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AI, Ethics, and Policy considerations when technology meets biology

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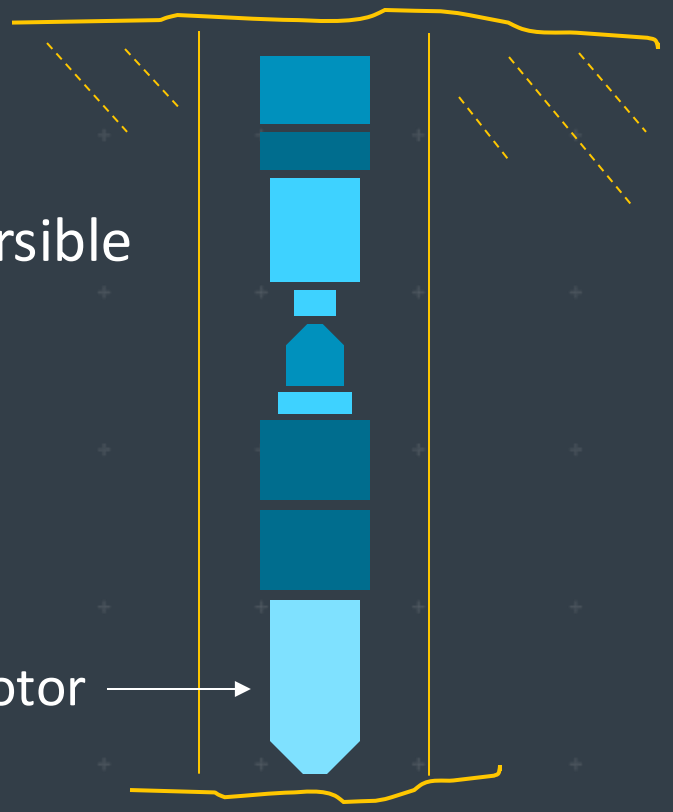

Crude oil

Marketing and advertising data

Drinking water

Bio data

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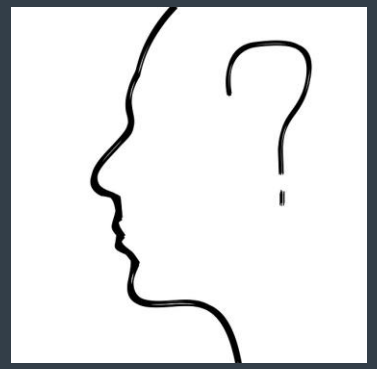
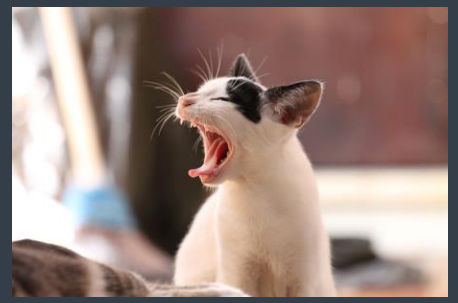
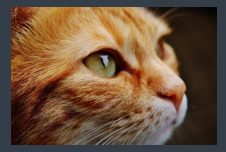
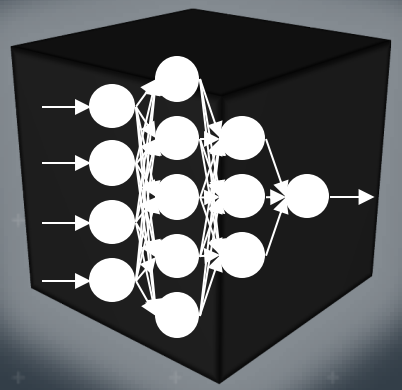
Machine Learning





Learns through observation of examples (data).

Useful!

Cat

?

Approximate (Probability)

Universal Function Approximator

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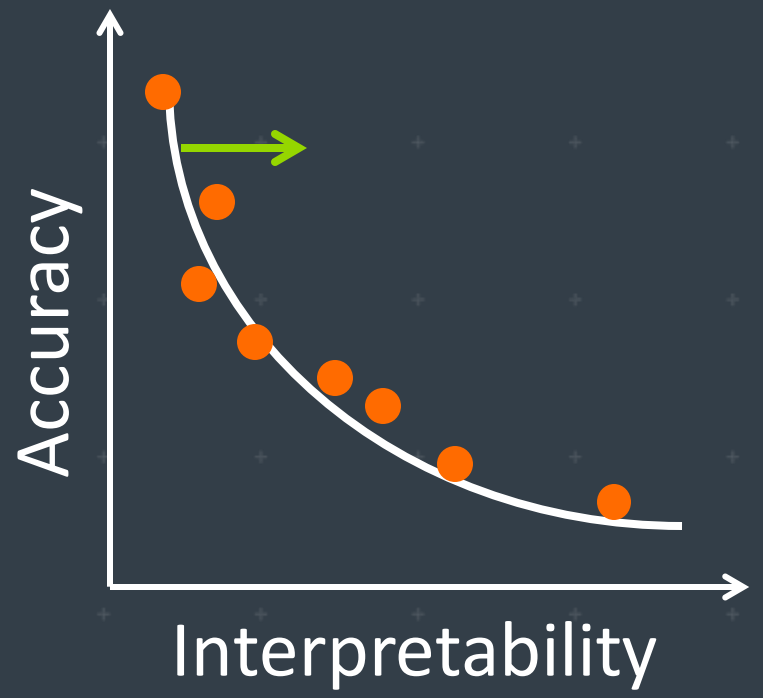
Explainable (Interpretable) AI - XAI

Bringing transparency to the black box



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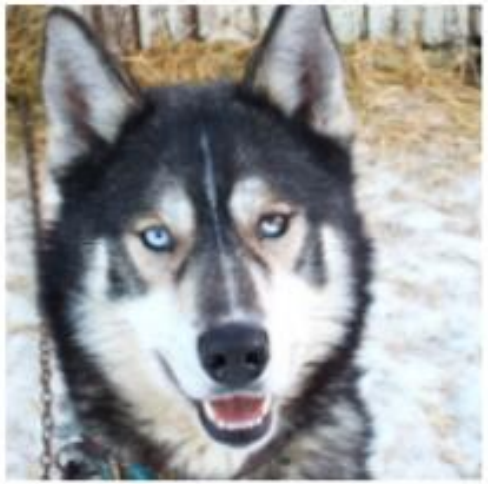
XAI Example



(a) Husky classified as wolf

Ribeiro et al. *Why should I trust you? Explaining the predictions of any classifier.* KDD2016
(aka LIME: Local Interpretable Model-Agnostic Explanations)

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Why bring the focus to explainability?

- Stakeholder Trust
- Risk Mitigation
- Scientific Discovery
- Requirements of Policy and Regulation
- Ethical Responsibility

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Stakeholder Trust

Stakeholder Trust

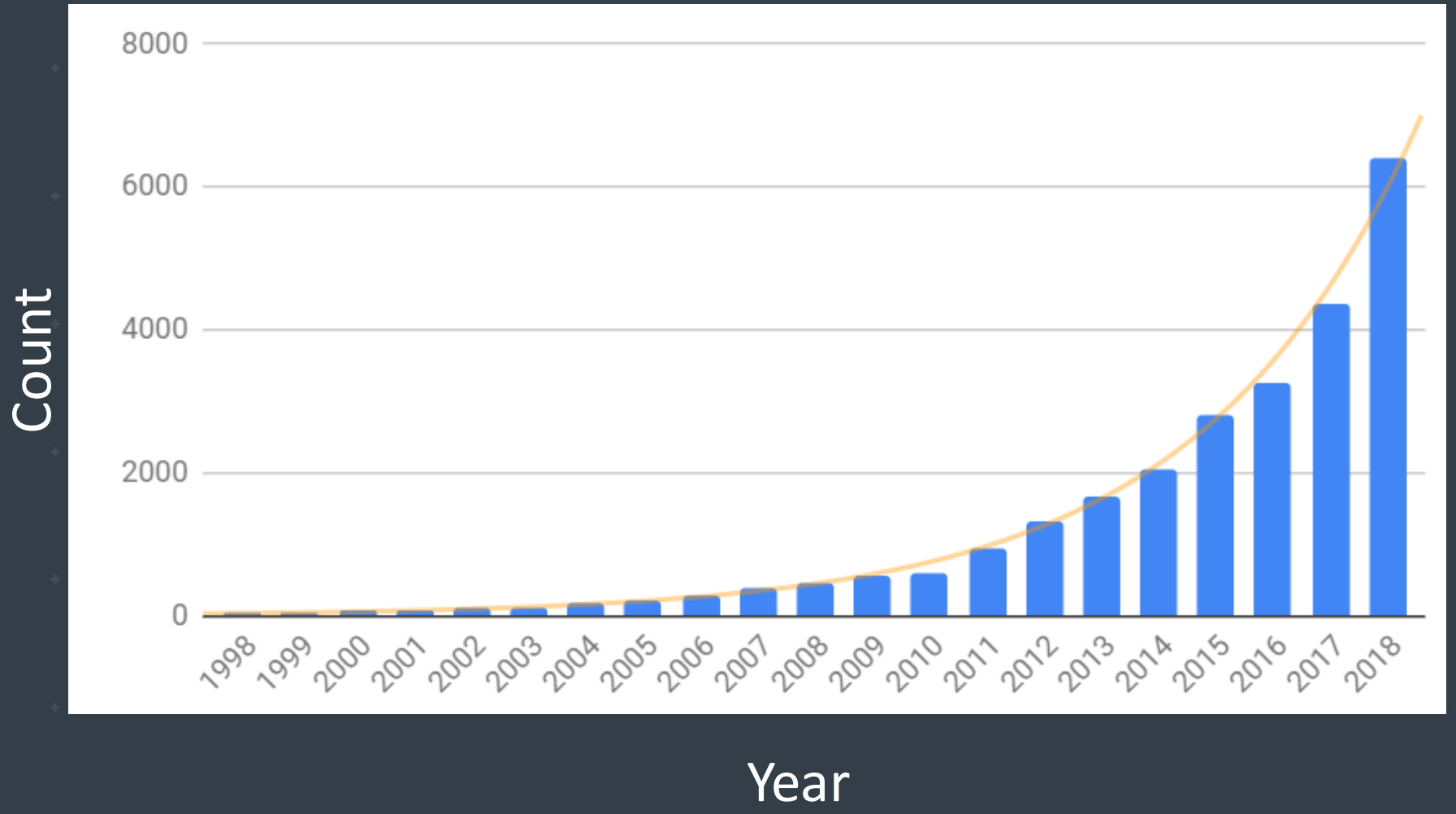
Risk Mitigation

Scientific Discovery

Requirements of Policy and Regulation

Ethical Responsibility

PubMed Publications using “Machine Learning”



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Stakeholder Trust

- Leveraging the value of the prediction may require explainability

- In healthcare, the utility may be in what is actionable…
- ***Why*** has the probability of cancer increased?

- Patients still entitled to accuracy

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Risk Mitigation

Stakeholder Trust

Risk Mitigation

Scientific Discovery

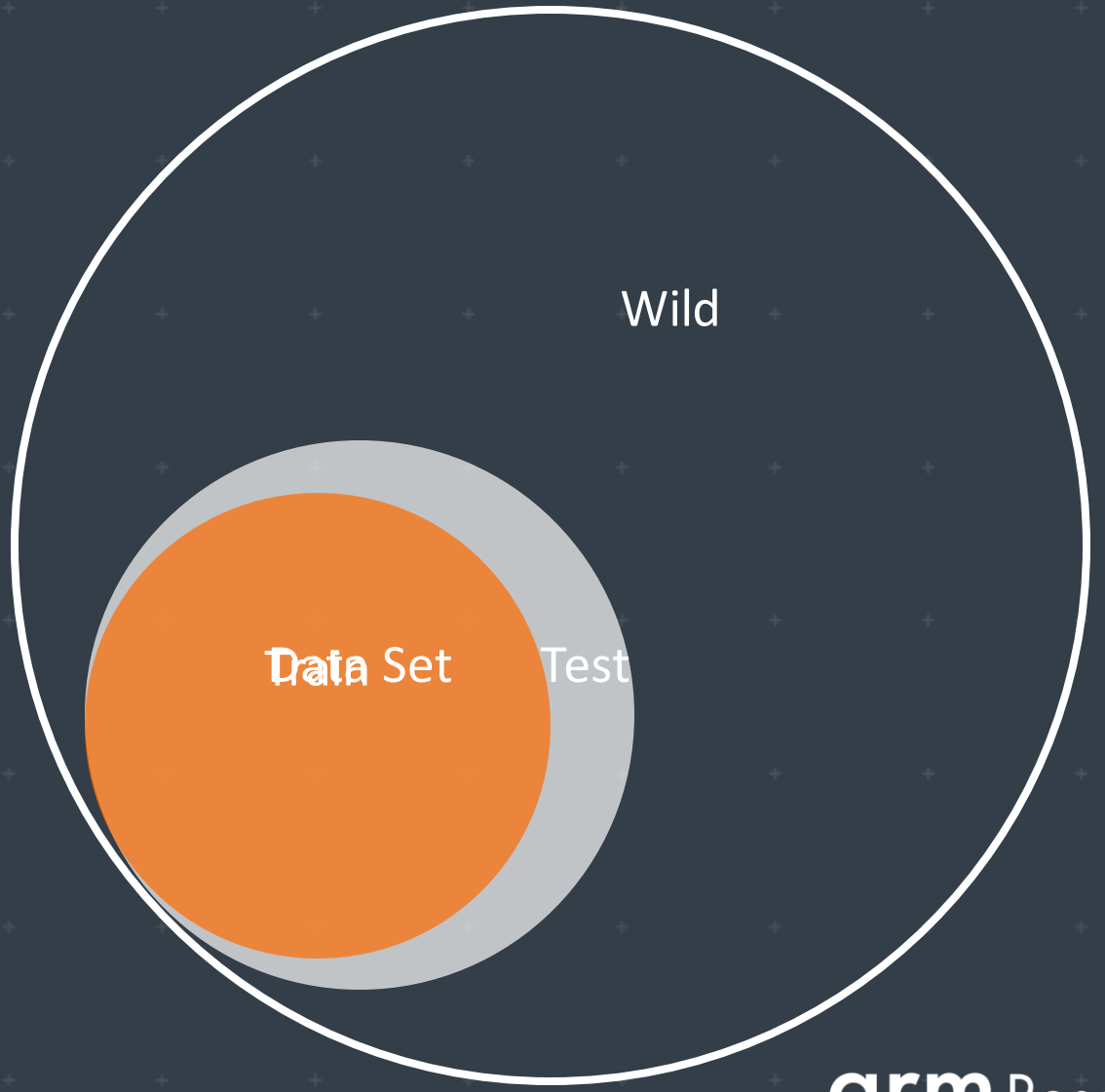
Requirements of Policy and Regulation

Ethical Responsibility

Risk Mitigation

- Biased Training Data
- Data Leakage

- Model performance dependent on training data
- Model doesn't necessarily translate to the wild



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Scientific Discovery

Stakeholder Trust

Risk Mitigation

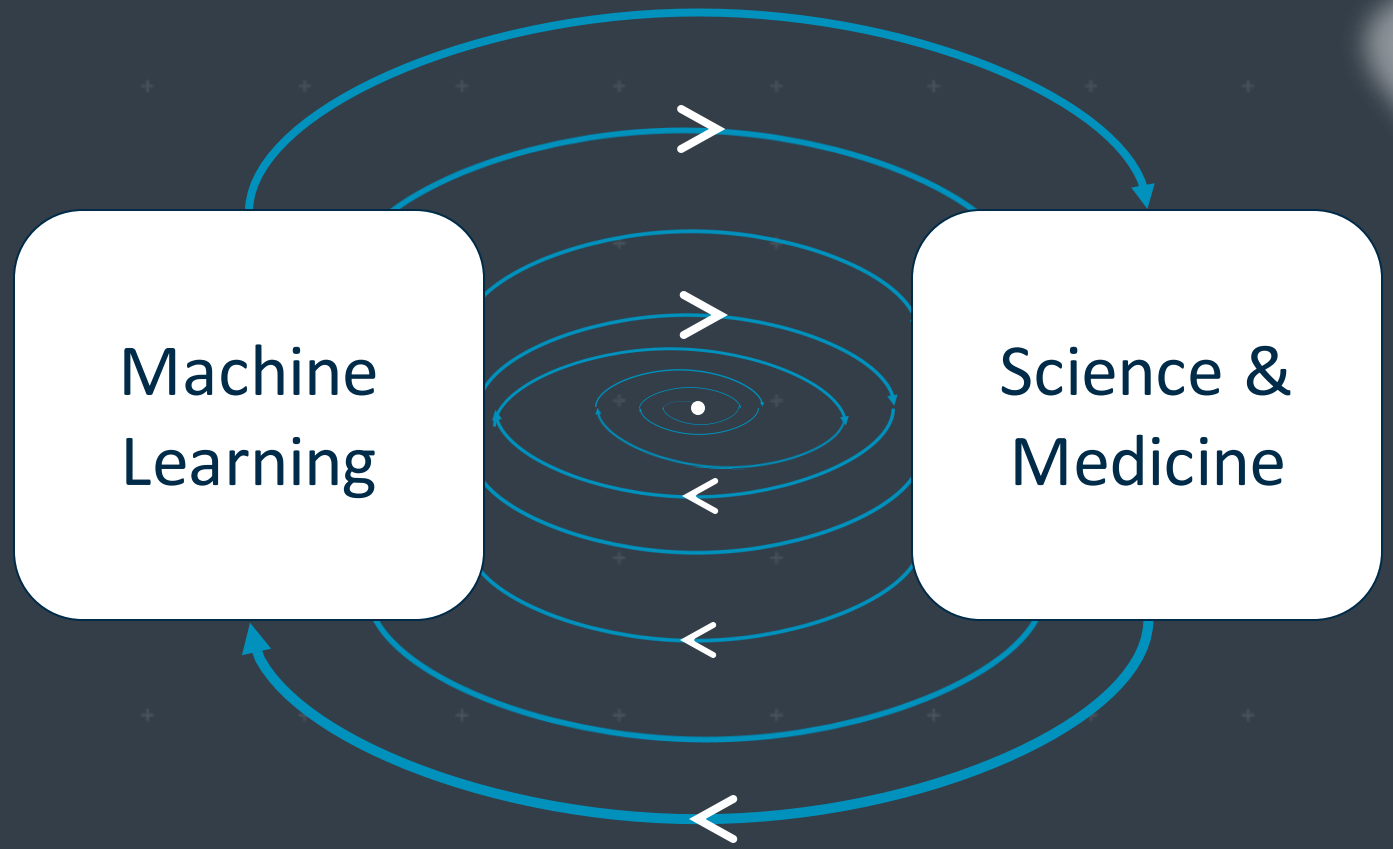
Scientific Discovery

Requirements of Policy and Regulation

Ethical Responsibility

Machine Learning Accelerating Scientific Discovery

Accelerating Returns



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Policy and Regulation

Stakeholder Trust

Risk Mitigation

Scientific Discovery

Requirements of Policy and Regulation

Ethical Responsibility

Policy and Regulation

- FDA and AI
  - SaMD: Software as a Medical Device
  - Allowing for modifications from real-world learning and adaptation, while still ensuring safety and effectiveness

- GDPR (EU General Data Protection Regulation) and AI
  - What constitutes personal data?
  - Simplified requests for consent + easy withdrawal (Right to Erasure)
  - Article 22, Recital 71: Right to an Explanation
    - Rights related to automated decision-making including profiling

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Ethical Responsibility

Stakeholder Trust

Risk Mitigation

Scientific Discovery

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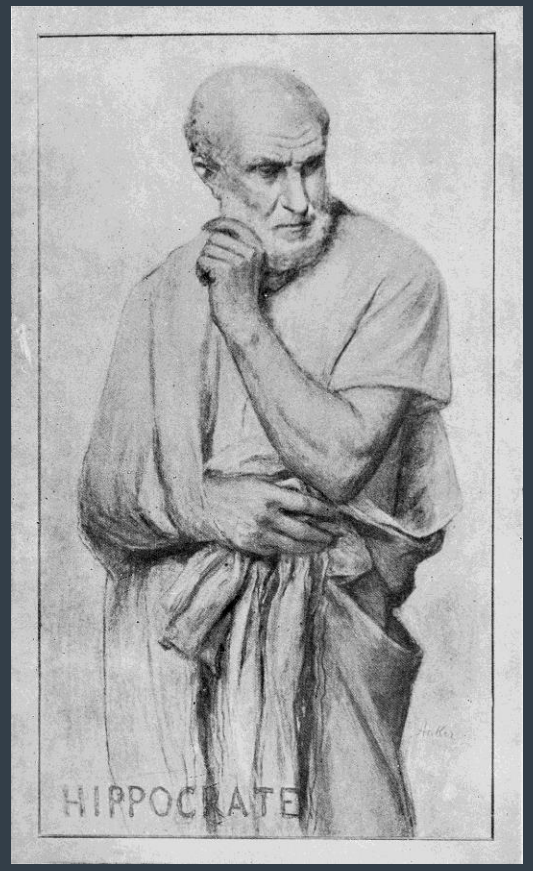
The Power of a Technologist

Engineers and Computer Scientists have more power to affect human life than doctors



"primum non nocere"

- "I will not be ashamed to say 'I know not'"
- "I will respect the privacy of my patients, for their problems are not disclosed to me that the world may know."
- "I will remember that I remain a member of society, with special obligations to all my fellow human beings."

Ethics education needed at the undergraduate and graduate levels

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Researcher Responsibilities

- Assume that anything you publish will get used in a different situation
  - Provide the components such that it is less likely to be used incorrectly
  - Explain the bounds of good model performance, all assumptions, and potential points of failure

- Ethical responsibility to shine light on the holes in your work

Fighting “publish or perish” mentality

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Biotech-Specific Ethical Problems

Multi-generational opt-in?

Cost of technology limits availability

Individual's opt-in choices are tied to an education level that we are not meeting

Ability to create societal-level consensus

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Thank You
Danke
Merci
谢谢
ありがとう
Gracias
Kiitos
감사합니다
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