AECT Webinar 3 on ChatGPT

Making the Future: What Should Educators Do with AI Systems?

Ted Frick

Professor Emeritus
Indiana University

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Consider these two quotes:

1. “The best way to predict the future is to make it.” (Alan Kay, guest speaker, Indianapolis Children’s Museum, circa 1988)

2. “… *think of A.I. as a tool*, not a creature.” (Jaron Lanier, 2023, para. 5).

Computers executing programs are in essence *tools*

- This includes chatbots and other AI Systems.
- These tools can be used for both good and bad purposes.
- As an analogy, a well-honed and balanced chef's knife can be used to prepare food. If used carefully and correctly.
- But, it's easy to cut a finger accidentally, even while being careful.
- Worse, a chef's knife can be used as a murder weapon.
- Computers running AI chatbots are tools also, as is a chef's knife. We must use them carefully to avoid harming ourselves and others.

I’ve been working with computers in education for over 50 years

- I’ve developed complex computer programs in different software languages in each era—from the 1970s to the present.
- As a professor, I’ve taught students to use computers who include K-12 teachers, higher education faculty, Ph.D. and master’s level students, and instructional designers.
- I’ve personally witnessed several major inflection points since the early 1970s.

Eras of Major Inflection Points

1. Mainframe and mini computers
2. Microcomputers (personal desktops and laptops)
3. The Web (interoperability among personal devices)
4. Pocketable and wearable computers (e.g., iPhone, Android, VR headsets, Apple Watch)
5. Cloud Computing (massive parallel processing of big data).
6. Artificial Intelligence and robotics

The latest inflection point: Chatbots and AI

- Right now, I see a lot of wonderment. Reminds me of when personal computers first came out.
- What are these AI chatbots and how do they work?

MACHINE LEARNING

Chatbots

Chatbots such as ChatGPT utilize *neural networks* created by machine learning (ML):

https://xkcd.com/1838

Complex digraphs are constructed when a chatbot's neural net is trained

- The vertices (nodes) are associated with tokens.
  - *Each word in the language (e.g., English) is associated with a unique token*
  - *When being trained, text that is scraped from the Web (e.g., all of Wikipedia) is converted to tokenized data.*
- Numerical weights of edges are estimated from data provided during training.
  - *The edge weights are based on statistical association of words that follow and are near to each other in the very large amounts of texts used in training.*
  - *Mathematical algorithms (such as gradient descent during backpropagation) are used to derive the best estimates of edge weights that minimize errors of prediction.*
  - *Think of the edge weights as being analogous to beta coefficients in a multiple regression analysis* (actually more like path analysis in statistics)

Digraph of vertices and edges with weights.* The edge weight between vertices circled here in red is 15

Affect-Relation Weight. An ***affect-relation weight***, $\omega(\mathfrak{e} \in G \subset \mathcal{G}_{\mathcal{A}})$, is the ***weight*** or ***value*** associated with an affect-relation.

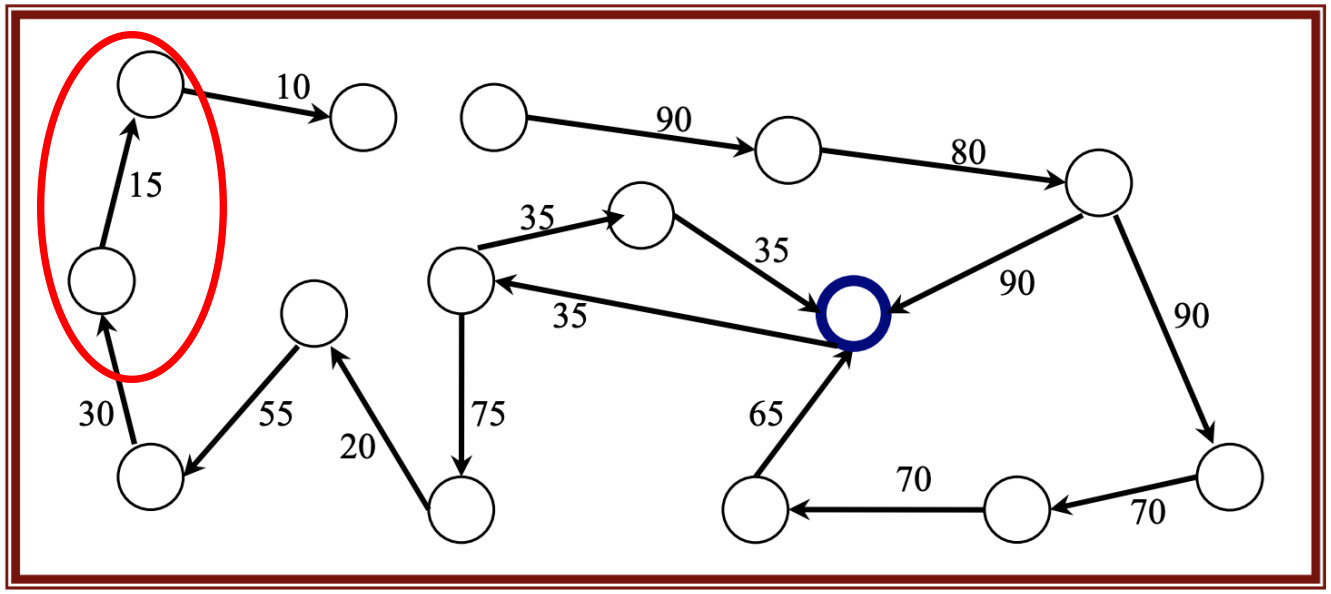
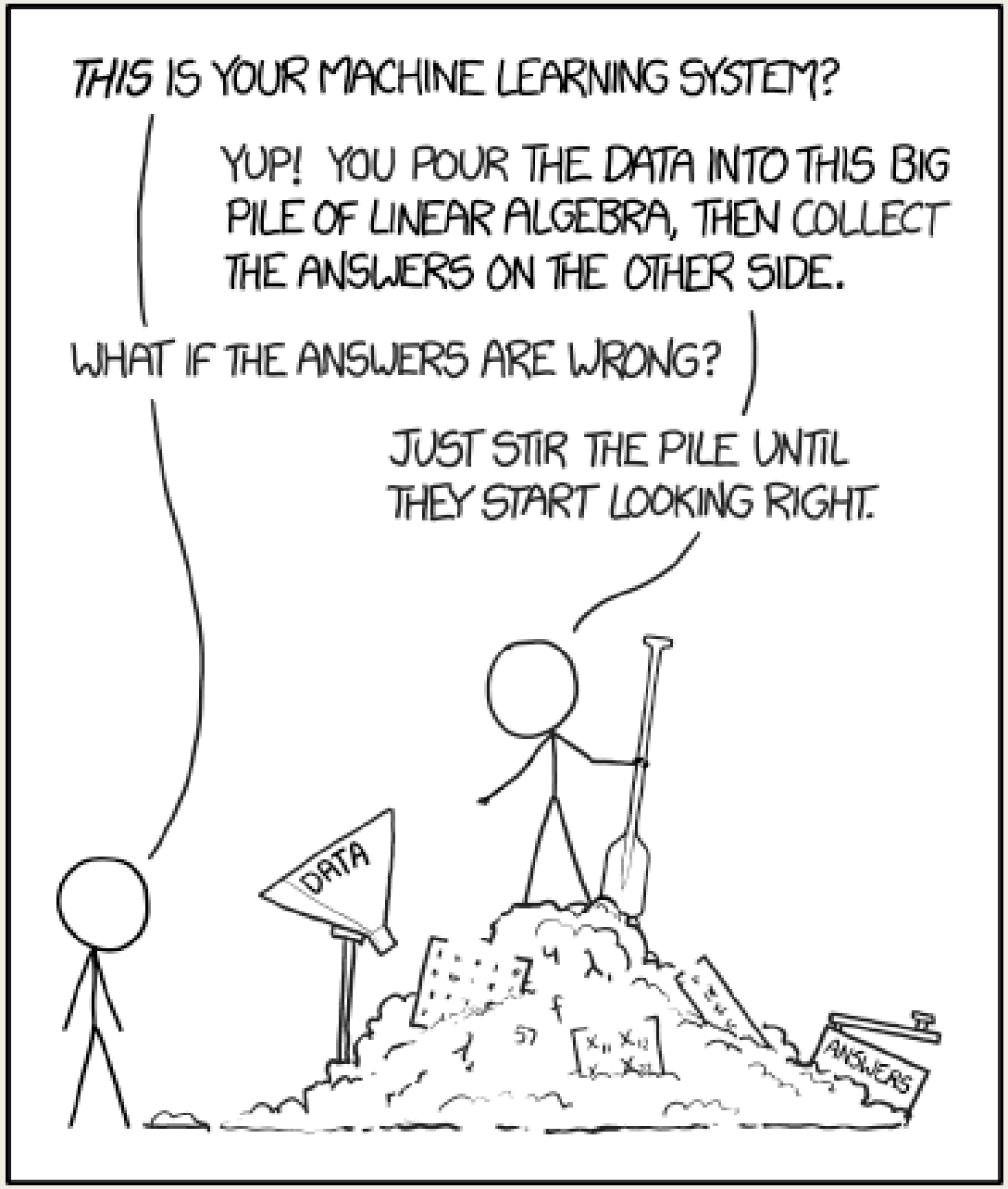


Diagram 5

In Diagram 5, the ***affect-relation weights*** are the values associated with each affect-relation.

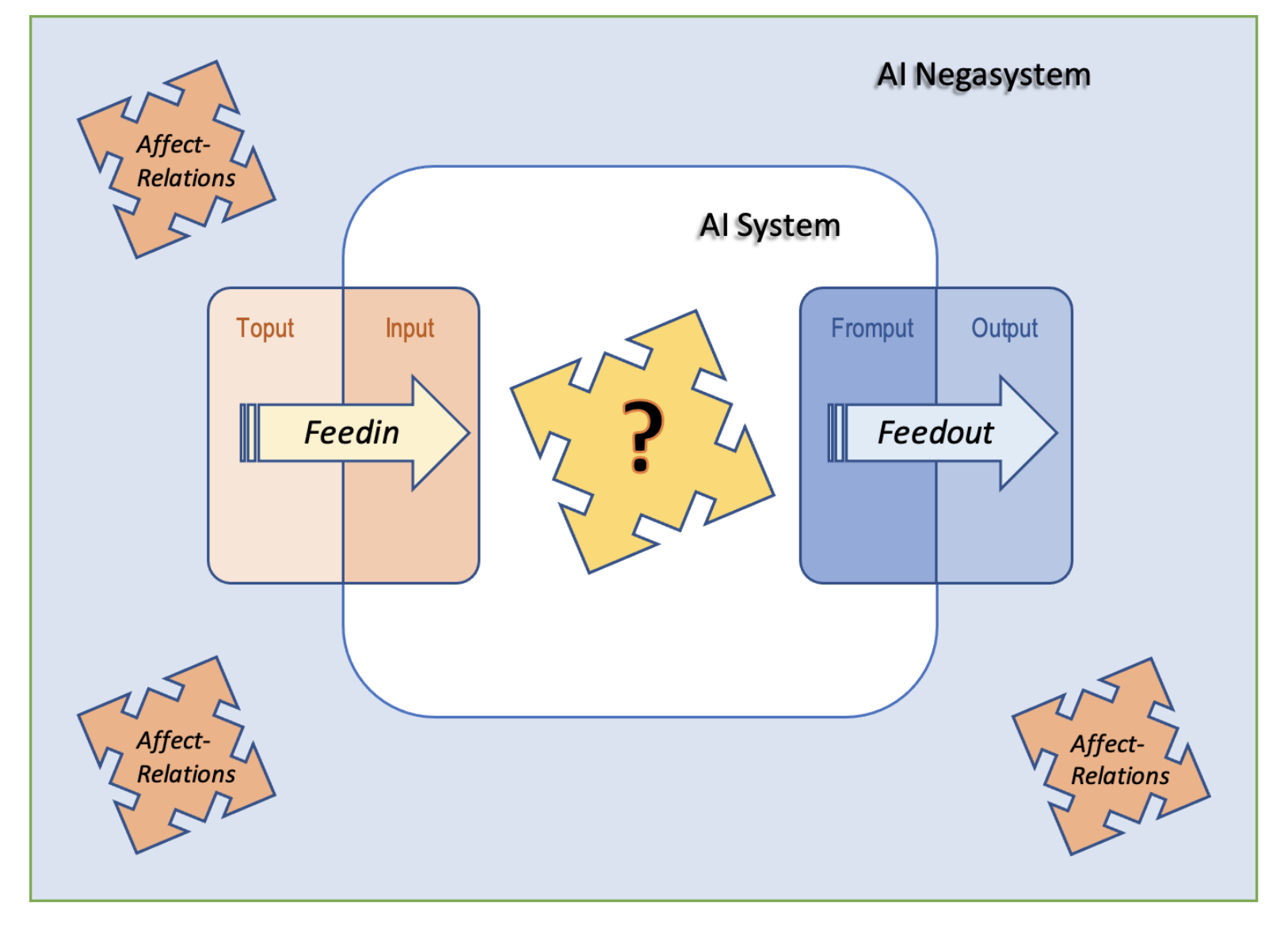
*Thompson, K. R. (2008). ATIS graph theory. System Predictive Technologies. (p. 24) https://tedfrick.me/aptfrick/reports/11ATISgraphtheory.pdf



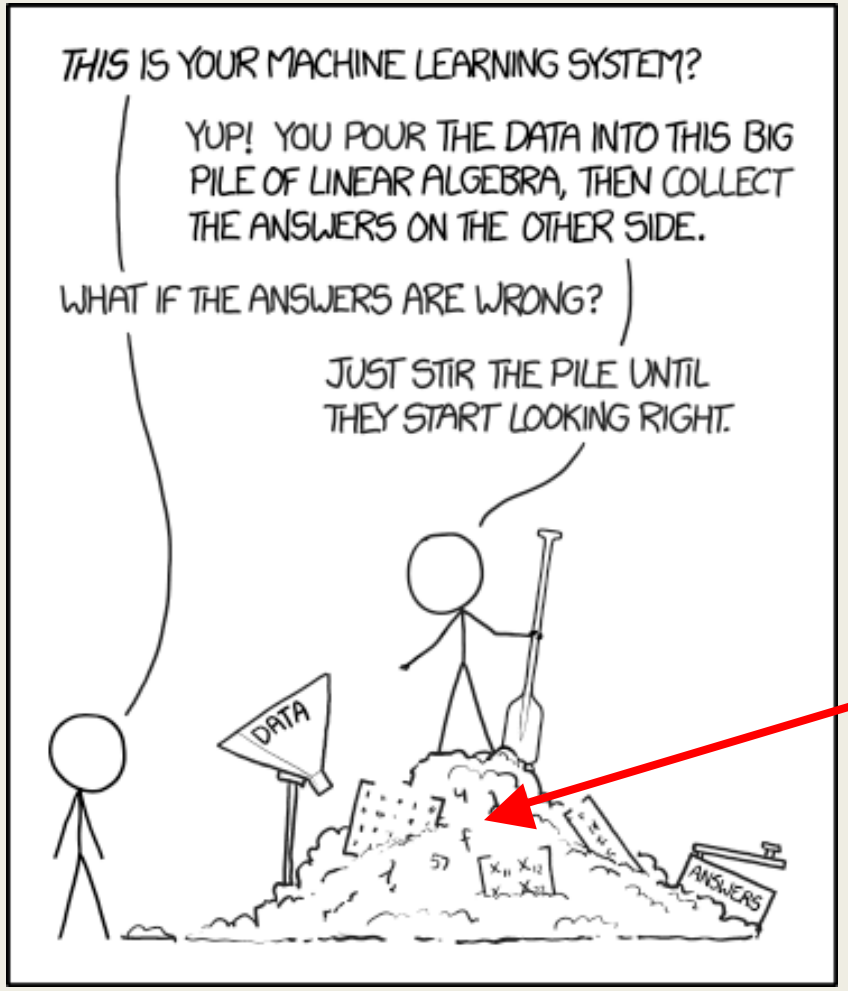
Now, imagine layers of digraphs consisting of thousands of vertices and trillions of edges. The edge weights are estimated in a way that minimizes errors of prediction (minimizes the loss function).

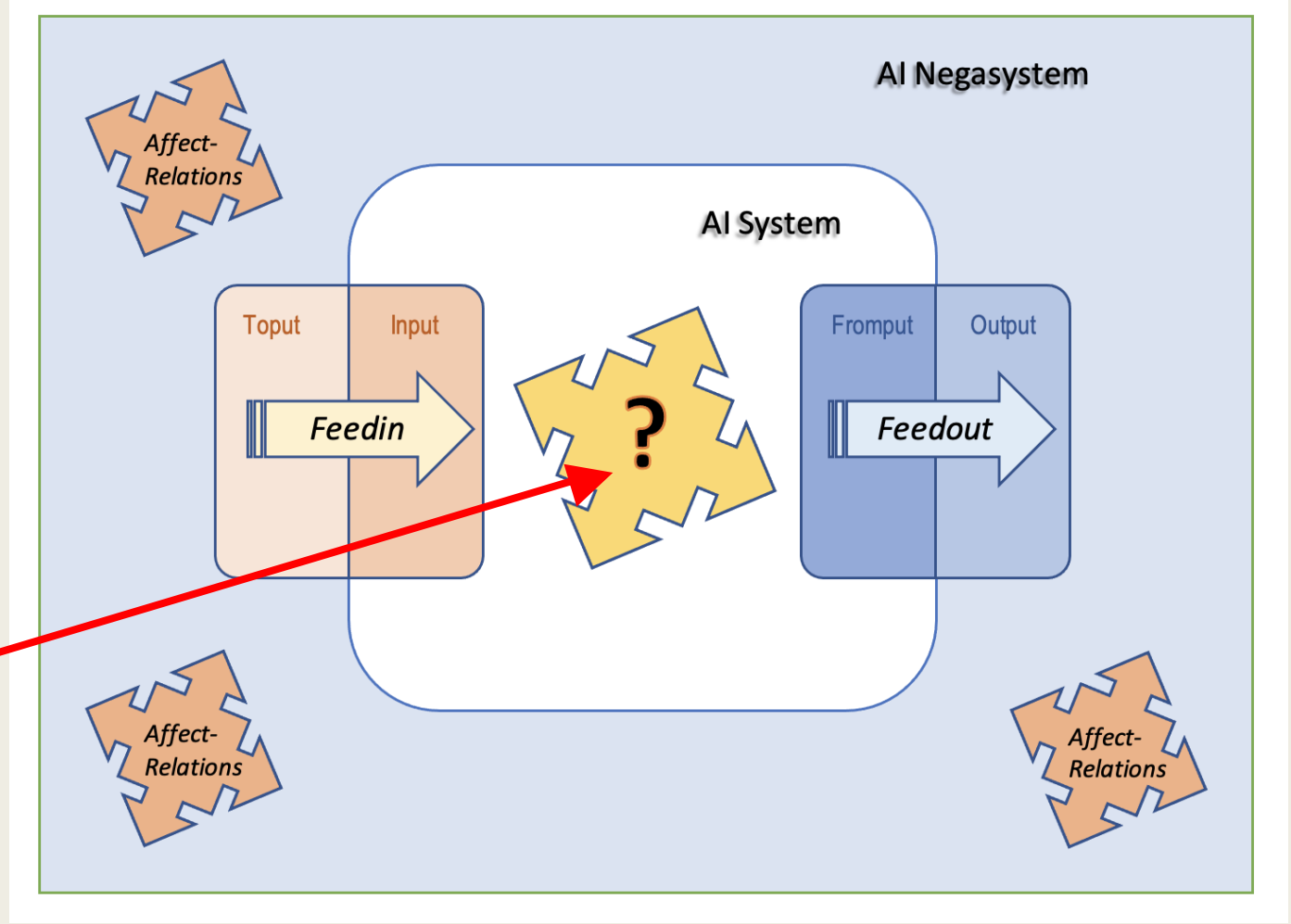
Remember: the vertices are just tokens for words, no different than naming variables *x* and *y* in multiple regression analysis.

A Systems View: An AI *System* and its *Negasytem*



We humans in the AI Negasystem do not understand the affect-relations in the AI system. We can observe the AI System toput and output.





The family of affect-relation sets in the AI System is a black box. Actually, it is a representation of layers of digraphs with an extremely large number of vertices (tokens) and edge weights indicating strengths of statistical relationships among vertices.

LIMITATIONS OF A.I.

Chatbots

Tiptoe through the Toput: The map is not the territory

- There is a very large part of the AI Negasystem that is NOT toput.
- AI System toput consists of *signs* created by humans—digital text, images.
- AI System does NOT have toput which is the world and culture we humans can directly experience
  - *Bloomington Farmer's Market example: carrot vendor*
- On the other hand, we humans understand what the signs mean, because they *represent* what we have experienced (Charles Sanders Peirce, 1932)

Quote from Gregory Bateson (1979):

> *"The* map *is not the territory, and the* name *is not the thing named"* (p. 30, emphasis added).

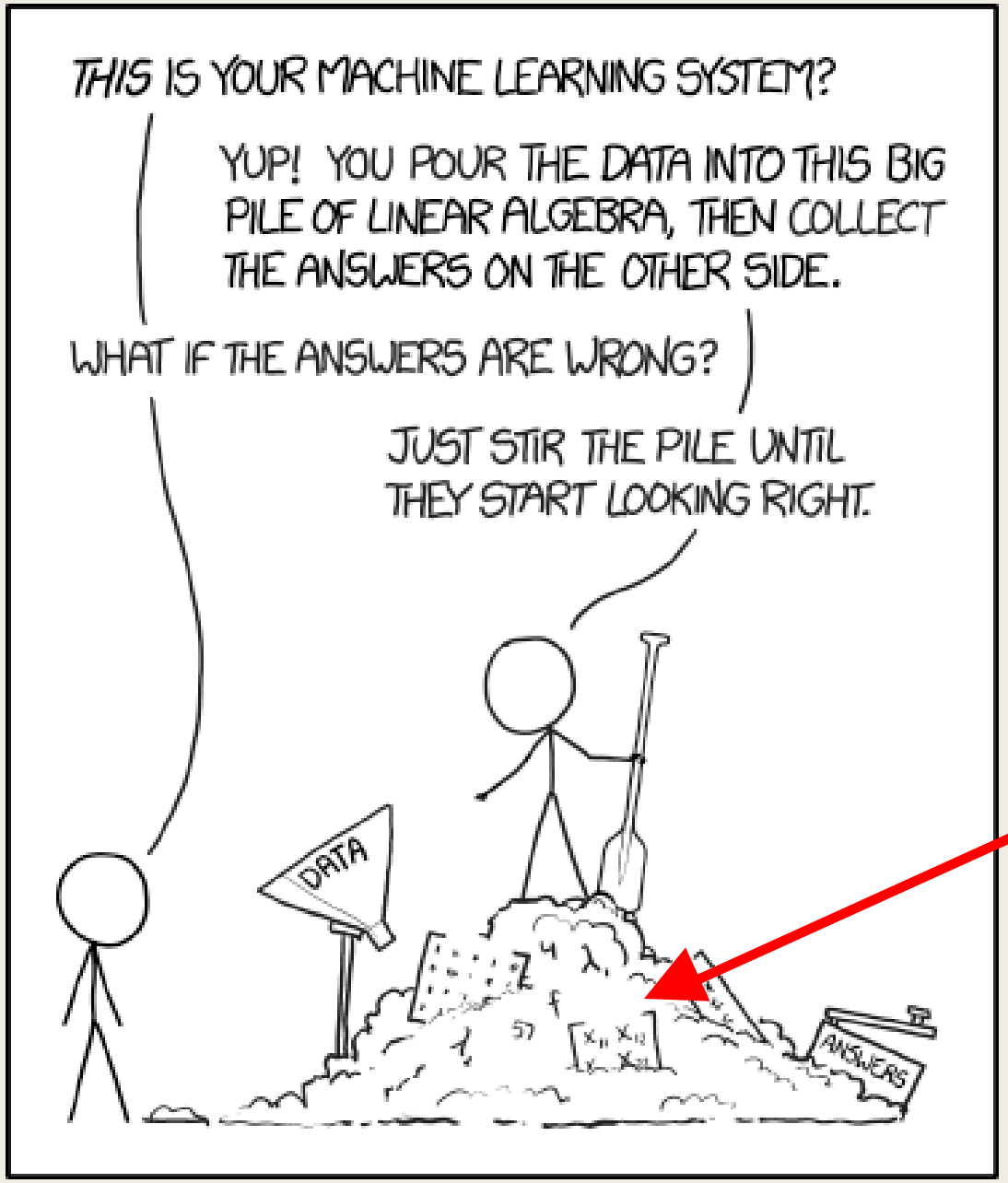
Current AI Systems Lack Common Sense and Understanding

AI experts, Gary Marcus and Ernest Davis (2020):

> *"You can't build reliable cognitive models of complex texts unless you know a lot about how the world works, about people, and places, and objects and how they interact. Without this, the vast majority of what you would read would make no sense at all."* (location 1551)

Douglas Hofstadter (2018) notes problems with extant language translation by AI:

> *"Machine translation has never focused on understanding language. Instead, the field has always tried to "decode"—to get away with not worrying about what understanding and meaning are."* (para. 10)



Lanier (2023):

"… Large-model A.I. systems … aren't made of explicit ideas…. There is only a giant ocean of jello—a *vast mathematical mixing*." (para. 16)

MAKING THE FUTURE

We Need to Be Very Careful with Chatbots

- Chatbots can provide false claims (hallucinations) that are inseparable from correct facts and concepts.
- How can we separate the wheat from the chaff?
- My response:
  - *Teachers and students must think critically.*
  - *Without thinking critically and checking facts independently, we can be fooled by responses of those AI systems.*

Stay Tuned

I have submitted a manuscript to *TechTrends* for a special issue on *A Systems Thinking View on Emerging Learning Technologies:*

Are We Dupes? Limitations of AI Systems: What Should Educators Do with Them?

(since published in 2024)

In the meantime, I leave you with the two quotes we began with:

"… think of A.I. as a tool, not a creature." (Lanier)

"The best way to predict the future is to make it." (Kay)

REFERENCES

References

Bateson, G. (1979). *Mind and nature: A necessary unity*. E. P. Dutton.

Frick, T. W. (1991). *Restructuring education through technology*. Phi Delta Kappa Educational Foundation. https://bio.tedfrick.me/fastback/fastback326.html

Hofstadter, D. (2018, Jan. 30). The shallowness of Google Translate. *The Atlantic*.

Lanier, J. (2023, April 20). There is no A.I. There are ways of controlling the new technology—but first we have to stop mythologizing it. *The New Yorker*. https://www.newyorker.com/science/annals-of-artificial-intelligence/there-is-no-ai

Marcus, G. & Davis, E. (2020). *Rebooting AI: Building artificial intelligence we can trust* (Kindle edition). Pantheon Books.

Peirce, C. S. (1932). *Collected papers: Elements of logic* (Vol. II, C. Hartshorne & P. Weiss, Eds.). Harvard University Press.

Thompson, K. R. (2008). ATIS graph theory. System Predictive Technologies. https://tedfrick.me/aptfrick/reports/11ATISgraphtheory.pdf

Link to this presentation:

https://bio.tedfrick.me/epistemology/AI_AECT_Webinar3_Frick.pdf