Artificial Intelligence in Clinical Practice – A Primer

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Outline

What is Artificial Intelligence?

How can AI help in clinical practice?

The lifecycle of an AI project

What is ethical AI?

Leading successful AI projects

Learning Objectives

Recognize	Recognize artificial intelligence as a type of outcome that is distinct from the methods that are used to achieve it.
List	List examples of how AI methods have been applied in nursing care.
Describe	Describe the role of the nurse informaticist in leading successful AI projects.

What is artificial intelligence?

The Dartmouth Summer Research Project of 1956

"The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve the kinds of problems now reserved for humans, and improve themselves."

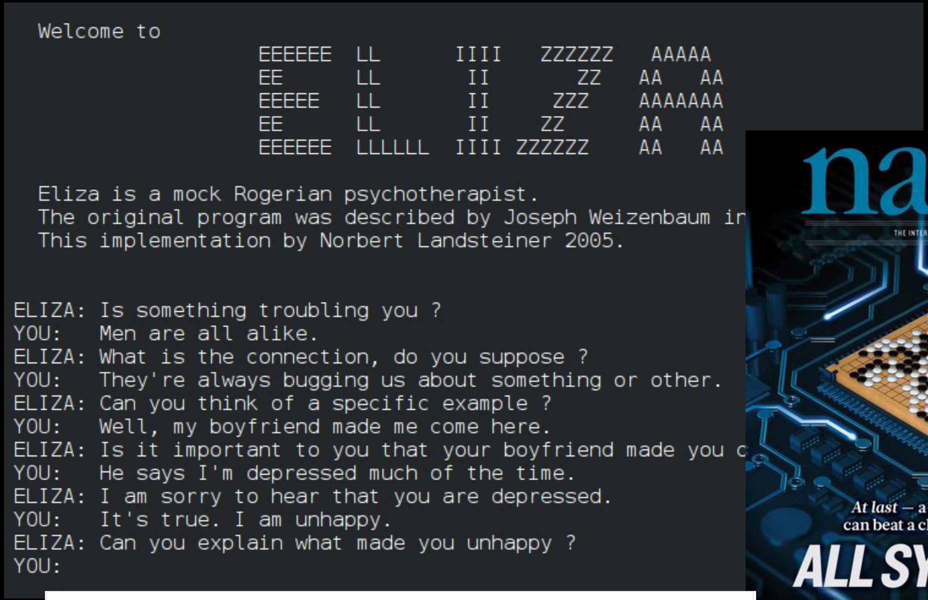
- *John McCarthy, Marvin L. Minsky Nathaniel Rochester, and Claude E. Shannon*

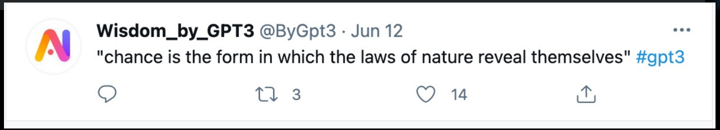
AI is an **outcome (i.e., a simulation of human abilities)** that does not specify a means, other than that it is achieved by a computational machine.

A “Turing Test”, attributed to computer scientist Alan Turing, is a test of a computer’s ability to imitate human intelligent behavior.

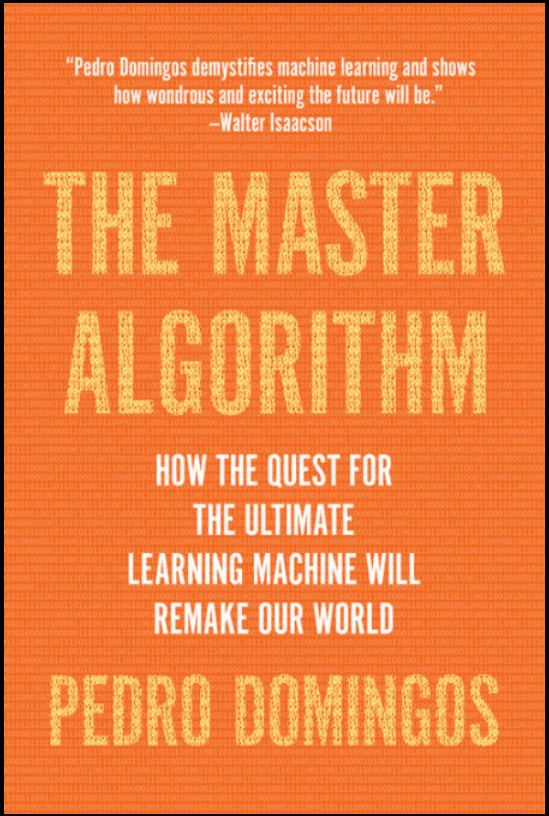
General AI

ELIZA, Deep Blue, Watson, AlphaGo, GPT-3



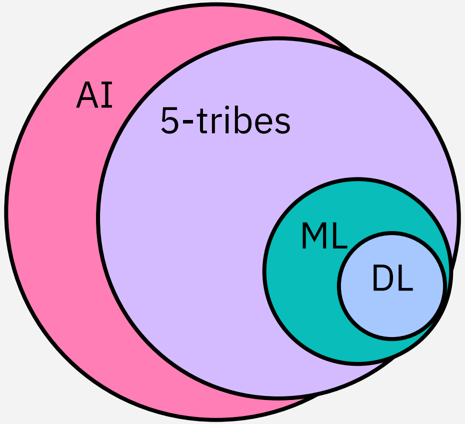


The Master Algorithm



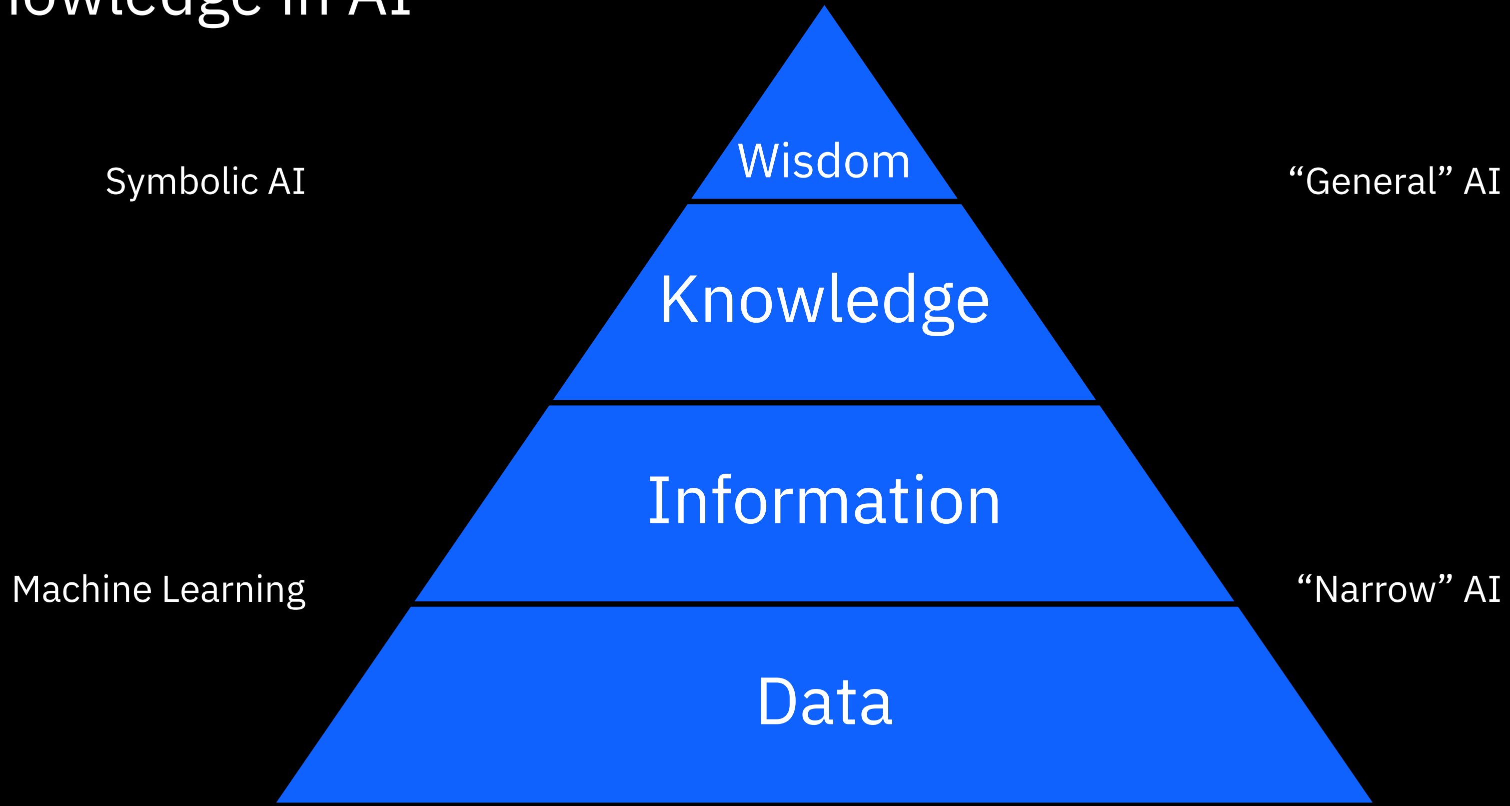
5 Tribes for inferring knowledge:

1. Symbolists → logic
2. Bayesians → probability
3. Evolutionaries → trial and error
4. Connectionists → neural networks
5. Analogizers → similarity



ML – Machine Learning
DL – Deep Learning

The role of data and knowledge in AI



How can AI help in clinical practice?

Potential areas to apply AI methods in healthcare

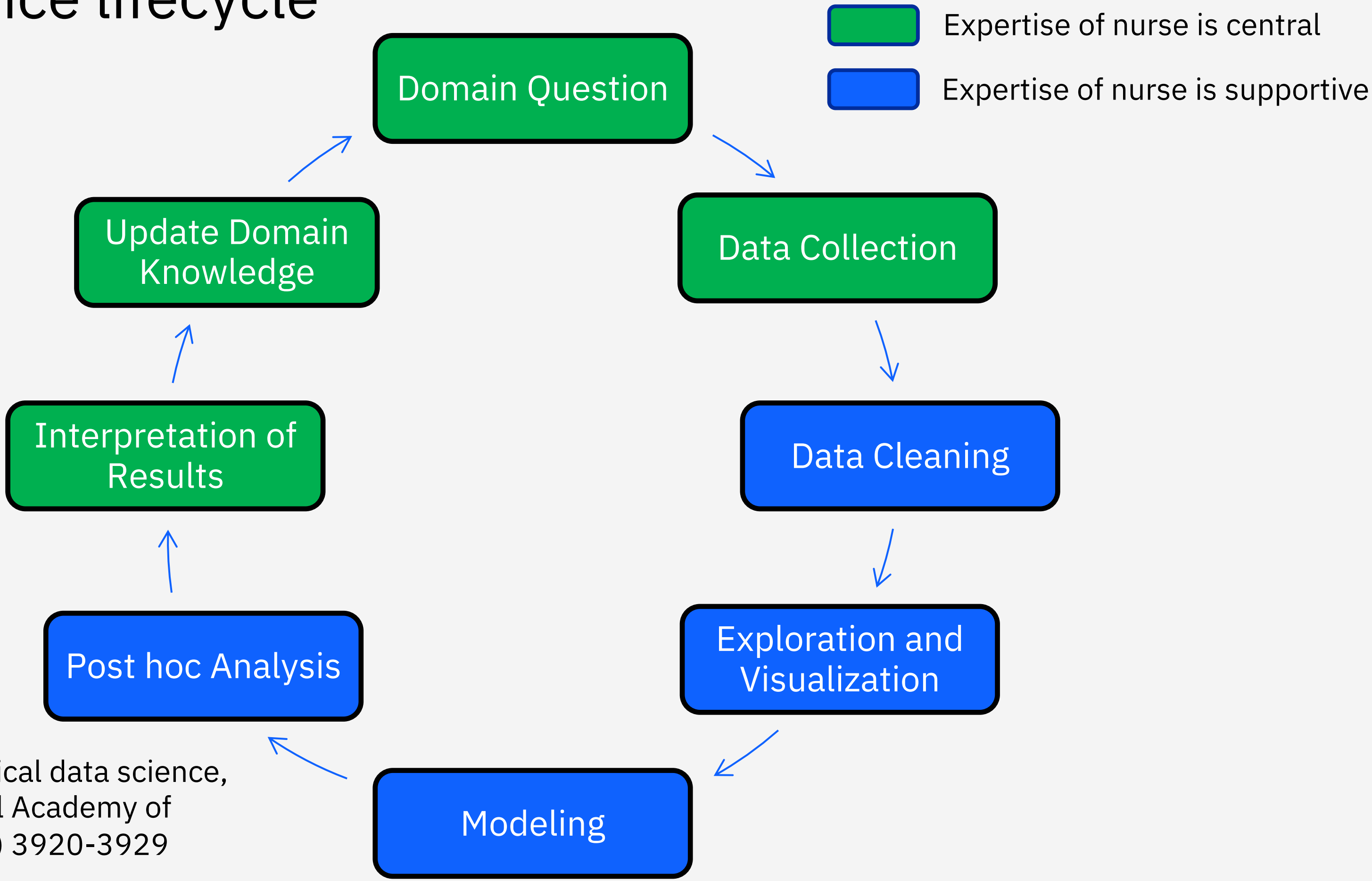
Application area	General	Nursing Care
Diagnosis & Treatment	Cancer diagnosis Precision medicine Drug repurposing Risk prediction Clinical trial matching	Assessing risk of decompensation, sepsis, readmission Home care Care management Skin and wound integrity Identify non-verbal cues for pain Monitor breathing patterns
Patient engagement	Non-adherence prediction Digital phenotyping	Health coaching Digital behavior change interventions
Administration	Claims processing and adjudication Clinical documentation Prescription refills Appointment scheduling Integration of fragmented records	Nursing staff scheduling Nurse-patient assignments Retrieval of nursing policies

Sources:

- Davenport T, Kalakota R. The potential for artificial intelligence in healthcare. Future Healthc J. 2019;6(2):94-98.
- Buchanan C, Howitt ML, Wilson R, Booth RG, Risling T, Bamford M. Predicted Influences of Artificial Intelligence on the Domains of Nursing: Scoping Review. JMIR Nursing 2020;3(1):e23939
- https://consultqd.clevelandclinic.org/how-artificial-intelligence-is-partnering-with-nursing-to-provide-care/
- http://maryland.ccproject.com/2017/01/29/%EF%BF%BCrothman-beyond-the-early-warning-score-the-rothman-index/

The lifecyle of an AI project

The data science lifecycle



Adapted from:
Bin Yu, Karl Kumbier, Veridical data science, Proceedings of the National Academy of Sciences Feb 2020, 117 (8) 3920-3929

(Supervised) Machine Learning Pipeline

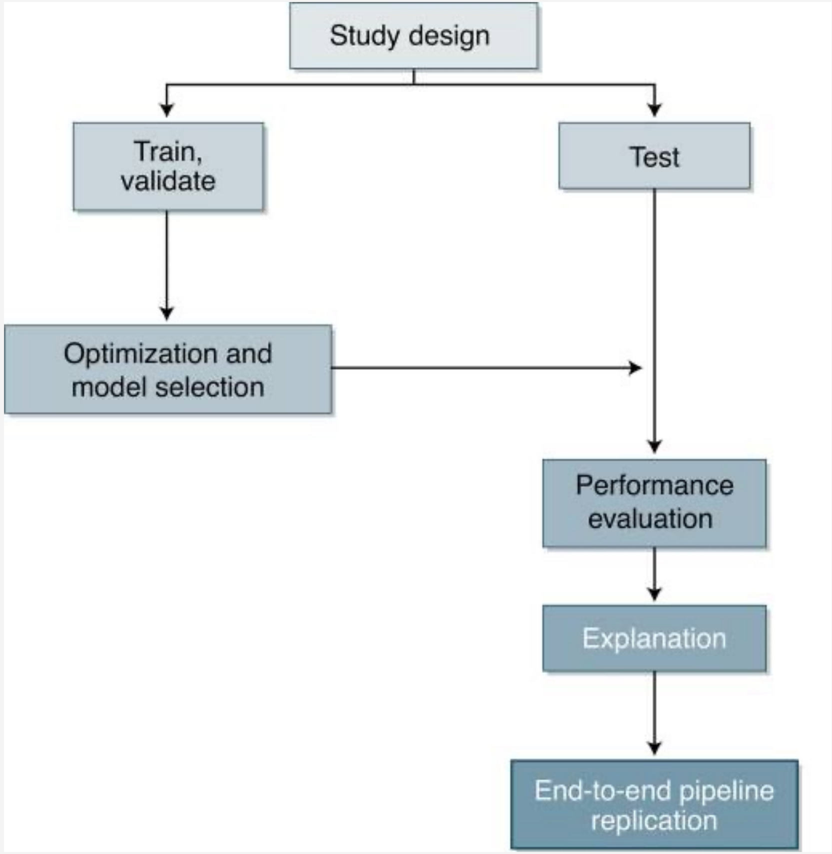


Image Source: Norgeot B, Quer G, Beaulieu-Jones BK, et al. Minimum information about clinical artificial intelligence modeling: the MI-CLAIM checklist. *Nat Med*. 2020;26(9):1320-1324. doi:10.1038/s41591-020-1041-y

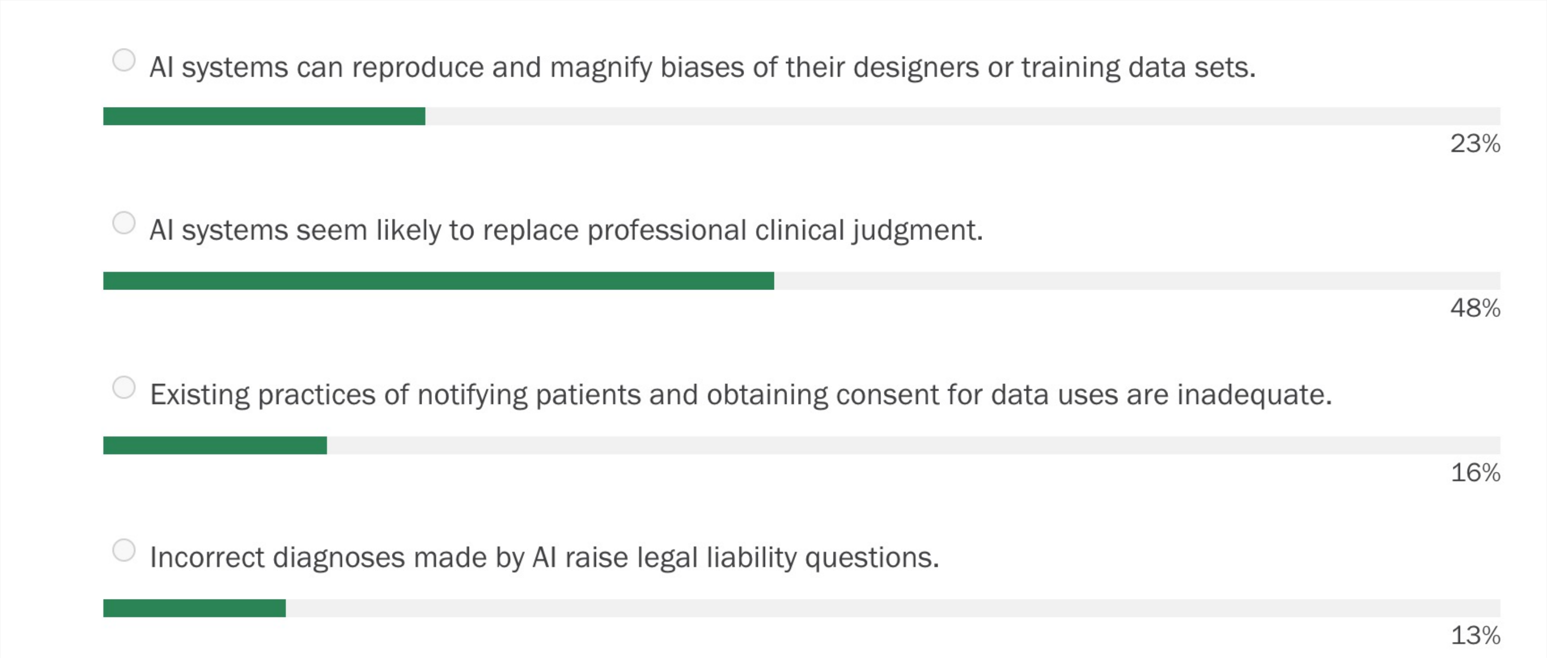
The nurse as subject-matter-expert: Questions for nurse leaders to ask about potential AI/CDS tools

DIKW Level	Question
Data	What data are used in the AI/CDS tool? How are data captured? Does the data capture fit into the existing clinical workflow? Is there an appropriate life cycle plan for the CDS?
Information	Does the AI/CDS information take into account the clinical context? Does the information produced make clinical sense and have clinical relevance?
Knowledge	Does the AI/CDS help solve a clinical problem? What were the examples used to teach the model? Does the CDS fit nursing processes?
Wisdom	Is the AI/CDS augmenting or taking over decision-making? Is the AI explainable to the clinician? Is the required short- and long-term training in place?

Source: Cato, Kenrick, McGrow, Kathleen, Rossetti, Sarah Collins. Transforming clinical data into wisdom, Nursing Management (Springhouse): November 2020 - Volume 51 - Issue 11 - p 24-30

What is ethical AI?

What is <u>not</u> one of the most prominent challenges for incorporating AI into health care?



Sources:
https://journalofethics.ama-assn.org/issue/artificial-intelligence-health-care
Crigger, E. and Khoury, C. AMA J Ethics. 2019;21(2):E188-191.

Fairness

"It is impossible to satisfy some of the fairness constraints at once except in highly constrained special cases."

N. Mehrabi, F. Morstatter, N. Saxena, K. Lerman and A. Galstyan, A survey on bias and fairness in machine learning, Sep. 2019, [online] Available: http://www.arXiv:1908.09635.

Categories of Fairness Measures

- **Individual Fairness**
  - Fairness through unawareness
  - Fairness through awareness
  - Counterfactual fairness
- **Group Fairness**
  - Demographic parity
  - Conditional statistical parity
  - Equalized odds
  - Equal opportunity
- **Subgroup Fairness**

Sources of Bias

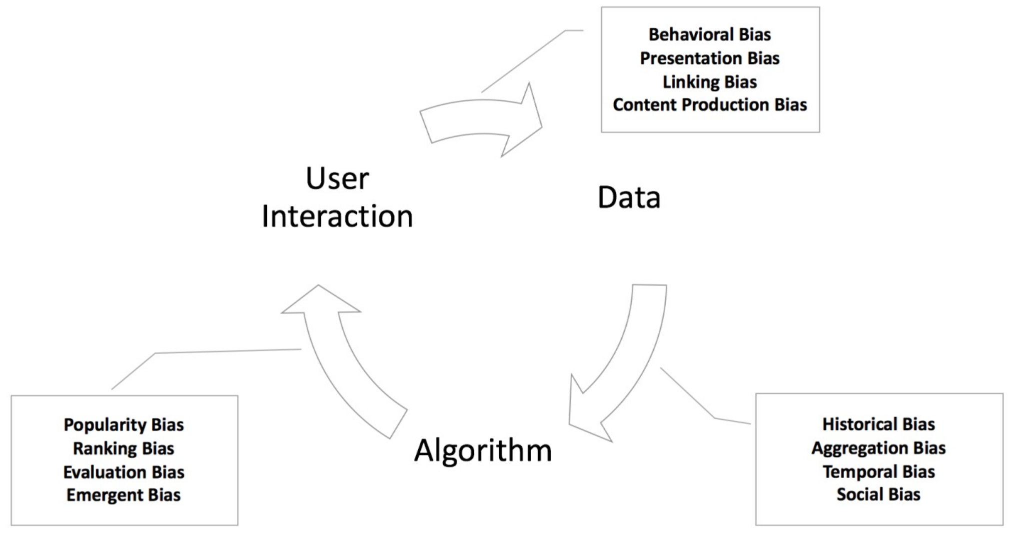


Fig. 2. Bias definitions in the data, algorithm, and user interaction feedback loop are placed on their most appropriate arrows.

Image source: N. Mehrabi, F. Morstatter, N. Saxena, K. Lerman and A. Galstyan, A survey on bias and fairness in machine learning, Sep. 2019, [online] Available: http://www.arXiv:1908.09635.

Leading successful AI projects

Focus on the hope, not the hype

*Source: Special National Academy of Medicine (NAM) publication titled: “Artificial Intelligence in Healthcare: The Hope, The Hype, The Promise, The Peril.”

- The translation of new knowledge into the practice of health care delivery has always had its challenges.
- While the adoption of AI in healthcare is still limited, now is absolutely the time to be pushing the frontier of how AI methods can impact health and health care.
- The pipeline of R&D in AI and Healthcare is very rich and increasingly appreciative of the limitations of existing methods with respect to delivering clinically meaningful insights.
- However, focusing only on the AI itself is not sufficient*
  - Clinician and patient engagement
  - Data quality and access
  - Workflow integration
  - Workforce education
  - Oversight and regulation
  - Problem prioritization

Nurses as co-inventors of the future of AI in health care

- Now is absolutely the right time for nurses to lead both successful AND unsuccessful AI projects.

- A confident nursing perspective on the prioritization of investments in R&D and pilot program, based on first-hand experience, will provide valuable input to policymakers, providers, payors, businesses, and educators.

"Strong and proactive nursing leadership in all roles, sectors, and domains will be required to effectively implement these technologies in ways that preserve person-centered compassionate care. The new and evolving nursing care delivery models that are envisioned will require strong leadership from nurse executives, who will play a significant leadership role in identifying the requisite competencies for direct care providers who will be using AIHTs in practice."

Buchanan et al., 2020

Thank you.

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