2019 IMAGING INFORMATICS SUMMIT

SESSION 5: Ethical, Robust, and Valuable Data and AI

Raym Geis – Ethics of AI in radiology

Daniel Rubin – Developing robust AI

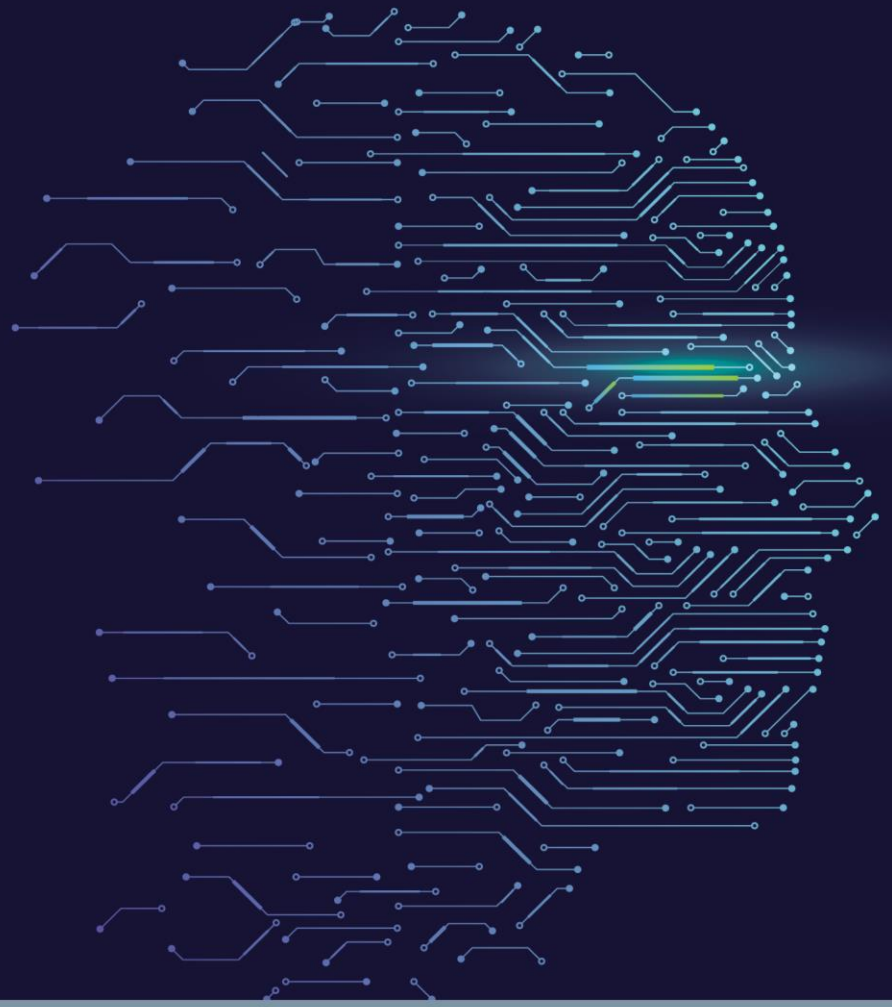
Juan Battle – Data sharing

Wende Gibbs – Building good data for AI

ACR® American College of Radiology

WASHINGTON

2019 IMAGING INFORMATICS SUMMIT



Ethics of AI in Radiology

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ACR® American College of Radiology

WASHINGTON

Disclosures

- Investor and advisor, Innosphere [startup incubator]
  - ACR DSI
  - Chair, SIIM liaison committee – interface with other specialties, academic engineering and CS departments, and international societies
  - NJH does machine learning for respiratory disease

Computer Vision Machine Learning (CVML)

- Image classification – category A, B, C…
- Object detection
- Segmentation
- Object tracking

Ethics of AI in Radiology: European and North American Multisociety Statement

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ESR
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RSNA®

AAPM
AMERICAN ASSOCIATION of PHYSICISTS IN MEDICINE

EuSoMII

CAR
Canadian Association of Radiologists
L'Association canadienne des radiologistes

SIIM
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Marc Kohli

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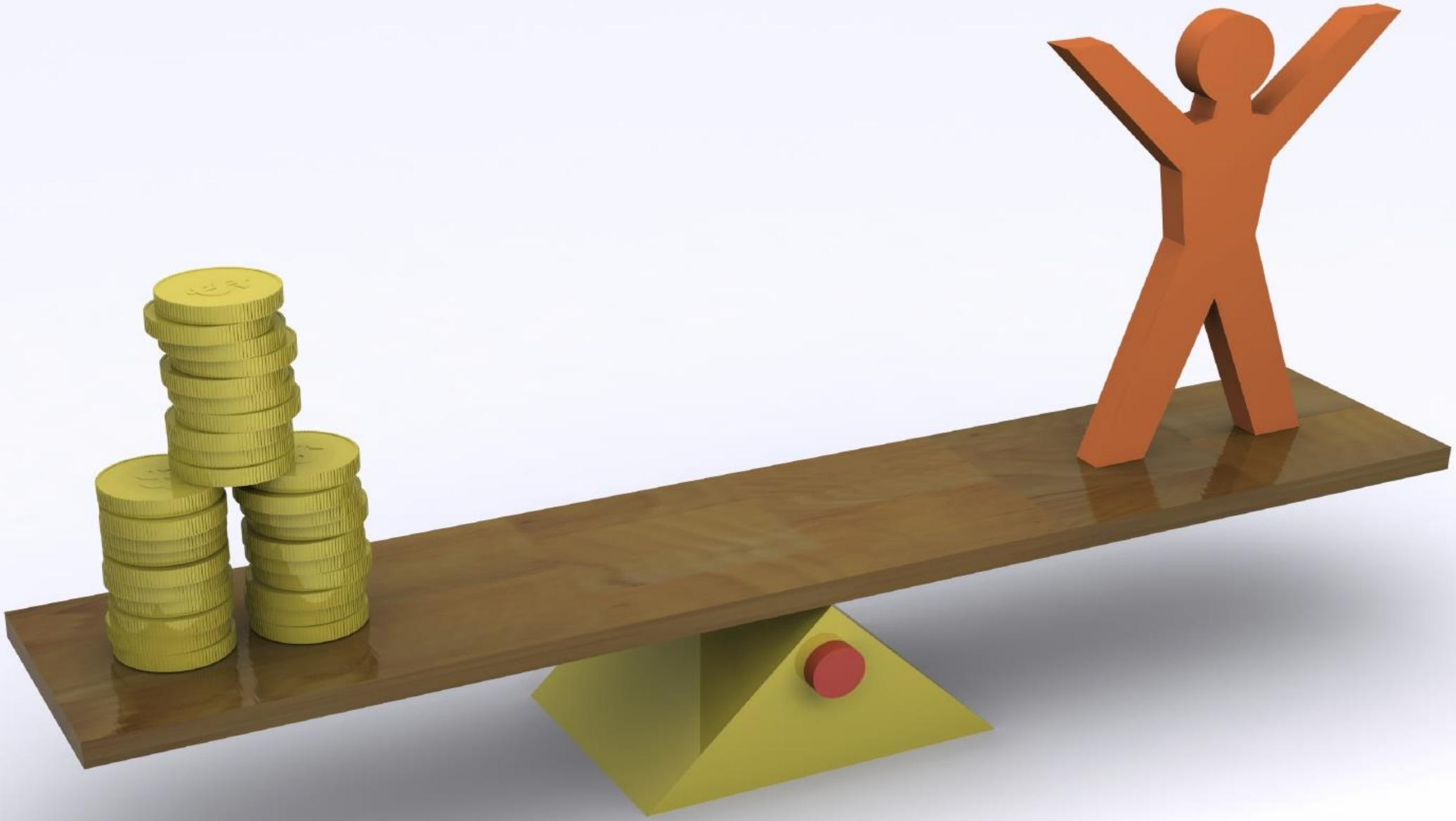
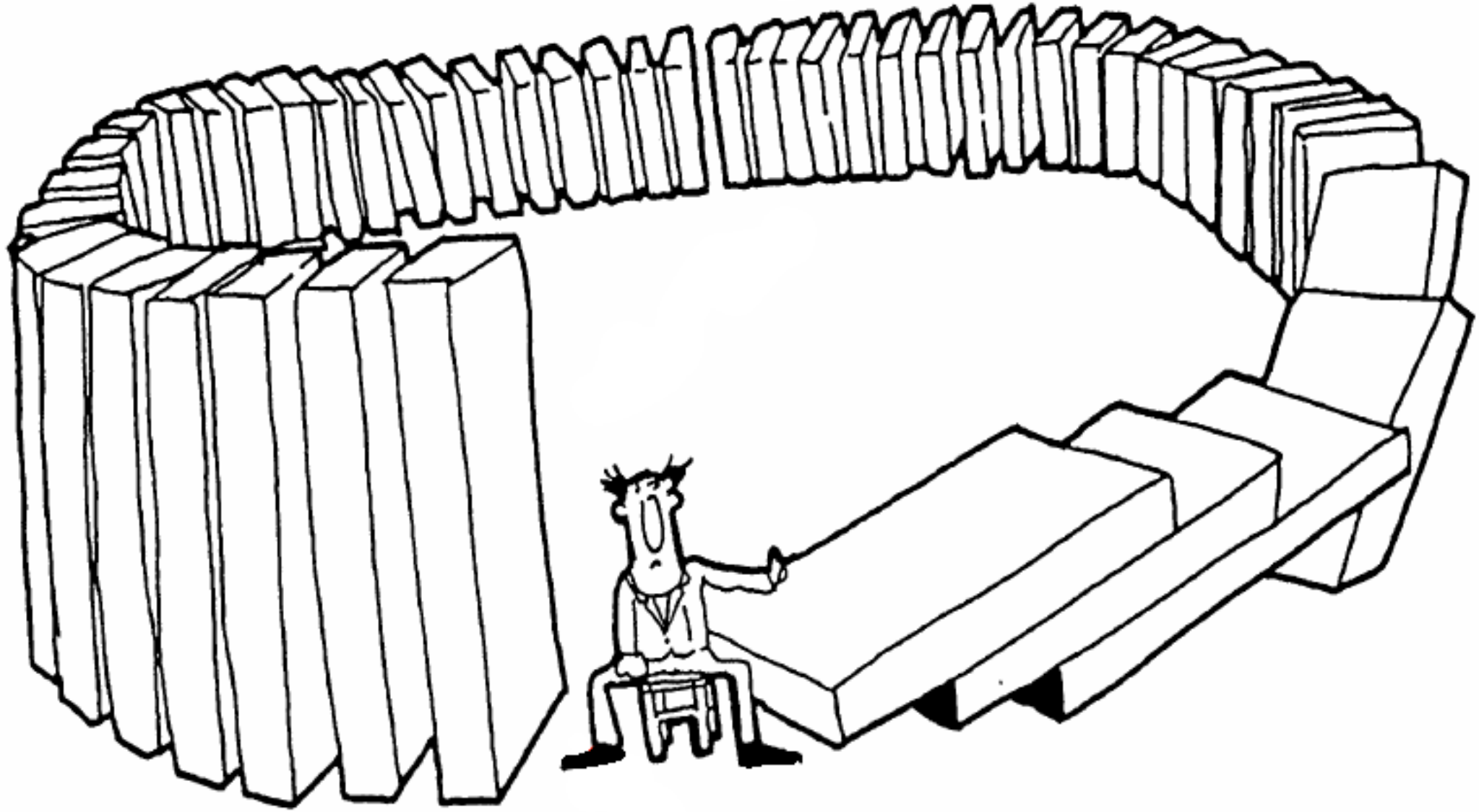
Specialization and Bridges

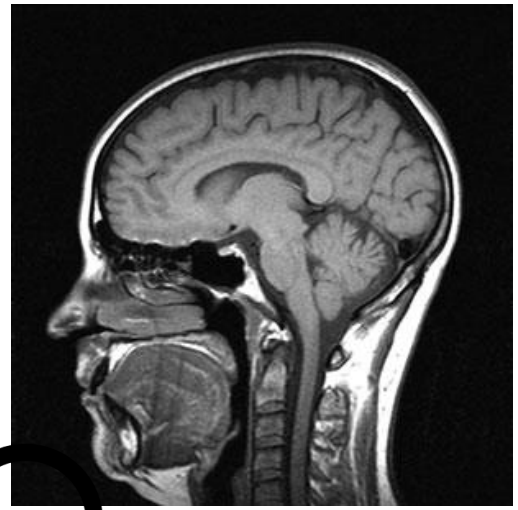
Our community has a moral duty to make radiology AI worthy of patients' trust

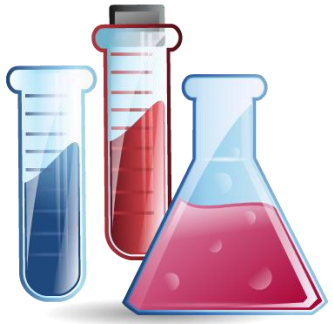




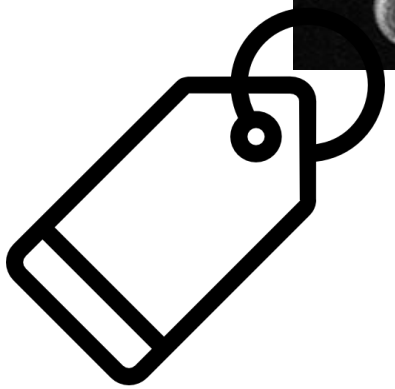
Data Algorithms Practice

We have a moral duty to make radiology data most useful to the patients from whom we collected it.

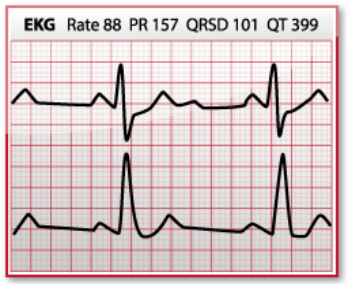


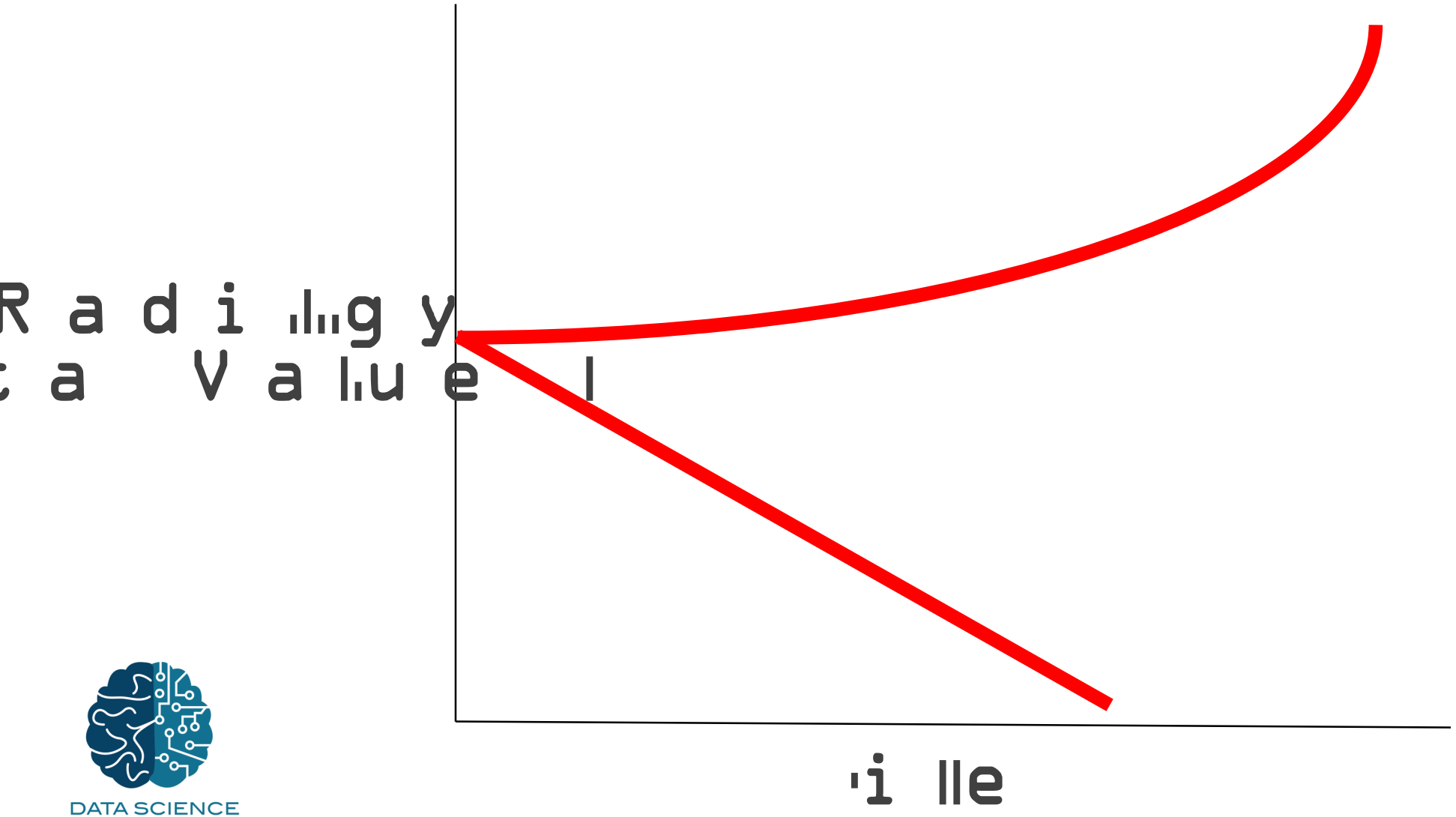



Restricted
Access




2019


EKG Rate 88 PR 157 QRSD 101 QT 399



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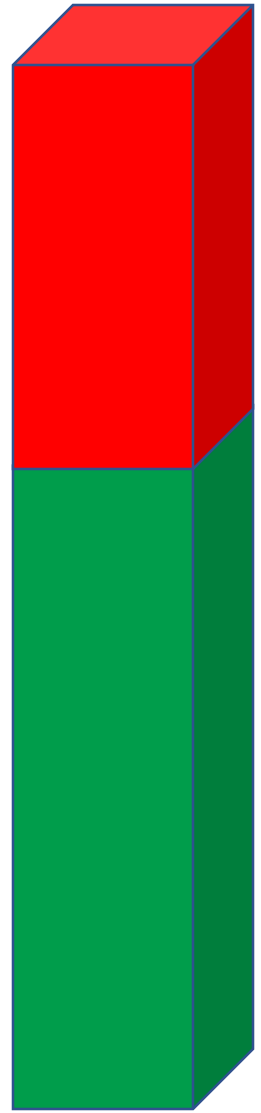
Maximize barriers to obtaining value from unethical data use and AI

Maximize value from ethical data use and AI



Considerations for Data Use Agreements

- Data use for:
  - One well defined use case
  - Defined time period
- Data should not be:
  - Used for anything else
  - Made visible, or otherwise made available, to anyone else for any reason
- All variations of original data, including augmented or synthetic data, falls under the same rules as the original data
- Any data acquired or generated about the institution, including data obtained about any radiologist or other employee, shall not be shared with anyone unless explicitly specified.

Implicit (Unintended) Bias

Appearance

Marital Status

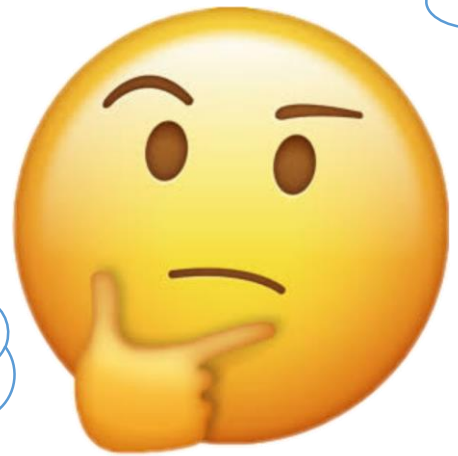
Upbringing

Physical Ability

Race

Gender

Physical Attributes



Education

Ethnicity

Confounding Attributes - Comorbities

Age

Sexual Orientation

Culture

Parental Status

Environment

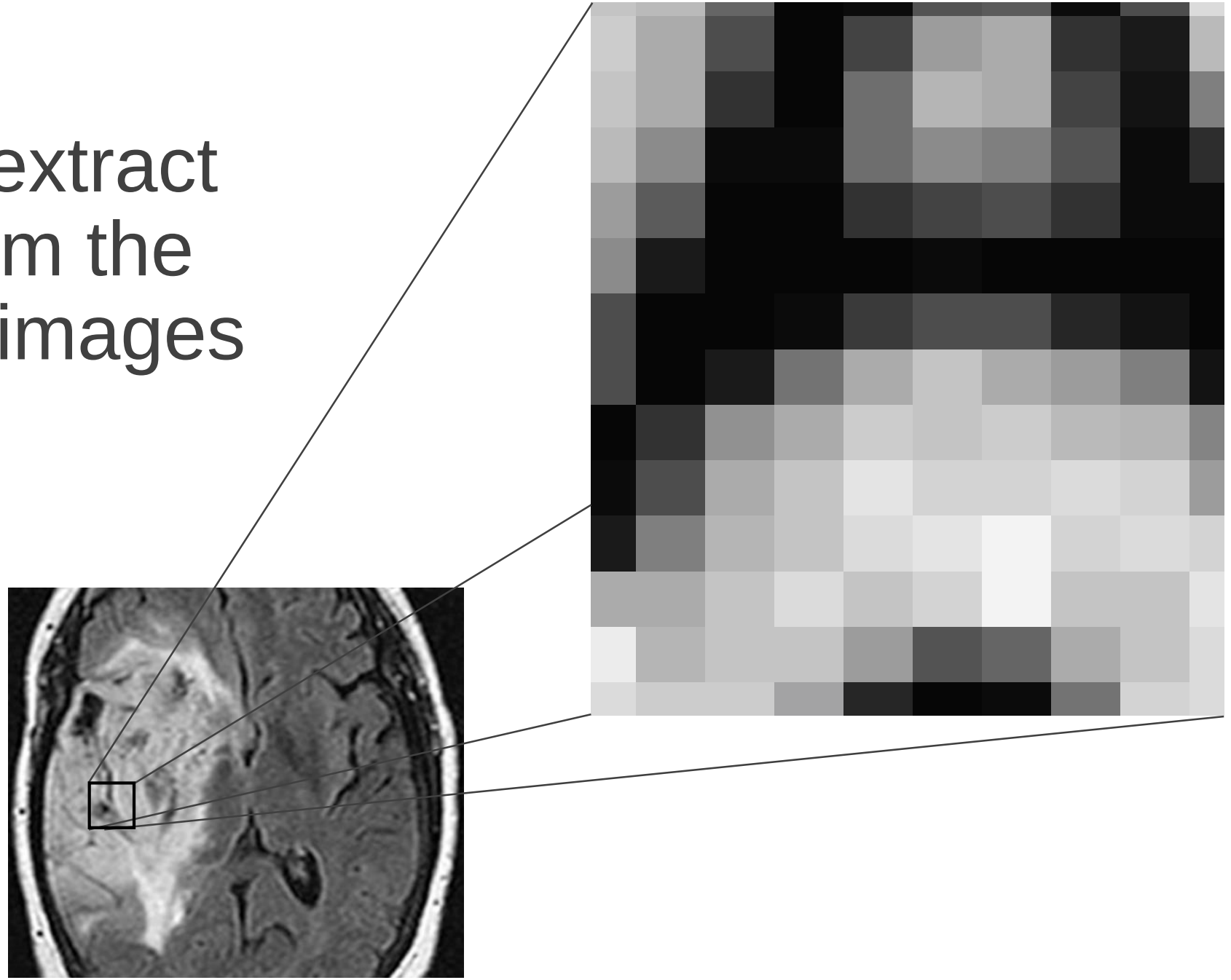
Dataset shift

Location

Religion

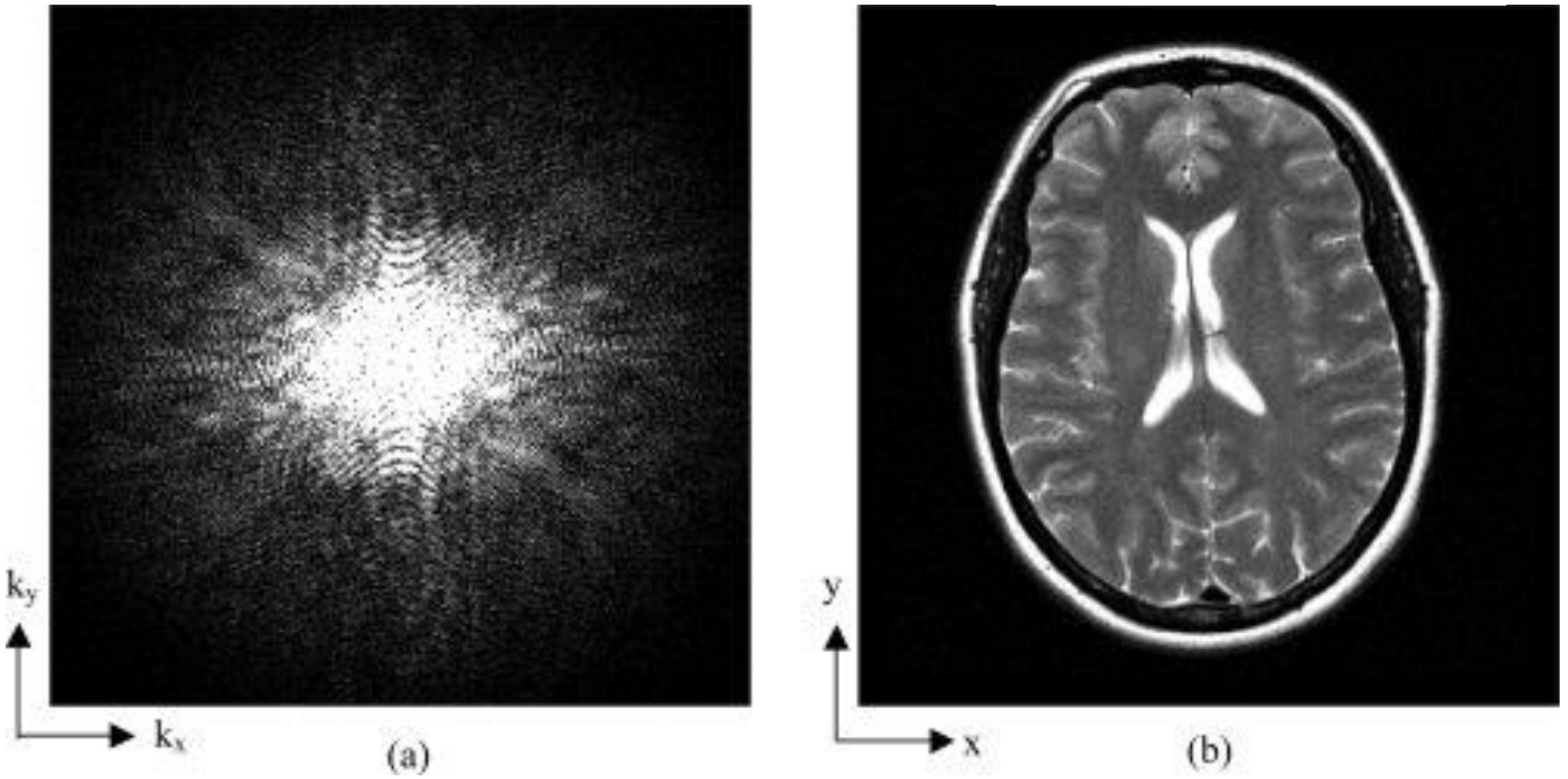
Dataset Shift

Computers extract features from the pixel data of images



Dataset Shift

- Covariate shift– different input pixel patterns



- Concept drift – input data change over time

Ethics of Data

- How to notify patients about how their data are used?
- How much privacy is enough, and how to achieve it?
- Data versioning infrastructure?
- How and by whom are labels generated?
- What bias exists in the data used to train and test algorithms?
- What are risks of those biases?
- Are labels appropriate to the clinical use case?

Codes of Conduct and Regulation

- Guide data use
  - Ownership
  - Patients' roles in use of their data
  - Guardrails for data use agreements
    - Very tightly defined data use and reuse
- Description of bias and potential risks

Ethics of Algorithms

Human+Machine

Automated deep learning design for medical image classification by health-care professionals with no coding experience: a feasibility study

Livia Faes, Siegfried K Wagner*, Dun Jack Fu, Xiaoxuan Liu, Edward Korot, Joseph R Ledsam, Trevor Back, Reena Chopra, Nikolas Pontikos, Christoph Kern, Gabriella Moraes, Martin K Schmid, Dawn Sim, Konstantinos Balaskas, Lucas M Bachmann, Alastair K Denniston, Pearse A Keane*

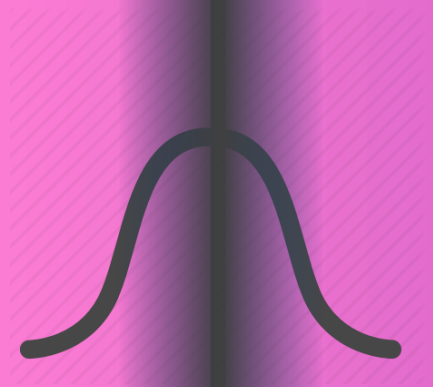
Summary

Background Deep learning has the potential to transform health care; however, substantial expertise is required to train such models. We sought to evaluate the utility of automated deep learning software to develop medical image diagnostic classifiers by health-care professionals with no coding—and no deep learning—expertise.

Faes L et al. Lancet Digital Health 2019; 1:e232-42

Prototype

- Greek - πρωτότυπον (prototypon), "primitive form”
- “an early…model…of a product built to *test* a concept...”
- “…used to *evaluate* a new design…”
- Prototype ≠ production quality



Categories are discrete
Humanity often isn’t

Consistency

Domain Sense

Generalizability

Algorithm Transparency and Explainability

Fairness

Model Components

Fidelity

Performance

Ethics of Algorithms

- How does our AI makes predictions?
- How to protect against malicious attacks?
- How to evaluate AI for clinical effectiveness, ethical behavior, and security?
- How to monitor AI in clinical workflow to ensure they perform as predicted and performance doesn’t degrade over time?

Codes of Conduct and Regulation

- Algorithms – trust but verify
  - Verify that algorithms work clinically as expected
    - For all patient groups
  - Dealing with specific adversarial and rare/aberrant/unexpected cases
    - “I don’t know” (this case has significantly atypical features)

Ethics of Practice

Ethics of Practice

- Is what we do with AI helping patients?
- What are the risks of an AI tool, and what level of human oversight is necessary to mitigate risks?
- What education and skills are needed?
- How to continuously and actively monitor AI in clinical practice?
- How to monitor the impact (outcomes, privacy, and unintended discrimination) of AI on patients and providers?
- What guardrails for when, or when not, to implement AI?

AI's promise and risk – where to devote resources

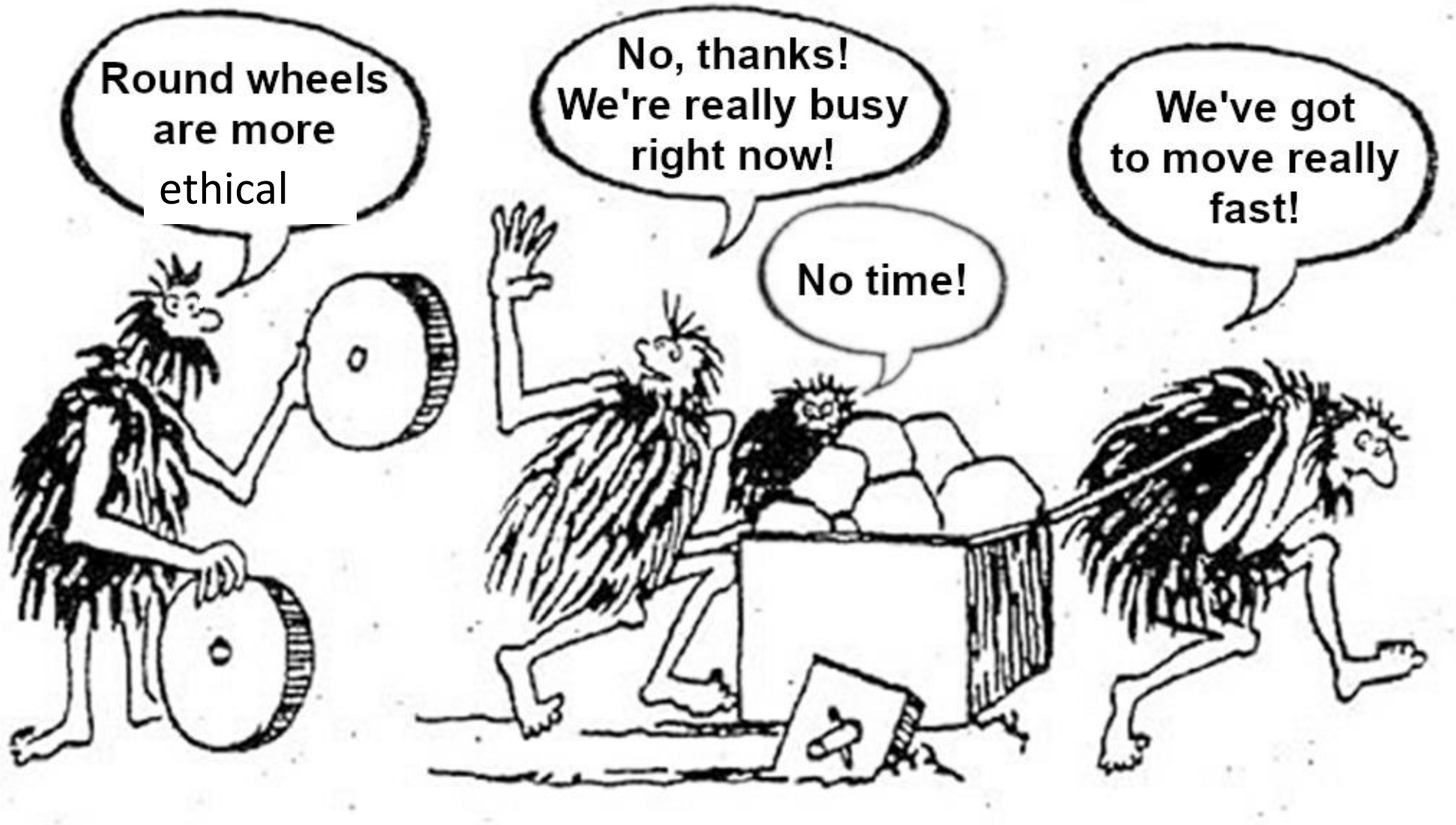
- Discover patterns in complex data
  - AI vs 2 human eyes
  - AI vs current technology

- Do current things better/faster/cheaper
- Discover *new patterns* in data
  - Benefits and risks of finding new patterns

Distribute benefits and harms equally

- AI to predict no shows: If high probability of no-show
  - Send Uber
  - Double book scanner

Technical Debt



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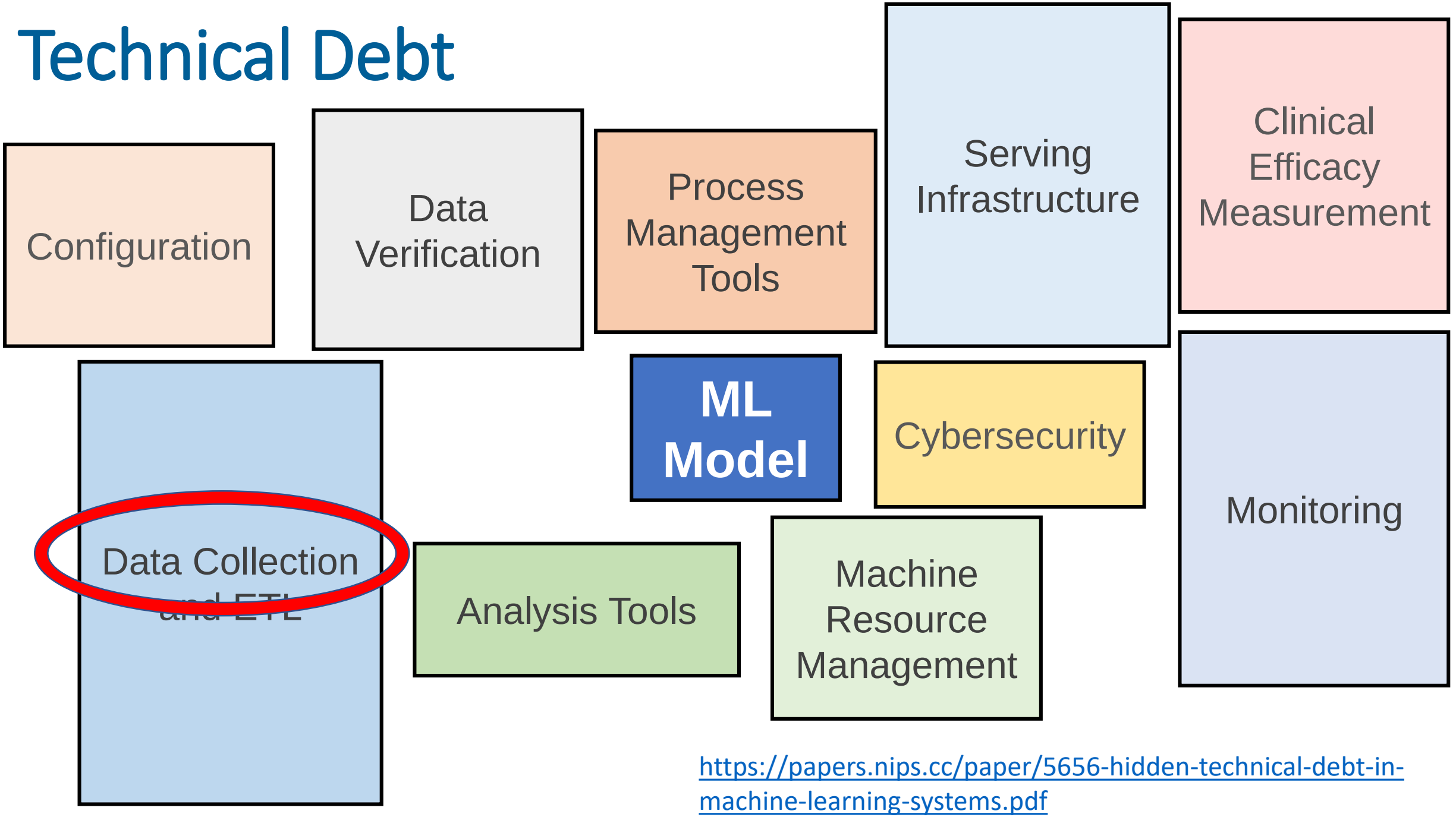
Technical Debt



https://papers.nips.cc/paper/5656-hidden-technical-debt-in-machine-learning-systems.pdf


737 MAX
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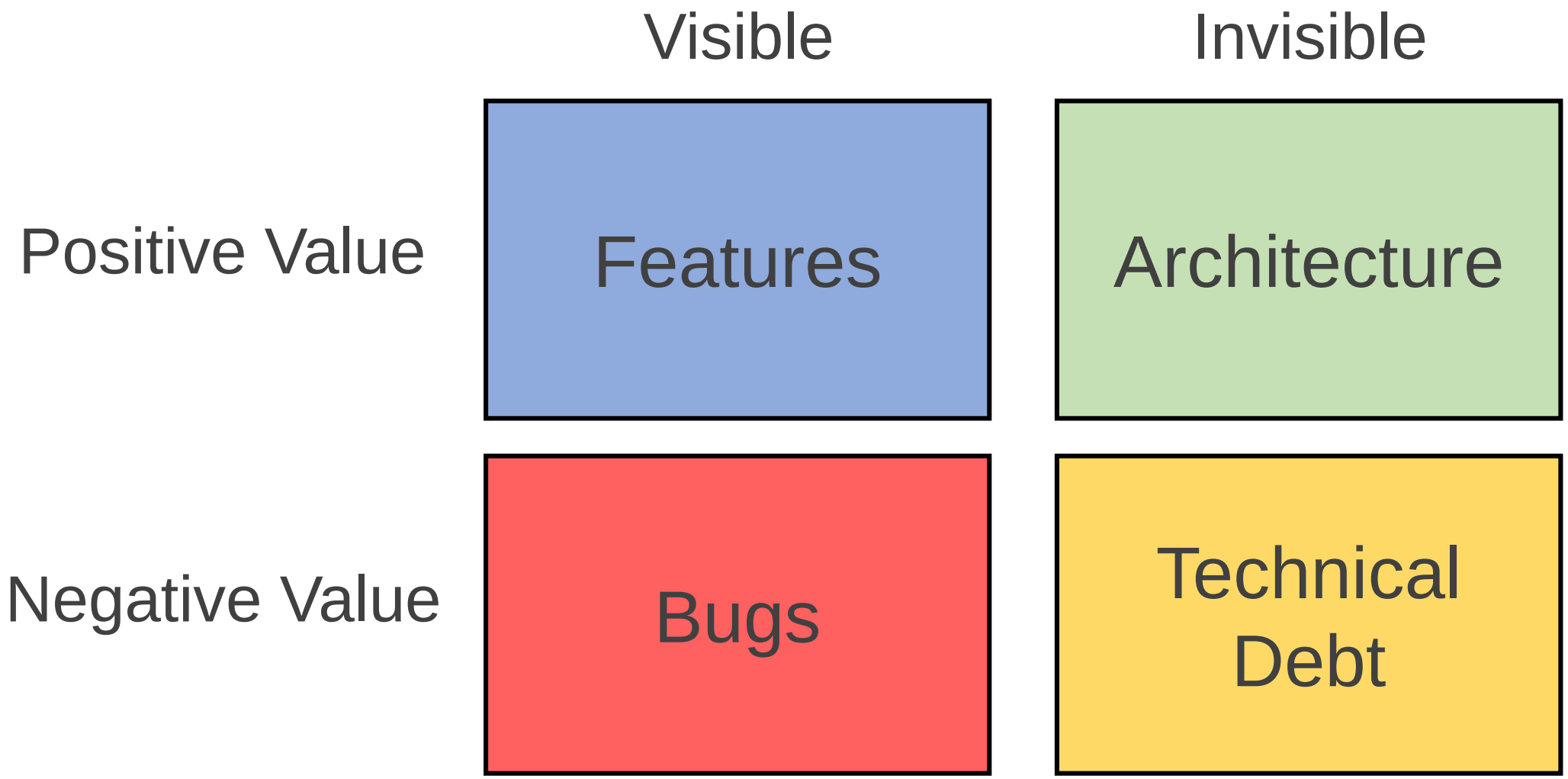
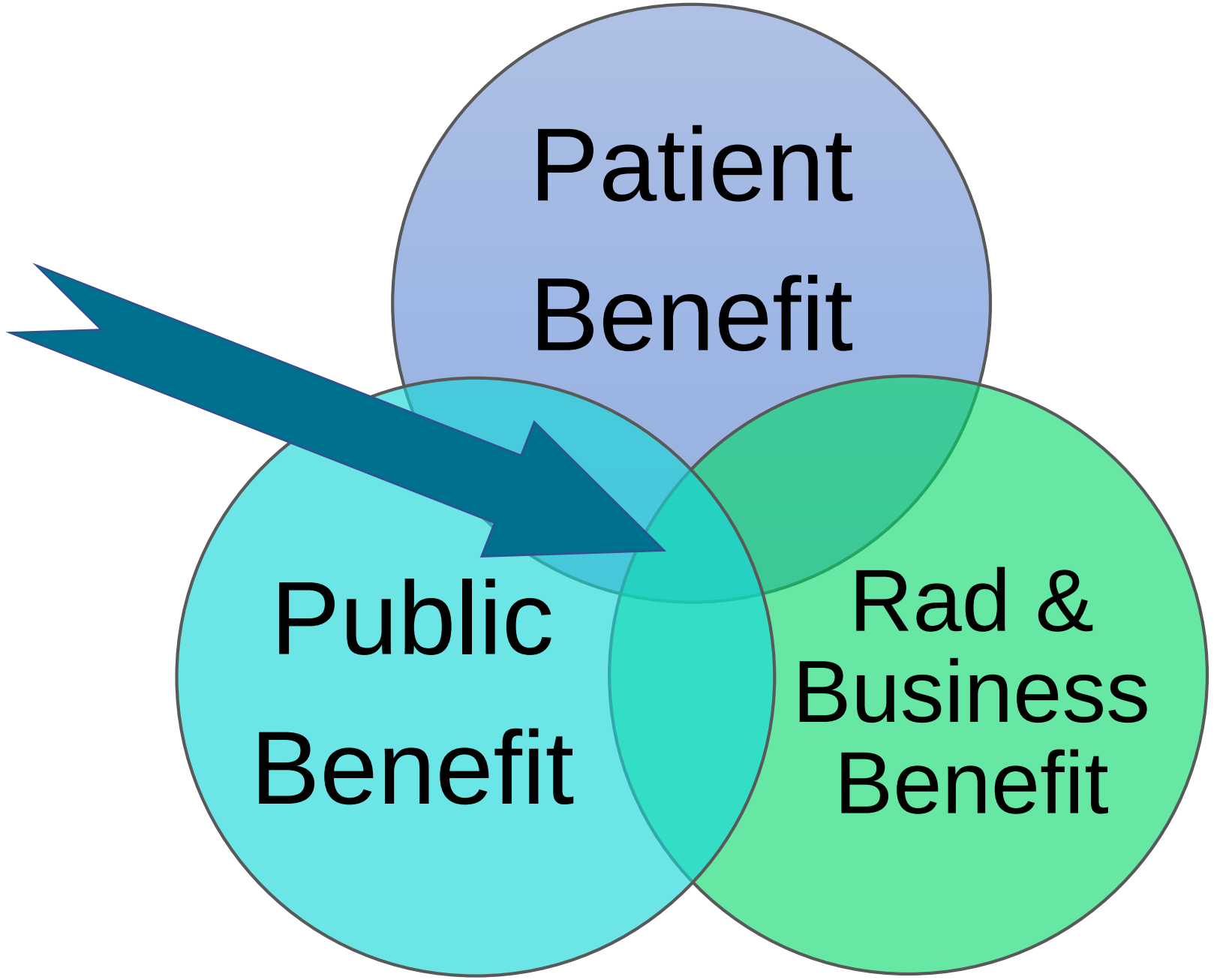
Manage Technical Debt Appropriately




Patient
Benefit
Public
Benefit
Rad &
Business
Benefit

Good science is flourishing as never before, though it moves cautiously and slowly, its insights checked by continual self-testing and experimentation…

…only science, aided by human decency, common sense, farsightedness, and concern for the unfortunate and poor, offers the world any hope.

--- Oliver Sacks