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- Awad distinguishes between different “types” of AI. What classification scheme does the paper use and why do these types matter for scientific research?

Awad uses seven different classifications of AI in the paper, which are predictive, descriptive, generative, optimization, causal and interpretable, privacy-aware, and meta-scientific AI. These classifications matter because they describe the different roles AI has and how it can work well together to support scientific research in all stages of the process. Different scientific questions require different types of AI, for example, in the paper predictive AI helps forecast future trends while generative AI helps propose new hypotheses or generate synthetic data that is difficult to get. AI has not only made research more efficient but has also expanded scientific discovery in many ways such as identifying patterns that humans may miss and by generating new research directions. These types of AI also support responsible and trustworthy science through features like explainability, privacy protection, and causal analysis.

- Does Awad make a clear distinction between AI as a tool and AI as a scientific collaborator? If so, what are the differences and what are some examples given to support the differences? Do these examples suggest a real shift in how science is conducted, or mostly an extension of existing methods?

Yes, Awad does make a pretty clear distinction between AI as a tool and as a scientific collaborator. As a tool, AI can assist human researchers by making tasks more efficient by processing large datasets or automating repetitive tasks. In this way, humans still remain in control of interpretation. An example from the paper of AI as a tool is using convolutional neural networks to recognize patterns in image data to detect edges, shapes, and textures. Another example is AutoML which automates the steps to building a machine learning model such as preprocessing data, choosing the right model and fine-tuning settings. As a scientific collaborator or “epistemic agent” as the paper says, it can influence what counts as evidence, how explanations are formed and who participates in the construction of knowledge. An example from the reading of AI as a collaborator is using generative AI in biomedical imaging and genomics to generate medical images to “expand small datasets, fill in missing data from scans or tests, and help researchers explore hidden factors in complex biological datasets.” Another example is DeepMind’s AlphaFold that predicts protein structures.

- What are some limitations or risks of using AI in science? How do these relate to issues such as interpretability, bias, reproducibility, or theory formation?

Awad discusses some limitations and risks of using AI in science. One mentioned was the “black box” concept and opacity. Unlike traditional models like decision trees which are easy to follow, more advanced models are like “black boxes” in the sense that they produce results without revealing how they got there which is bad because you need to know the “why” to justify findings. Another risk is that AI systems learn from historic data and if the data contains bias, the model could reproduce it such as race and gender stereotypes. Another risk mentioned is reliability, since sometimes models have made up fake citations and claims. The paper uses the example of Galactica, though trained on millions of scientific papers it was found to produce fabricated citations and fake claims. Another limitation is that AI needs massive amounts of high-quality data. This is because when datasets are too small, models can “overfit” and learn from random noise rather than actual patterns leading to unreliable outputs that other scientists can’t replicate. Lastly, because AI systems “elude intuitive interpretation” they might start defining what counts as “evidence” in ways humans don’t fully understand which risks losing the human in the loop.

- According to Awad’s arguments, is AI more likely to accelerate scientific discovery or to reshape the scientific method itself? Do you agree or disagree?

Awad’s arguments are definitely saying that AI is doing both, accelerating scientific discovery and reshaping the scientific method but I think Awad leans more towards how AI is reshaping the scientific method. She mentions that AI is accelerating scientific progress right now but this will lead to a deeper shift in how knowledge is actually produced. Awad argues that AI is restructuring the scientific enterprise by moving it from human-centric deduction, theory to experimentation, to AI-driven “abductive inference,” data patterns to explanation. Instead of starting from a human theory, insights now come from data patterns. AI systems also have become agents that influence what scientists count as evidence and how explanations are formed. The paper also mentions how AI generates knowledge through processes that humans might not even find interpretable. I agree with Awad that AI has evolved so much to the point they are becoming a real collaborator and even forming new ideas and hypotheses. AI is definitely capable of things humans can’t do such as detecting patterns that the human brain can’t, especially faster as well. However, I feel that the limitations and risks that are mentioned in the paper such as hallucinations and the black box models suggest that AI can’t fully replace human reasoning. Even though AI is reshaping scientific practice, a human is still much needed to overlook the results and understand how the AI came to certain conclusions. So I definitely think AI is significantly impacting science but it’s definitely not going to replace the traditional theory-driven way yet.