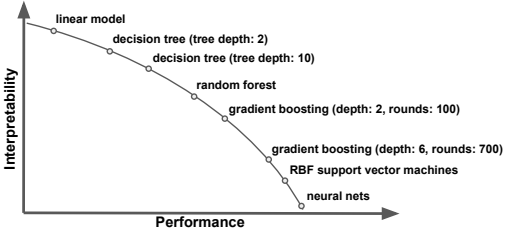




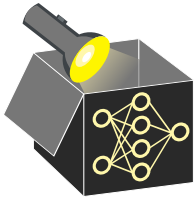




INTERPRETABILITY IN HIGH-STAKES DECISIONS

Examples of critical areas where decisions based on ML models can affect human life

- Credit scoring and insurance applications
  ▸ Society of Actuaries
  - Reasons for not granting a loan
  - Fraud detection in insurance claims



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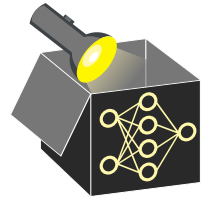

Examples of critical areas where decisions based on ML models can affect human life

- Credit scoring and insurance applications
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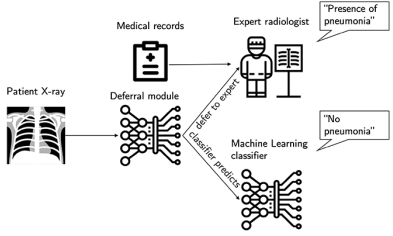
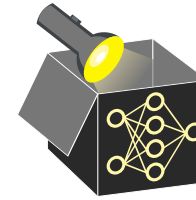
- Medical applications
  - Identification of diseases
  - Recommendations of treatments
- . . .



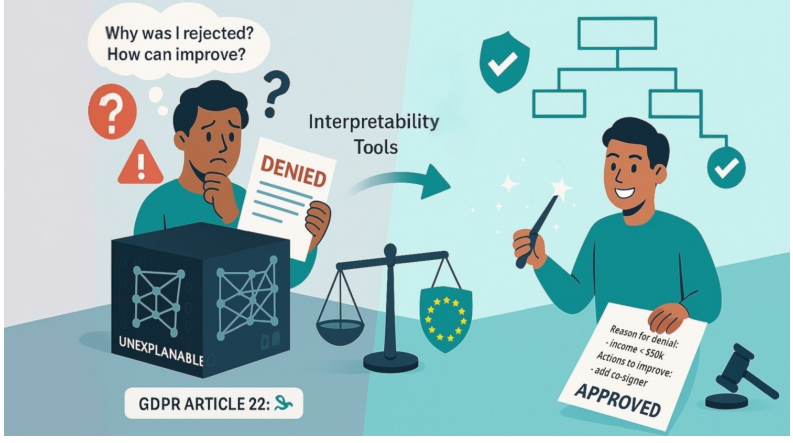
▸ Miliard (2020)

NEED FOR INTERPRETABILITY



Need for interpretability becoming increasingly important from a legal perspective

- General Data Protection Regulation (GDPR) requires for some applications that models have to be explainable ▸ Goodman & Flaxman (2017)
  ⇝ *EU Regulations on Algorithmic Decision-Making and a "Right to Explanation"*
- *Ethics guidelines for trustworthy AI* ▸ European Commission (2019)



BRIEF HISTORY OF INTERPRETABILITY

- 18th and 19th century:
  Linear regression models (Gauss, Legendre, Quetelet)
- 1940s:
  Emergence of sensitivity analysis (SA)
- Middle of 20th century:
  Rule-based ML, incl. decision rules and decision trees
- 2001:
  Built-in feature importance measure of random forests
- >2010:
  Explainable AI (XAI) for deep learning
- >2015:
  IML as an independent field of research

▸ Carl Friedrich Gauss

▸ Wikipedia