data-ppf.github.io mar 10, 2020

lecture 8 of 14: Birth and death of AI

chris wiggins + matt jones, Columbia

logistics/housecleaning

- Welcome to the Desert of the Real

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  - feat. Slack®, Zoom®, etc.

logistics/housecleaning

- Welcome to the Desert of the Real
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- 1 day extension on oped

student reactions

student reactions: some data on people, ideas, things

```
212 intelligence
135 turing
 79 artificial
 33 mccarthy
 22 lighthill
 14 amazon
 13 stephanie
 12 alphago
 11 interrogator
 9 replicate
 9 information
 8 women
```

student reactions: Turing

This week's readings have me miffed. they [McCarthy and Turing] are both basing their beliefs on machine cognition on very questionable anthropology and psychology.

"the best strategy [in the imitation game] is to try to provide answers that would naturally be given by a man". What does that even mean? I honestly do not really understand what Turning is trying to do here . . .

student reactions: Lighthill

Because Lighthill's research is prompted by Brian Flowers of the Science Research Council, it is evident that the science community is particularly invested in the development of AI, which I find very interesting, in addition to that fact that Lighthill ultimately denounces the field.

I was caught off guard with Lighthill's analysis of the robot and its builder as "pseudo-maternal." This seems like a misunderstanding?

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  - e.g., Dreyfus: US philosopher, tied to tech & epistemological claims
  - e.g., ALPAC report, 1964-1966 led by John Pierce of Bell

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- Scientific and mathematical development

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- how did new capabilities rearrange power? (who can now do what, from what, to whom?) (rights, harms, justice)

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    - US: Dreyfus

historical & social context: logic/philosophy enters the trading zone

Another trading zone: Turing, McCarthy, and ANNs drew from logic and aspirations of axiomatic understanding of math, logic, and thought

big questions

- are the truths that can't be proven using a logical system?

Turing big player here in 1930s

historical & social context: logic/philosophy enters the trading zone

Another trading zone: Turing, McCarthy, and ANNs drew from logic and aspirations of axiomatic understanding of math, logic, and thought

big questions

- are the truths that can't be proven using a logical system?
- are there numbers that can't be computed?

Turing big player here in 1930s

historical & social context: logic/philosophy enters the trading zone

How do we know $1 + 1 = 2$?

***54·43.** $\vdash :. \alpha, \beta \in 1 . \supset : \alpha \cap \beta = \Lambda . \equiv . \alpha \cup \beta \in 2$

Dem.

$\vdash . *54{\cdot}26 . \supset \vdash :. \alpha = \iota`x . \beta = \iota`y . \supset : \alpha \cup \beta \in 2 . \equiv . x \neq y .$

[*51·231] $\equiv . \iota`x \cap \iota`y = \Lambda .$

[*13·12] $\equiv . \alpha \cap \beta = \Lambda$ (1)

$\vdash . (1) . *11{\cdot}11{\cdot}35 . \supset$

$\vdash :. (\exists x, y) . \alpha = \iota`x . \beta = \iota`y . \supset : \alpha \cup \beta \in 2 . \equiv . \alpha \cap \beta = \Lambda$ (2)

$\vdash . (2) . *11{\cdot}54 . *52{\cdot}1 . \supset \vdash .$ Prop

From this proposition it will follow, when arithmetical addition has been defined, that $1 + 1 = 2$.

historical & social context: WWII and computation

- Turing, Michie and others thinking about computation in 1940s

Because it tied AI to a realizable development program with a wide range of practical uses, this connection led to AI's most important institutional support: the Information Processing Techniques Office (IPTO) of the Advanced Research Projects Agency (ARPA). IPTO's founder, ... aggressively promoted a vision of computerized military command and control that helped to shape the AI research agenda for the next twenty five years. . . . Since its founding, IPTO has typically provided between 50 and 80 percent of the federal government's share, which is usually by far the largest share, of AI research budgets in the academic centers it funds

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- Paul N Edwards, *The closed world: Computers and the politics of discourse in Cold War America*. MIT Press, 1997.

Readings: Stephanie Dick, Edwards, AMT, Dartmouth 4, JCM, Lighthill, Pamela McCorduck

“standard account”

> *standard account of the history of Artificial Intelligence: that it was born in 1955 when these veterans of early military computing applied to the Rockefeller Foundation for a summer grant to fund the workshop that in turn shaped the field.*

- Stephanie Dick (assistant professor at Penn) (2019)

“trading zone” as drawn out in the SD reading

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- SD, enumeration added

Turing: imitation game

The new form of the problem can be described in terms of a game which we call the 'imitation game'. It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman.

Turing: imitation game

We now ask the question, 'What will happen when a machine takes the part of A in this game ?' Will the interrogator decide wrongly as often when the game is played like this as he does when the game is played between a man and a woman ? These questions replace our original, 'Can machines think?'

Turing: objection

May not machines carry out something which ought to be described as thinking but which is very different from what a man does ? This objection is a very strong one, but at least we can say that if, nevertheless, a machine can be constructed to play the imitation game satisfactorily, we need not be troubled by this objection.

arguments against

(5) Arguments from Various Disabilities. These arguments take the form, " I grant you that you can make machines do all the things you have mentioned but you will never be able to make one to do X". . . . . I offer a selection: Be kind, resourceful, beautiful, friendly (p. 448), have initiative, have a sense of humour, tell right from wrong, make mistakes (p. 448), fall in love, enjoy strawberries and cream (p. 448), make some one fall in love with it, learn from experience (pp. 456 f.), use words properly, be the subject of its own thought (p. 449), have as much diversity of behaviour as a man, do something really new (p. 450).

Turing: group break out

- Pick one of the critiques

What features might machines have to overcome the objection?

Turing: group break out

- Pick one of the critiques
- Reconstruct the positions

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Turing: group break out

- Pick one of the critiques
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  - Turing's reply

What features might machines have to overcome the objection?

Turing: Machines that learn

a machine undoubtedly can be its own subject matter. It may be used to help in making up its own programmes, or to predict the effect of alterations in its own structure. By observing the results of its own behaviour it can modify its own programmes so as to achieve some purpose more effectively. These are possibilities of the near future, rather than Utopian dreams.

Turing: intelligence needs memory

The criticism that a machine cannot have much diversity of behaviour is just a way of saying that it cannot have much storage capacity. Until fairly recently a storage capacity of even a thousand digits was very rare.

- hidden background of massive data analysis at Bletchley

Turing: impact of AI work in UK

influenced many UK "machine intelligence" researchers, e.g., Strachey, who wrote programs to

- play checkers (1951, before Arthur Samuel at IBM coins "machine learning" to play checkers in 1959)

Figure 1: Strachey "discouraged"

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influenced many UK "machine intelligence" researchers, e.g., Strachey, who wrote programs to

- play checkers (1951, before Arthur Samuel at IBM coins "machine learning" to play checkers in 1959)
- write love poems (try it at home! www.gingerbeardman.com/loveletter)

Figure 1: Strachey "discouraged"

NB: early ML for AI was barely I

consider Chess vs NLP: both are done by humans, but Chess is a game: - mechanized - abstracted

In some ways, getting mechanical devices to imitate human intelligence first succeeds in arenas when humans have allowed themselves to behave like machines (e.g., with algorithmic rules of production (e.g., robots) or games (e.g., chess))

Dartmouth 1956 Conference

J. McCarthy, M. L. Minsky, N. Rochester, and C.E. Shannon. August 31, 1955.

> *We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. 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.*

- dream of precise description *programmed* into computers

Dartmouth 1955 proposal for 1956 Conference

Figure 2: partial attendee photo

Name AI always a branding exercise

JCM: "Excuse me. I invented the term artificial intelligence. I invented it because . . . we were trying to get money for a summer study in 1956. . . aimed at the long term goal of achieving human-level intelligence."

- From the Lighthill debate on artificial intelligence, 1973

Figure 3: JCM

D56: goals (which become fields of CS)

1. "Automatic Computers" (programming languages)

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6. "Abstractions" (feature engineering)
7. "Randomness and Creativity" (Monte Carlo and stochastic learning)

D56: success?

anybody who was there was pretty stubborn about pursuing the ideas that he had before he came, nor was there, as far as I could see, any real exchange of ideas

- JCM from Pamela McCorduck, 2004

  Newell and Simon seemed. . . to be addressing psychologists. . . Minsky wasn't. . . necessarily convinced that human and artificial intelligence needed to resemble each other. This last was a very strong theme in AI research in the early years.

D56: babel of approaches?

brain modelers–how thought *embodied*

mind modelers–how thought doesn't require *body*

> *The physical machine became little more than an arbitrary vehicle for the interactions of pure information.*

- Edwards

D56 impact:

One vision was that AI means to "take symbolic information as input, manipulate it according to a set of formal rules, and in so doing can solve problems. . .

> *After the 1956 workshop, this became the dominant approach*
>
> *most notably, human intelligence was the central exemplar around which early automation attempts were oriented.*

- SD

Q: what might be the other approach?

Where's data?

For the first several decades in the life of artificial intelligence, *learning from data* seemed to be the wrong approach, a non-scientific approach, used by those who weren't willing "to just program" the knowledge into the computer.

Prestige of logic » analysis of data

knowledge » data

> *In this approach, 'knowledge engineers' would interview human experts, observe their problem-solving practices, and so on, in hopes of eliciting and making explicit what they knew such that it could be encoded for automated use (Feigenbaum, 1977, p. 4). Expert systems offered a different explanation of human intelligence, and their own theory of knowledge, revealing that both were moving targets in this early research.*

- SD2019

Winter

Lighthill report and AI winter

1973 "Lighthill Report":

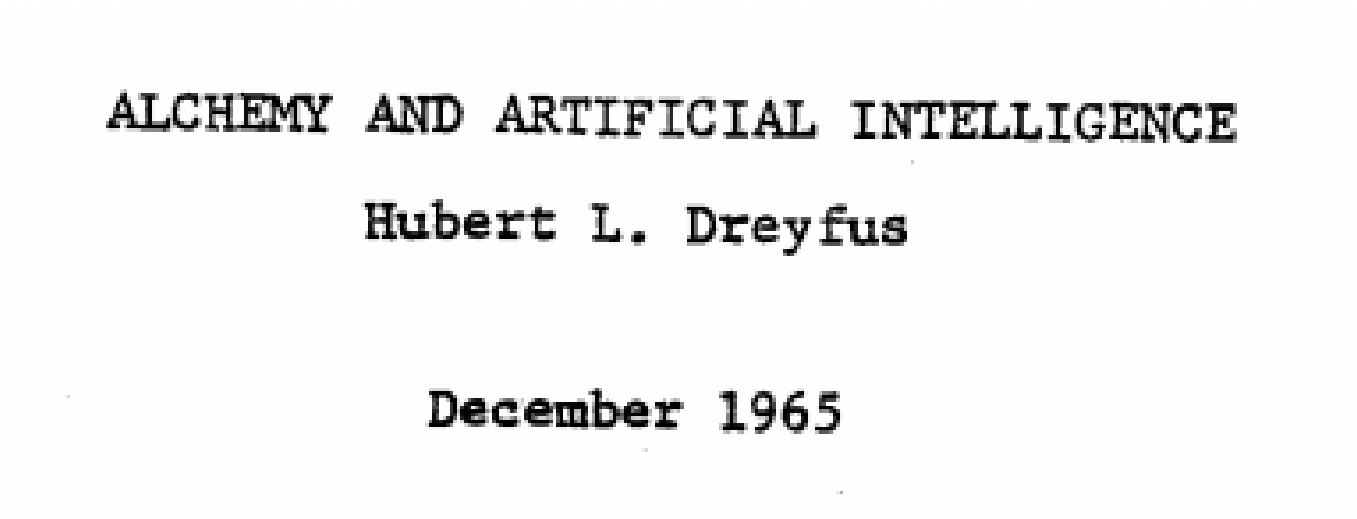
> *The Category B research work on problem solving in these abstract play situations has produced many ingenious and interesting programs. A fair description of the success of these programs seems to be that they are effective when and only when the programming has taken into account a really substantial quantity of human knowledge about the particular problem domain. Just as in category A, the pure mathematical logic methods suffer defeat at the hands of the combinatorial explosion, and have to be replaced by heuristic methods. Some very interesting researches have been carried out to develop general problem-solving programs, and such work can be of research interest to psychologists, but the performance of these programs on actual problems has always been disappointing. Students of all this work have generally concluded that it is unrealistic to expect highly generalised systems that can handle a large knowledge base effectively in a learning or*

In US: Dreyfus, shot

Reaction to, among other things, Simon+Newell claims from the 1950s: (from Edwards)

"Within ten years, they claimed,

- a computer would be world chess champion,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Hubert L. Dreyfus

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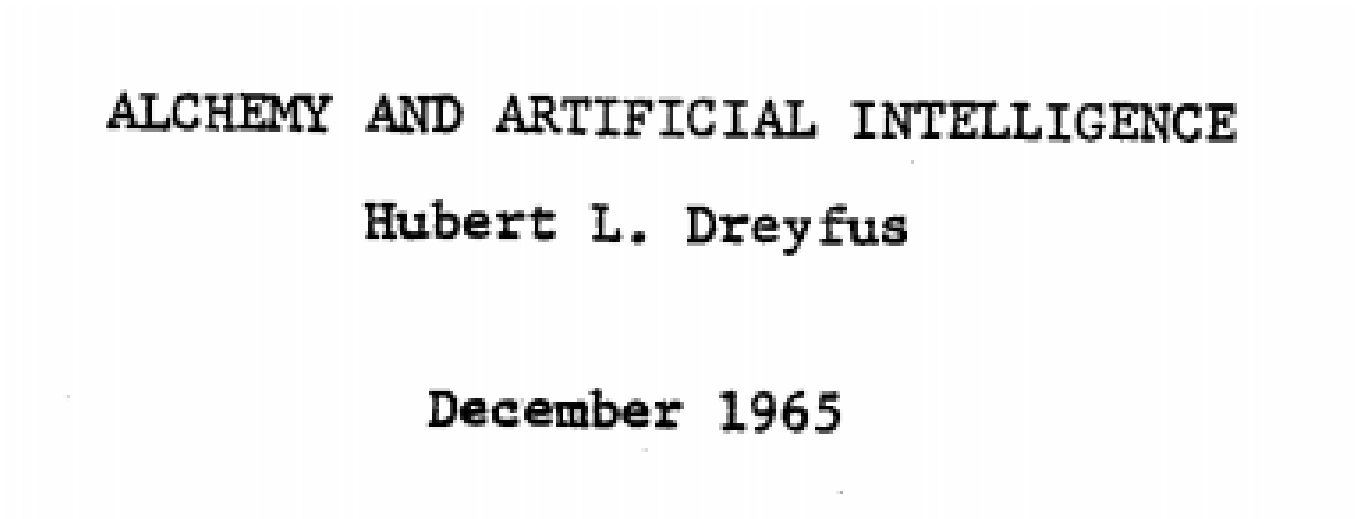
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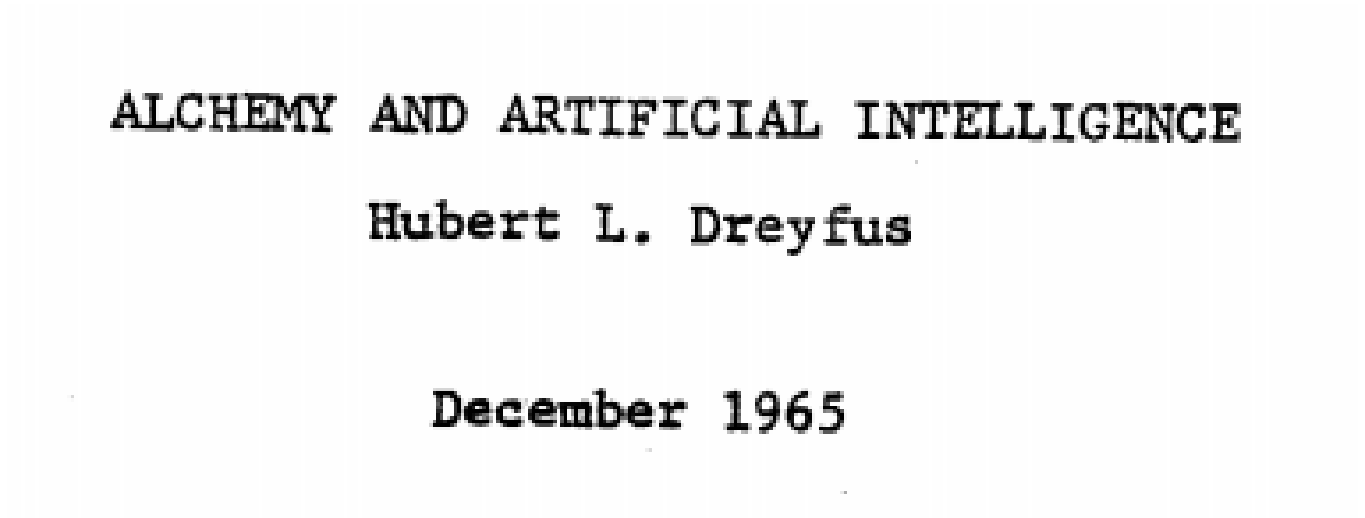

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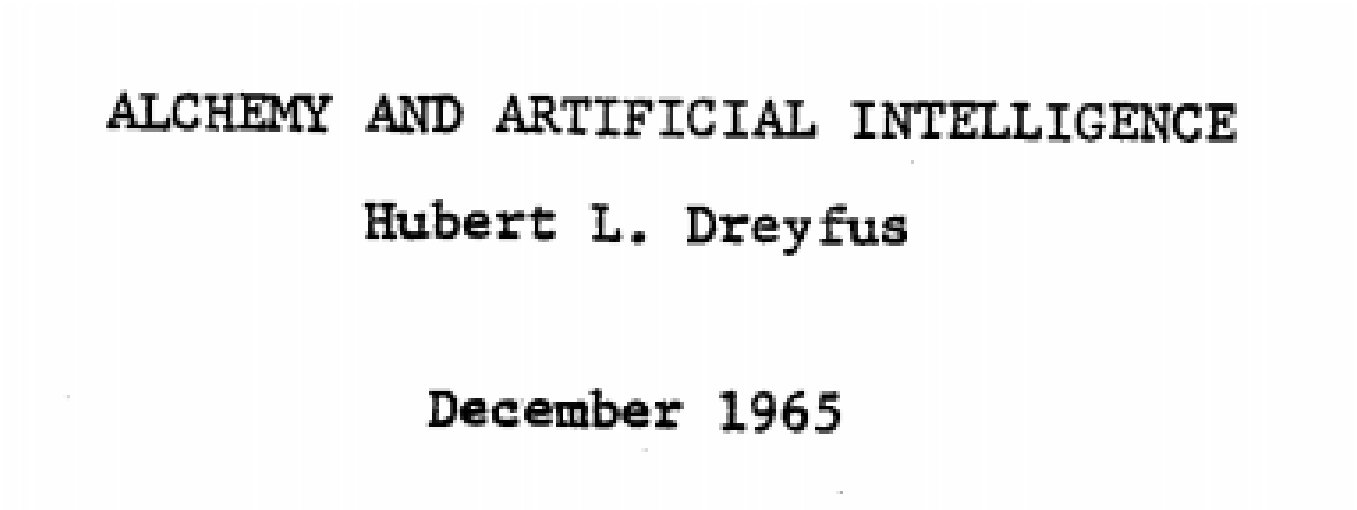
- a computer would compose aesthetically valuable music,
- a computer would discover and prove an important unknown mathematical theorem, and
- most psychological theories would take the form of computer programs."



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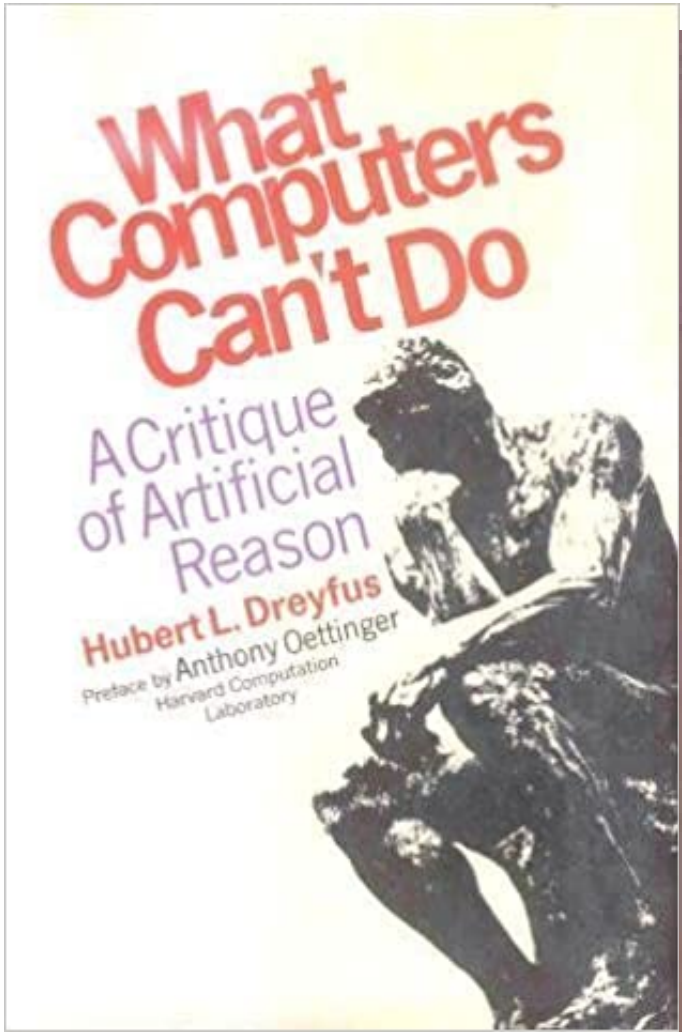
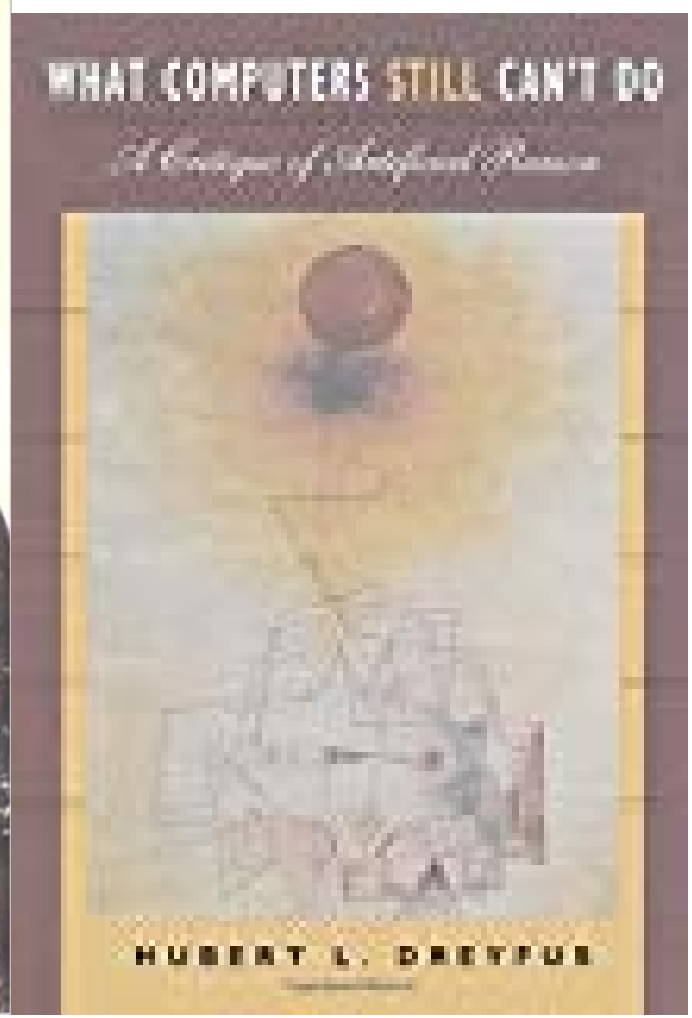
In US: Dreyfus, 1972+1992





in machine translation: ALPAC 1964-1966

The Department of Defense, the National Science Foundation, and the Central Intelligence Agency have supported projects in the automatic processing of foreign languages for about a decade; these have been primarily projects in mechanical translation.

there is no immediate or predictable prospect of useful machine translation.

Machine Learning as AI subaltern, the last half-century:

- 1950s: setting goals (but also: Sputnik, ARPA)

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- 2010s shatter this via "deep nets", an echo of ANN's from 1943
  - "Overwhelmingly, machine learning systems are oriented towards one specific task: to make accurate predictions." – SD2019

aside: a fun resonance from M & P 1943

One more thing is to be remarked in conclusion. It is easily shown: first, that every net, if furnished with a tape, scanners connected to afferents, and suitable efferents to perform the necessary motor-operations, can compute only such numbers as can a Turing machine;

This is of interest as affording a psychological justification of the Turing definition of computability and its equivalents, Church's 4 — definability and Kleene's primitive recursiveness: If any number can be computed by an organism, it is computable by these definitions, and conversely.

AI in 2020 means ML

rules-vs-learning was not so “heated” in 1950s, e.g.,

- Sec 7 of AMT50: “Learning Machines”

AI in 2020 means ML

rules-vs-learning was not so "heated" in 1950s, e.g.,

- Sec 7 of AMT50: "Learning Machines"
- D56's 7 topics include learning

Lasting impact/contemporary relevance

- your reality is now mediated by AI

Lasting impact/contemporary relevance

- your reality is now mediated by AI
  - in palm of your hand

Lasting impact/contemporary relevance

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  - in ADS ruling the professional, political, financial, ...

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- your reality is now mediated by AI
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  - in ADS ruling the professional, political, financial, ...
- data $\in$ math stats $\in$ ML $\in$ AI
- but we can also have data $\in$ AI w/o ML (e.g., ADS)

power and principles

how did this capability rearrange power? who can now do what, from what, to whom?

role of rights, harms, justice?

foreshadowing data for Thursday

(well, not this week... but for future we'll have a lab on AI)

reminder: themes for today

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- how did new capabilities rearrange power? (who can now do what, from what, to whom?) (rights, harms, justice)

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