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Intelligence, the elusive concept and general capability still not found in machines

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"*Together with sensors and learning management systems, Artificial Intelligence (AI) can give teachers a real sense of how different students learn differently, where students get interested and where they get bored, where they advance and where they get stuck. Technology can help adapt learning to different student needs and give learners greater ownership over what they learn, how they learn, where they learn and when they learn. […] And of course, AI is helping assessment and exams make big leaps, whether these are assessments through simulations, hands-on assessments in vocational settings, or machine-learning algorithms scoring essays.*"

Andreas Schleicher, Director, OECD Directorate for Education and Skills, commenting the *OECD Digital Education Outlook 2021*
https://oecdedutoday.com/how-radically-reimagine-teaching-learning-digital-technology/

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The reality of AI in education is looking very different...

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Cheating allegations engulf Dartmouth medical school

By Laura Krantz Globe Staff, Updated April 15, 2021, 6:52 p.m.

Administration, faculty! Typical case of anthropomorphism, a window to lack of accountability

The e-mail accused her — and, she later learned, more than a dozen other students — of cheating by accessing online course materials while taking a test on a different software platform. The school said that it had electronic evidence of misconduct, and that she was invited to make a brief statement defending herself at a tribunal to be held over Zoom in a week.

https://www.bostonglobe.com/2021/04/15/metro/cheating-allegations-chill-students-dartmouth-medical-school/

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A couple of months later...

Victory! Dartmouth Ends Unfounded Cheating Investigation After Students, Rights Groups Speak Out

DEEPLINKS BLOG

BY **JASON KELLEY**
JUNE 10, 2021

https://www.eff.org/deeplinks/2021/06/dartmouth-ends-misguided-investigation-after-students-rights-groups-speak-out

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Online proctoring, one among many!

- **Highly intrusive surveillance machinery**; Corporations' interests-driven
- **Lack of AI literacy**; educational institutions buy everything they are told
- Psychology, Sociology, Education experts **not involved**
- Identifies "suspicious" behaviours; "detects" fraud ⇒ **Inaccurate**; no extensive research comparing to human experience
- Privacy (data use and sharing **without students or parents' consent**)
- **No opt-out**; no alternative examination mechanisms
- **Zero** transparency; **blurry or no** accountability; **no** explainability
- **Discrimination** (e.g. students with special conditions), etc.

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RESEARCH ARTICLE

Check for updates

Good Proctor or "Big Brother"? Ethics of Online Exam Supervision Technologies

Simon Coghlan[1,2] · Tim Miller[1,2] · Jeannie Paterson[2,3]

https://link.springer.com/epdf/10.1007/s13347-021-00476-1

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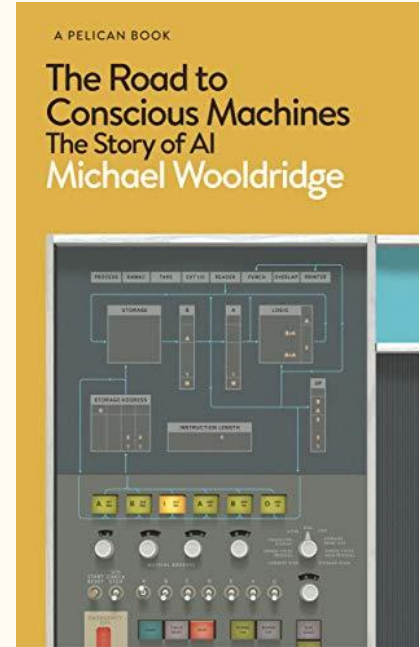
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The future of AI in education is bright, but we need to pay careful attention to *how*, *for what*, and *for whom* AI is used.

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The grand dream and the reality of AI

> "*The **long-term dream of AI** is to build machines that have the full range of capabilities for intelligent actions that people have—to build machines that are self-aware, conscious and autonomous in the same way that people like you and me are. [...] **The reality of AI for the foreseeable future is very different** to the grand dream.*" (Wooldridge, 2020)

A PELICAN BOOK

The Road to
Conscious Machines
The Story of AI
Michael Wooldridge

Wooldridge, M. (2020). *The Road to Conscious Machines: The Story of AI.* UK: Pelican Random House.

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@dmonett

A (very) brief history of the scientific study of (machine) intelligence

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The scientific study of intelligence originated in the 1870s ...

... about 150 years ago.
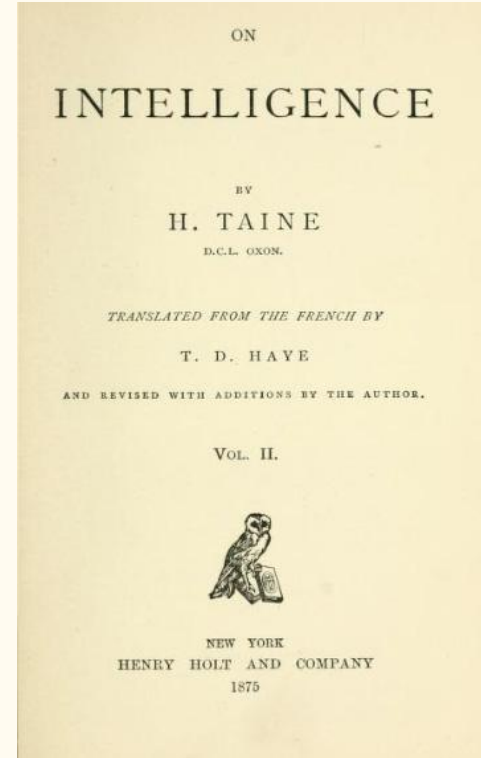
Long tradition in Psychology and related fields.

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First scientific definition of intelligence?

Hippolyte Adolphe Taine
(April 21, 1828 – March 5, 1893)

*"The **intelligent being**, animal or man, **supplies** its wants, **preserves** its life, **improves** its condition, only by the exact accordance of its present prevision and the near or even distant future"* (Taine 1875).

Taine, H. (1870). *De l' Intelligence*. Two volumes, Paris (engl. traduction by T. D. Have: 1875).

ON
INTELLIGENCE
BY
H. TAINE
D.C.L. OXON.

TRANSLATED FROM THE FRENCH BY
T. D. HAYE
AND REVISED WITH ADDITIONS BY THE AUTHOR.

VOL. II.

NEW YORK
HENRY HOLT AND COMPANY
1875

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Research in AI started in the 1950s

...

"*stimulated by the invention of modern computers. This inspired a flood of new ideas about **how machines could do what only minds had done previously***" (Minsky 1985)

Minsky, M. (1985). *The Society of Mind*. Simon and Schuster, New York.

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AI definition

"*[Intelligence is] the **ability to solve hard problems**"*
(Minsky 1985).

Minsky, M. (1985). *The Society of Mind*. Simon and Schuster, New York.

AI definition

*"**Artificial Intelligence** is . . . the **study of the computations** that make it possible to perceive, reason, and act"* (Winston 1992).

Winston, P. H. (1992). *Artificial Intelligence*. Third Edition, Addison-Wesley Publishing Company.

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Evolution of *perceive*, *reason*, and *act*[(*)]
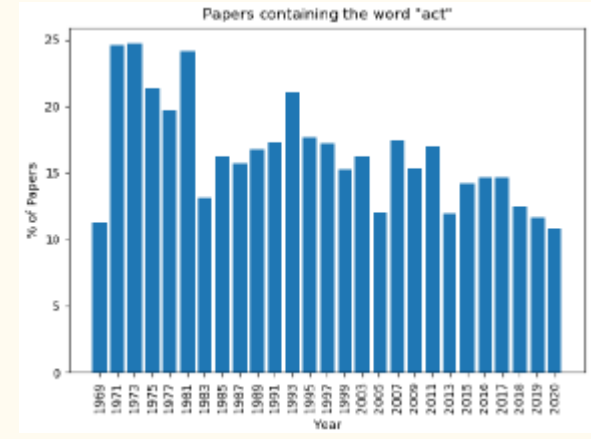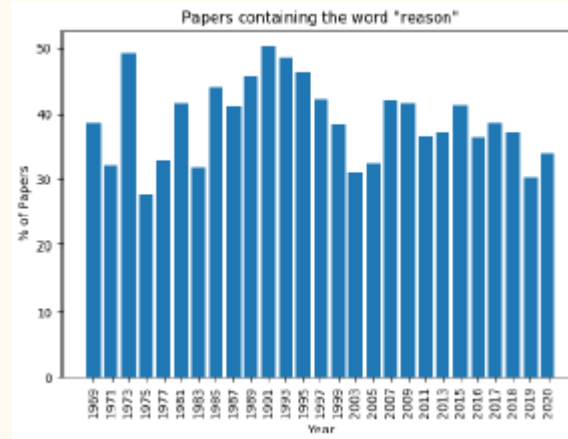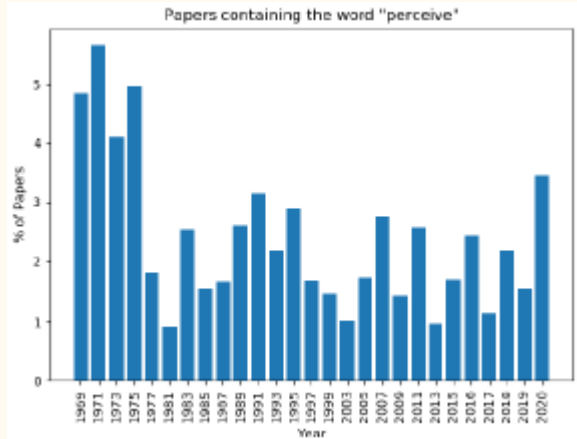
*: Examples of intelligence capabilities used in the texts of IJCAI papers (1997-2020).

Monett, D., **Lampe**, N., **Ehrlicher-Schmidt**, M., & **Bewer**, N. (2020). Intelligence Catalog-guided Tracking of the Evolution of (machine) Intelligence: Preliminary results. In Basile, P., Basile, V., Cabrio, E., & Croce, D. (eds.), Proceedings of the 4th Workshop on Natural Language for Artificial Intelligence, NL4AI 2020, 2735: 118-129, CEUR-WS, co-located with the 19th International Conference of the Italian Association for Artificial Intelligence, AIxIA 2020, November 25th-27th, 2020.

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A collection of 70+ definitions of intelligence.

Both of human and machine intelligence.

Legg, S. and **Hutter**, M. (2007a). A Collection of Definitions of Intelligence. In B. Goertzel and P. Wang (eds.), *Advances in Artificial General Intelligence: Concepts, Architectures and Algorithms*, 157:17-24, IOS Press, UK.

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No consensus, however.

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No consensus definition

*"There is **very great disagreement** concerning the concept of intelligence"* (Journal editors 1921).

*"[A] **substantial disagreement** on a single definition still abounds"* (Detterman 1986).

*"It is a testimony to the **immaturity of our field** that the question of what we mean when we talk about intelligence **still doesn't have a satisfying answer"*** (Chollet 2019)

Journal editors (1921). Intelligence and Its Measurement: A Symposium. *Journal of Educational Psychology*, Vol 12(3), 123-147.
Detterman, D. K. (1986). Qualitative Integration: The Last Word? In R. J. Sternberg and D. K. Detterman (eds.), *What is intelligence? Contemporary Viewpoints on its Nature and Definition*, pp. 163-166. Norwood, NJ: Ablex.
Chollet, F. (2019). *The Measure of Intelligence*. arXiv:1911.01547 [cs.AI].

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Why?

- Still no consensus definition(s) of (A)I
- Very polarized concept
- Interdisciplinarity, different contexts and applications

- Misleading news and hype around AI damaging the field
- Need to know the boundaries of the discourse

*"**The lack of specificity** allows journalists, entrepreneurs, and marketing departments to say virtually anything they want."* (Lipton, 2018)

http://approximatelycorrect.com/2018/06/05/ai-ml-ai-swirling-nomenclature-slurried-thought/

*"[T]he public knowledge and understanding on AI [...] is suffering from **a lack of transparency as to capabilities and thus impacts of AI**."* (Nemitz, 2018)

http://dx.doi.org/10.1098/rsta.2018.0089

*"[A] lack of clarity in terms of definitions and objectives seems to have plagued the [AI] field right back to its origins in the 1950s. This makes **tracing [its] evolution . . . a difficult task**."* (AI in the UK, 2018, p. 156)

https://publications.parliament.uk/pa/ld201719/ldselect/ldai/100/100.pdf

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AGISI Survey *Defining (machine) Intelligence*

24.7.2017—25.7.**2019**   **57+**   **184+**

9x**2** definitions of (human/machine) intelligence to agree upon

567 responses

4,128 opinions
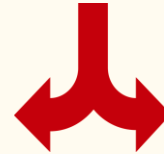
343 new, suggested definitions

Academia (*N*=452, **79.7%**)
Industry (*N*=116, **20.5%**)

Researchers (*N*=435, **76.7%**)
Educators (*N*=197, **34.7%**)
Developers, Engineers (*N*=90, **15.9%**)

Results as per closing the survey

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Findings: Cognitive biases undermine consensus on defining (machine) intelligence

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E.g.: Respondents tended to place too much importance on some words and overlooked others.

Focalism - The tendency to place too much importance on one aspect of an event (Kahneman et al., 2006)

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Most commented and second less accepted definition of machine intelligence

"*Intelligence is concerned mainly with rational action. Ideally, an intelligent agent takes the best possible action in a situation.*"

(Russell & Norvig, 2010)

"*Intelligence is concerned mainly with* **rational** *action. Ideally, an intelligent agent takes the* **best** *possible action in a situation.*"

"*Intelligence is concerned* **mainly** *with* **rational** *action.* **Ideally***, an intelligent agent takes the* **best** *possible action in a situation.*"

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What *is* AI actually, where are we now, and what is missing?

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On wishful mnemonics

McDermott, D. (1976). Artificial Intelligence meets Natural Stupidity. SIGART Newsletter 57:4-9, April 1976.

(h/t Melanie Mitchell)

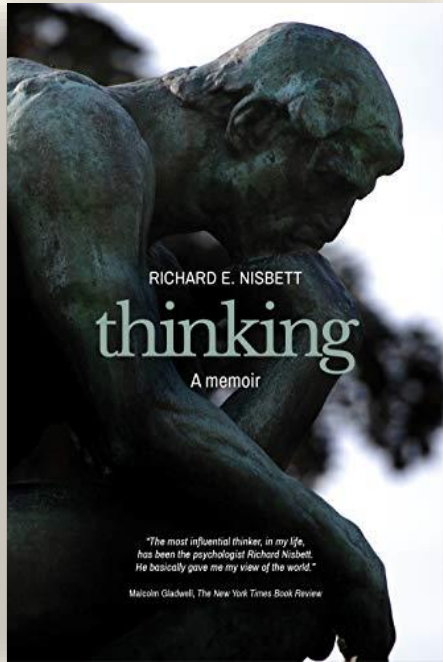## ARTIFICIAL INTELLIGENCE MEETS NATURAL STUPIDITY
Drew McDermott

MIT AI Lab   Cambridge, Mass 02139

As a field, artificial intelligence has always been on the border of respectability, and therefore on the border of crackpottery. Many critics <Dreyfus, 1972>, <Lighthill, 1973> have urged that we are over the border. We have been very defensive toward this charge, drawing ourselves up with dignity when it is made and folding the cloak of Science about us. On the other hand, in private, we have been justifiably proud of our willingness to explore weird ideas, because pursuing them is the only way to make progress.

Unfortunately, the necessity for speculation has combined with the culture of the hacker in computer science <Weizenbaum, 1975> to cripple our self-discipline. In a young field, self-discipline is not necessarily a virtue, but we are not getting any younger. In the past few years, our tolerance of sloppy thinking has led us to repeat many mistakes over and over. If we are to retain any credibility, this should stop.

This paper is an effort to ridicule some of these mistakes. Almost everyone I know should find himself the target at some point or other; if you don't, you are encouraged to write up your own favorite fault. The three described here I suffer from myself. I hope self-ridicule will be a complete catharsis, but I doubt it. Bad tendencies can be very deep-rooted. Remember, though, if we can't criticize ourselves, someone else will save us the trouble.

Acknowledgment-- I thank the AI Lab Playroom crowd for constructive play.
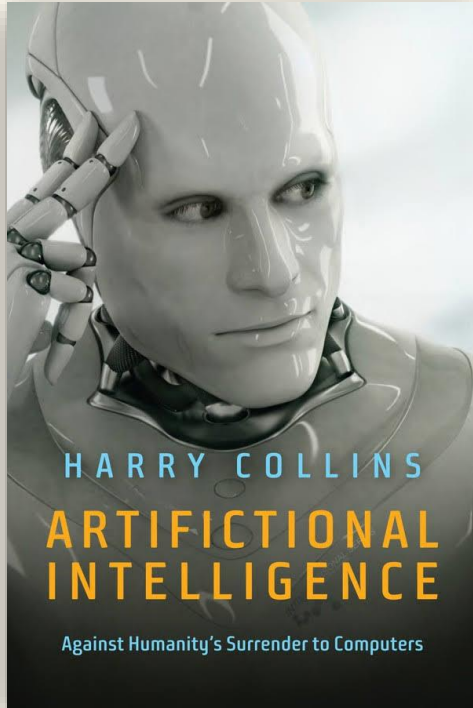
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RICHARD E. NISBETT
thinking
A memoir

"The most influential thinker, in my life, has been the psychologist Richard Nisbett. He basically gave me my view of the world."

Malcolm Gladwell, The New York Times Book Review

*"[P]eople may have **no idea**, or only a **largely incorrect idea**, of the reasoning processes that caused them to behave in a particular way."*

*"[P]eople can be **quite mistaken** about their reasoning processes, even about the most routine matters."*

*"**Reasoning is not language**. Whatever the merits of the competence/performance distinction in linguistics, there's no compelling reason to import it into inductive reasoning."*
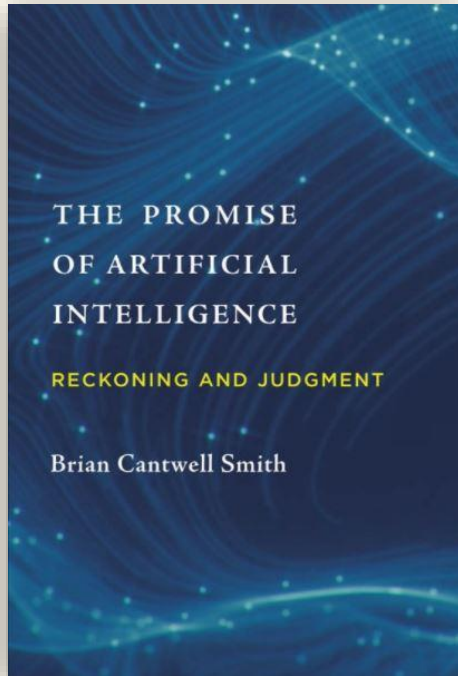
Nisbett, R. E. (2021). *Thinking: A memoir*. Agora Books.

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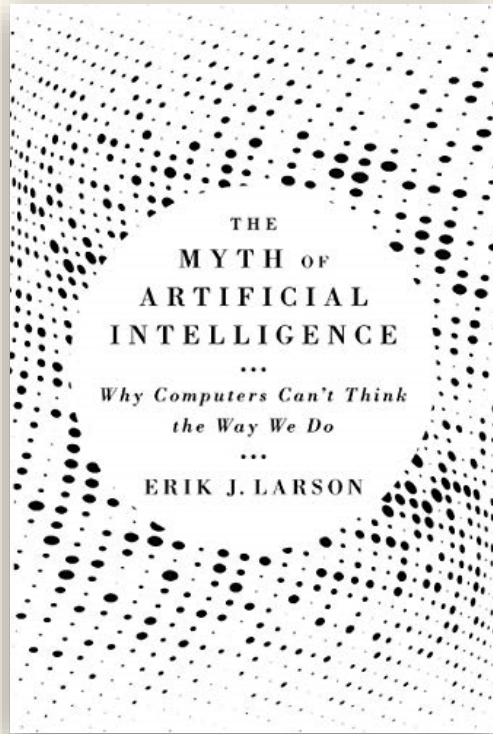**Artifictional** intelligence, the one "available through the newspapers, books and films."

"*No computer will be fluent in a natural language, pass a severe Turing Test and have full human-like intelligence <u>unless it is fully embedded in normal human society</u>. No computer will be fully embedded in human society <u>as a result of incremental progress based on current techniques</u>*" (Collins 2018).

HARRY COLLINS

ARTIFICTIONAL INTELLIGENCE

Against Humanity's Surrender to Computers

Collins, H. (2018). *Artifictional Intelligence: Against Humanity's Surrender to Computers*. Cambridge, UK: Polity Press.

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THE PROMISE
OF ARTIFICIAL
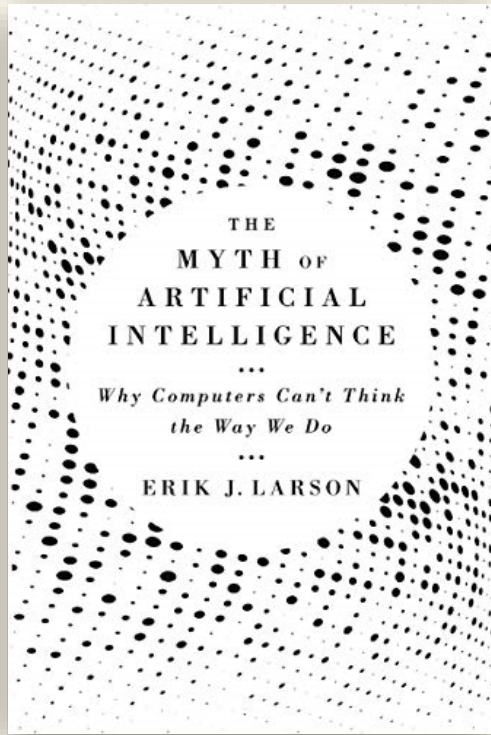INTELLIGENCE

RECKONING AND JUDGMENT

Brian Cantwell Smith

"*Neither deep learning nor other forms of second-wave AI, nor any proposals yet advanced for third-wave, will lead to genuine intelligence.*"

Smith, B. C. (2019). *The Promise of Artificial Intelligence: Reckoning and Judgment.* Cambridge, MA: The MIT Press.

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THE
MYTH of
ARTIFICIAL
INTELLIGENCE
...
*Why Computers Can't Think
the Way We Do*
...
ERIK J. LARSON

"The myth is not that true AI is possible. As to that, the future of AI is a scientific unknown. <u>The myth of artificial intelligence is that its arrival is inevitable, and only a matter of time—that we have already embarked on the path that will lead to human-level AI, and then superintelligence.</u> We have not."

Larson, E. J. (2021). *The Myth of Artificial Intelligence: Why computers can't think the way we do.* Cambridge, MA: Berlknap, Harvard University Press.

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THE MYTH of ARTIFICIAL INTELLIGENCE

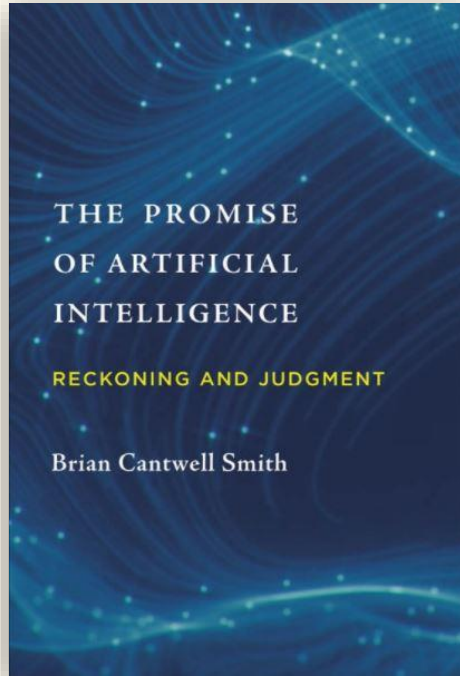... Why Computers Can't Think the Way We Do ...

ERIK J. LARSON

"Success on narrow applications get us not one step closer to general intelligence. The inferences that systems require for general intelligence [...] cannot be programmed, learned, or engineered with our current knowledge of AI. [...] No algorithm exists for general intelligence."

Larson, E. J. (2021). *The Myth of Artificial Intelligence: Why computers can't think the way we do.* Cambridge, MA: Berlknap, Harvard University Press.

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Open research: Standards of genuine intelligence

THE PROMISE OF ARTIFICIAL INTELLIGENCE

RECKONING AND JUDGMENT

Brian Cantwell Smith

Current AI is nowhere near:
- Orientation toward that which is represented (and not merely its representation)
- Distinguish appearance from reality
- Commitment, taking care about the difference
- Embracing actuality, possibility, impossibility
- Self-awareness

Smith, B. C. (2019). *The Promise of Artificial Intelligence: Reckoning and Judgment.* Cambridge, MA: The MIT Press.

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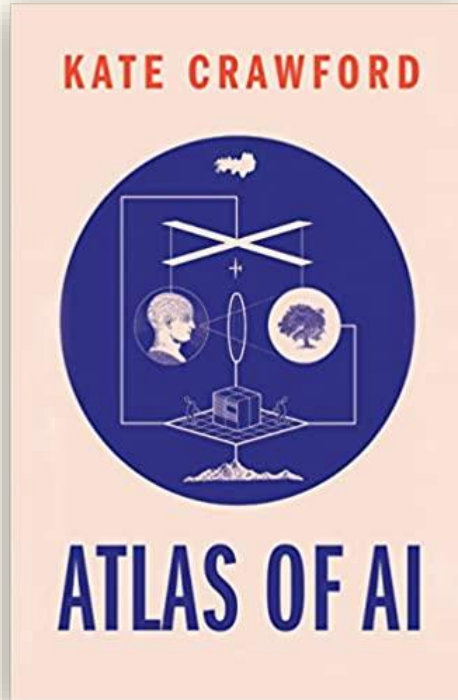
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What AI *is*

KATE CRAWFORD

ATLAS OF AI
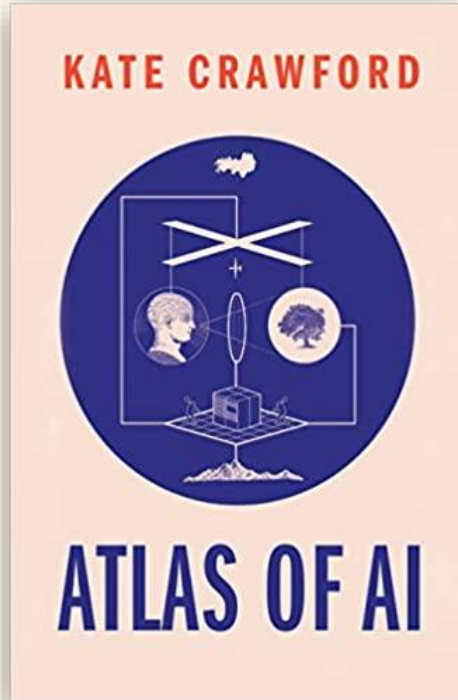
"*Many forms of work are **shrouded** in the term 'artificial intelligence,' hiding the fact that people are often performing rote tasks **to shore up the impression** that machines can do the work.*"

"*[M]any underpaid workers are required to help build, maintain, and test AI systems. […] The technical AI research community relies on cheap, crowd-sourced labor for many **tasks that can't be done by machines**.*"

Crawford, K. (2021). *Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence.* Yale University Press.

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What AI *is*

KATE CRAWFORD

ATLAS OF AI

"*AI is neither artificial not intelligent. Rather, artificial intelligence is both embodied and material*, made from natural resources, fuel, human labor, infrastructures, logistics, histories, and classifications. AI systems are not autonomous, rational, or able to discern anything without extensive, computationally intensive training with large datasets or predefined rules and rewards."

Crawford, K. (2021). *Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence*. Yale University Press.

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