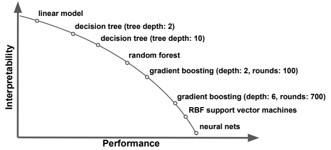
Interpretable Machine Learning

Introduction, Motivation, and History



Learning goals

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

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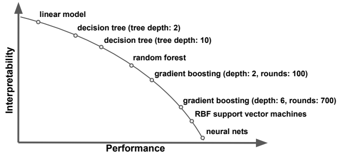

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WHY INTERPRETABILITY?

- ML: huge potential to aid decision-making process due to its predictive performance
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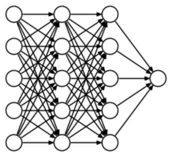
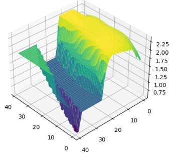
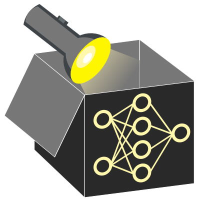
  ⇝ too complex to be understood by humans
- Some applications are "learn to understand"







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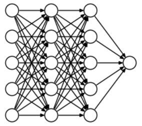

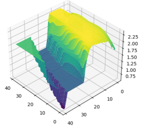

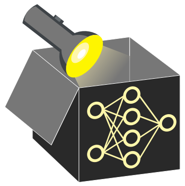

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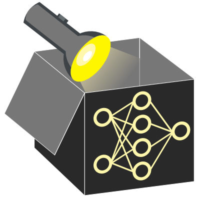

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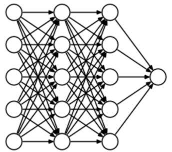
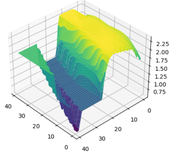
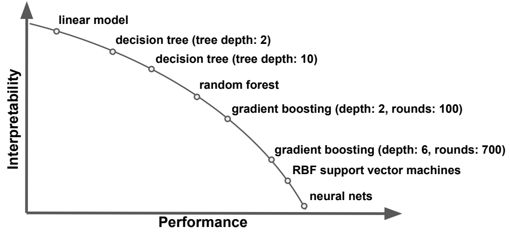
- When deploying ML models, lack of explanations
  1. hurts trust
  2. creates barriers





⇝ Many disciplines with required trust rely on traditional models, e.g., linear models, with less predictive performance



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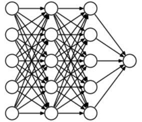
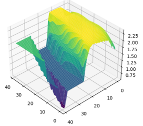
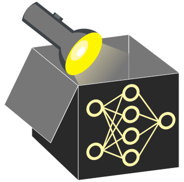
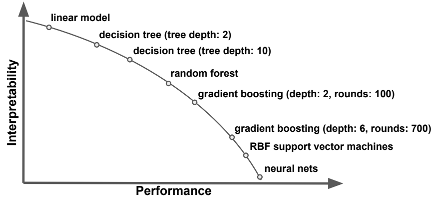
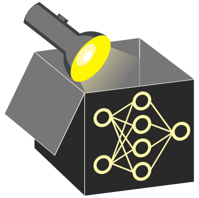






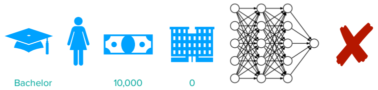


INTERPRETABILITY IN HIGH-STAKES DECISIONS



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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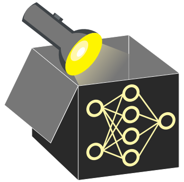

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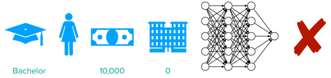

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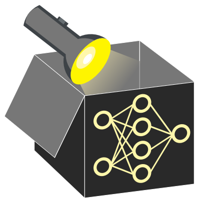

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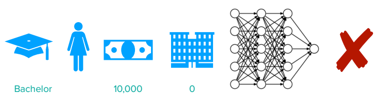

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  - Identification of diseases
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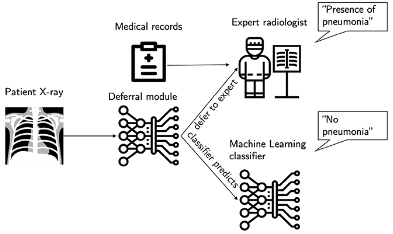

▸ Miliard (2020)

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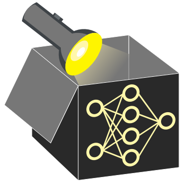

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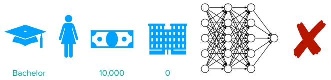

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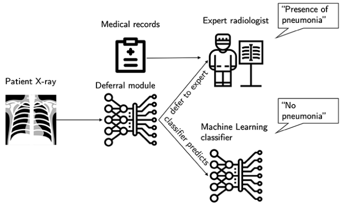

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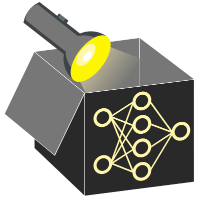
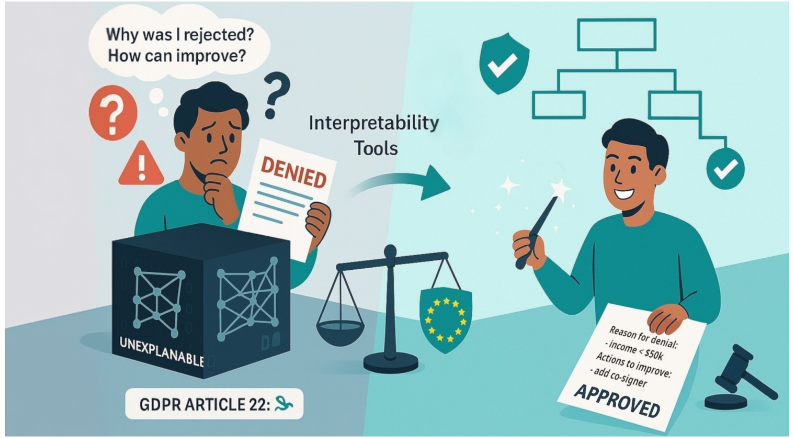
NEED FOR INTERPRETABILITY



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)



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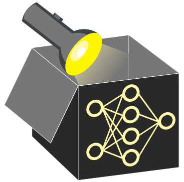

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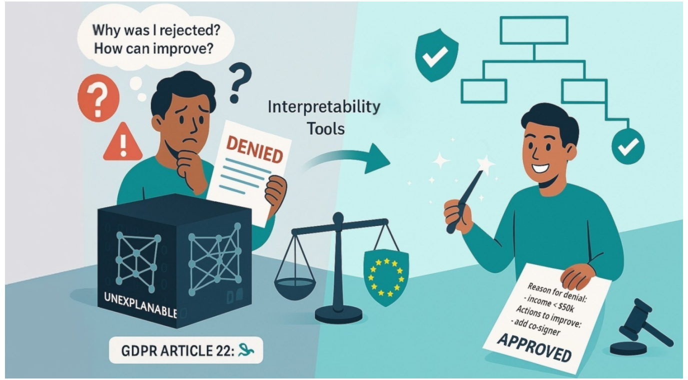
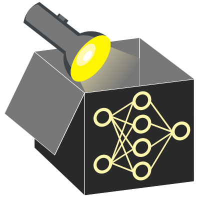


BRIEF HISTORY OF INTERPRETABILITY



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  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:
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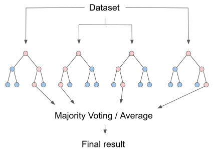
- >2015:
  IML as an independent field of research

▸ Carl Friedrich Gauss

▸ Wikipedia



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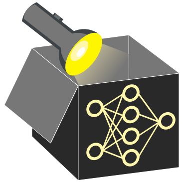

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