

CSC 595 - Research Skills

AI in Research: The Good, the Bad, and the Ugly

Nishant Mehta

THE GOOD THE BAD AND THE UGLY A.I.

A CORRUPTED GENERATIVE ODYSSEY



A FILM BY **DEDER FAKES PRODUCTIONS**

WRITTEN BY **LARGE LANGUATIO** **STOLEN DATA**



Ugly is misspelled!



You are absolutely right! My sincerest apologies for that persistent misspelling. I've corrected it. Here is the movie poster with "Ugly" spelled correctly.



Previous slide was *not* the first attempt

Generative AI Tools

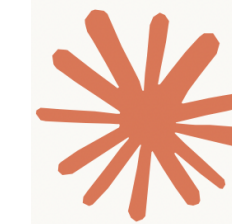
- Exciting new era
- Potential for accelerating research:
 - Doing “menial” tasks
 - Helping with creative process
 - Doing difficult tasks we don’t like to do
- Hidden costs: stay tuned!



ChatGPT



Gemini



Claude

Part I: The Good and the Bad



Writing Code

The Good:

- Saves time!
- For researchers, code not considered part of creative process (undergrad could do it)
- Can be more enjoyable: think about goals, and let “minion” to low-level labor



The Bad:

- Need to verify code of “someone else” (AI model)
- Lack of mental frame: less intuitive where to look for bugs

Writing Related Work Section of Paper

The Good:

- Saves time!
- Might find papers you would not have thought of

The Bad:

- Hallucinated papers (YOUR paper gets desk rejected)
- Papers not actually related (must filter)
- AI system has unknown biases:
which papers does it find and which does it miss?
- Reduced exploration because consideration set is pre-filtered - missed chances of discovery

Writing Papers

The Good:

- Saves time (does it?)
- Writes better than you (does it?)

The Bad:

- Grad school is ideal time to develop paper writing skills. Lost opportunity for advisor feedback if you don't write.
- Story of paper should be YOUR story, not AI's
- Research and writing often evolve together. Saving writing until end hurts planning of research

Brainstorming

The Good:

- Seemingly limitless way to generate ideas

The Bad:

- Brainstorming less will reduce your creativity (consumer vs producer)
- Ideas “generated” by AI might be from less-well-known papers
 - Without citation, this is academic fraud (YOU are responsible for papers, not AI)

Getting Feedback

Lesser-known use case: asking AI for feedback on your paper (or fellowship proposal)

The Good:

- Instant reviewer!
- Don't need to bother labmates for feedback

The Bad:

- Avoid if worried your paper will be remembered by AI (becomes “public” prematurely)
- If used in isolation, may miss feedback about writing style (or too complex language) that human would pick up. Solution: still ask a labmate for feedback

Math

The Good:

- Can do tedious derivations

The Bad:

- Mistakes are common. Must verify
- Seriously, mistakes are COMMON. Must verify!
- Mistakes might not be as easy to spot
(writing is always confident, unlike human writing)

Math

The Good:

- Comes up with ideas you didn't think of

The Bad:

- Human as reviewer/manager rather than human as creator
- More fun to create your own ideas or review someone else's ideas?

Math

The Good:

- Comes up with ideas you didn't think of

The Bad:

- Where did LLM Chatbot's result from?
 - Obscure paper? Which one?
 - Proved by LLM? Then how is it *your* result?

Part II: The Ugly



Philosophical Issues

- Non-controversial: Research is *creative* process. Good to offload tedious tasks.
- How about offloading brainstorming and problem solving?
- If offloading creative tasks, what is the human's role?
- What is the purpose of humanity?

Personal Issues

- Cognitive offloading of mentally stimulating parts of research:
 - Less development of skills. Potential DEGRADATION of skills
 - Less creative thinking may reduce creativity
- Beware the model of famous researchers using LLMs.
They already developed skills long ago...

Not the way to be a
Great Researcher

Personal Issues

- Consider LLM as smart friend
- What happens if you ask human smart friend too many questions? Eventually they say no
 - **Result:** You solve things yourself, learn patience, develop independent strength
- What happens if you ask an LLM too many questions?
 - It never says no. You don't struggle. You don't get stronger

Missing the Path

- Is the purpose to get to the goal?
- Or is it the EXPERIENCE of getting to the goal?
 - LLM Chatbot gives an answer, but what path did it take?
- If you find an answer:
 - You experience the path... you EXPLORE
 - You get lost and find new paths... you make new CONNECTIONS

Missing the Path - Problem Solving

- Along the way to a solution, you may discover:
 - Discover new techniques
 - Encounter new papers (tangential, but interesting)
 - Think about ways to change your problem
 - Think of new problems to solve

Missing the Path - Writing Related Work Section

- When you craft Related Work section yourself:
 - Look at wider swath of papers (you did the filtering, not AI)
 - You are aware of the filtering process (less risk)
 - Again, encounter new papers (tangential, but interesting)

Social Issues

- Unwritten rules of research collaborations:
 - Don't invite new collaborators without asking collaborators first
 - Don't publicly mention ongoing work without asking collaborators first ("information leakage")
 - Typically, agree on who is working on what parts
 - Competition sometimes beneficial: humans motivated to compete with humans
- Asking LLM Chatbot to do some part of the work is similar to bringing in another collaborator
 - Ask your collaborators first! Also, beware "information leakage"
 - Can hurt competition aspect: human motivation to compete with AI is less clear

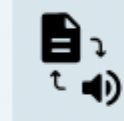
Nuclear Reactors

Google, Meta pledge to triple nuclear capacity by 2050 as technology sees looming 'renaissance'

Tech giants among group of large energy users backing commitment to ramp up nuclear power



[Paula Duhatschek](#) · CBC News · Posted: Mar 14, 2025 1:00 AM PDT | Last Updated: March 14



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Cooling Towers 4, left, and 3 are seen at the nuclear reactor facility at the Alvin W. Vogtle Electric Generating Plant, in May 2024, in Waynesboro, Ga. Nuclear power is seeing a resurgence in popularity thanks in part to significant growth in power demand due to AI. (Mike Stewart/The Associated Press)

Resource Consumption

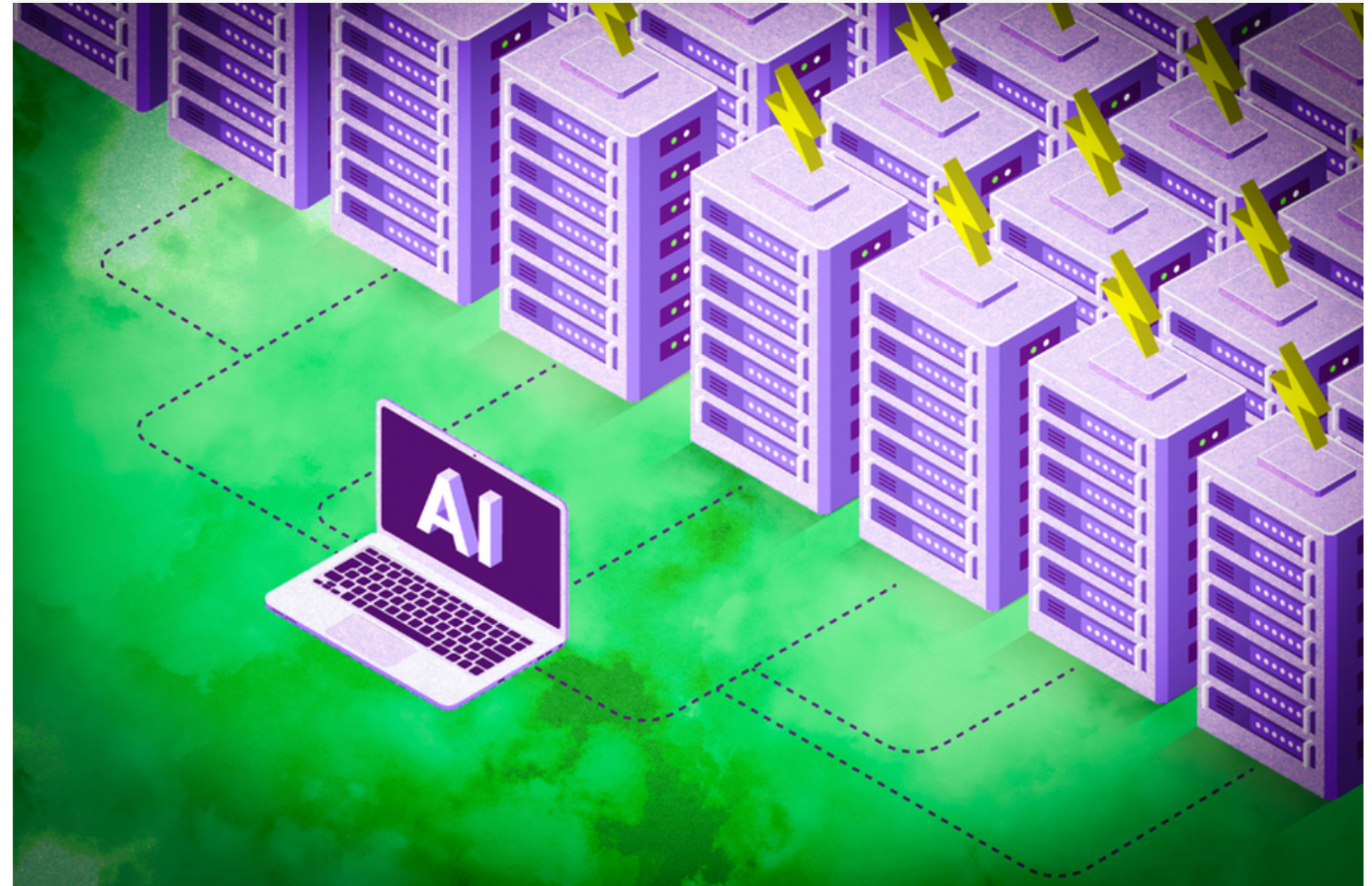
2023: Data centers consumed ~26% of total electricity supply in Virginia - [EPRI](#)

Moderate (5%) growth scenario for 2023–2030:
31% of total electricity supply of Virginia - [EPRI](#)

Explained: Generative AI's environmental impact

Rapid development and deployment of powerful generative AI models comes with environmental consequences, including increased electricity demand and water consumption.

Adam Zewe | MIT News
January 17, 2025



Resource Consumption

“Generative AI systems need enormous amounts of fresh water to cool their processors and generate electricity. In West Des Moines, Iowa, a giant data-centre cluster serves OpenAI’s most advanced model, GPT-4. A lawsuit by local residents revealed that in July 2022, the month before OpenAI finished training the model, the cluster used about 6% of the district’s water.” - [Nature](#)

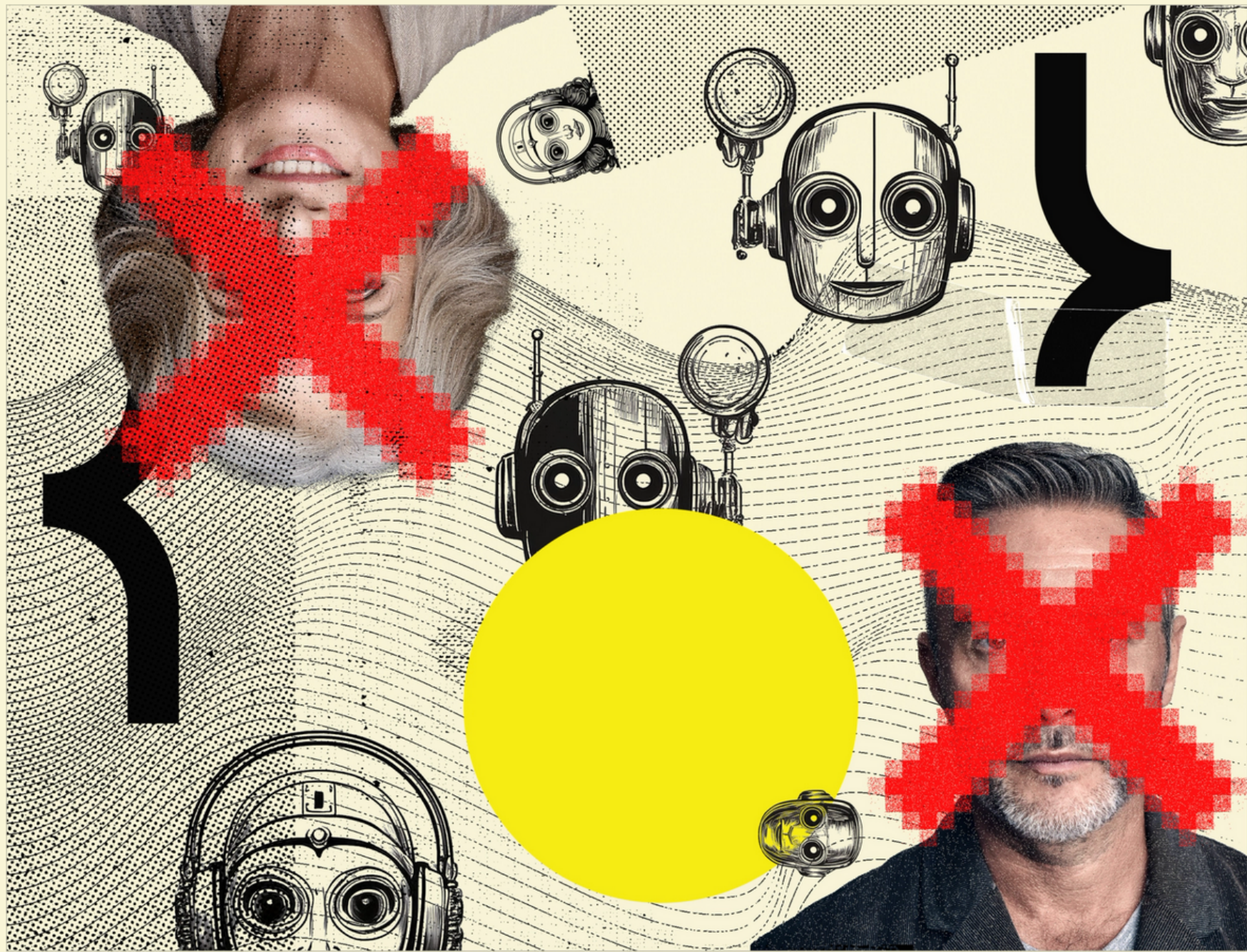
“Even considering the lower estimate, the combined scope-1 and scope-2 water withdrawal of global AI is projected to reach 4.2 – 6.6 billion cubic meters in 2027, which is ... half of the United Kingdom.” - [arXiv/ACM](#)

It's Happening

No people, no problem: AI chatbots predict elections better than humans

 Reed Albergotti
Tech Editor, Semafor

Sep 20, 2024, 10:40am PDT TECHNOLOGY



AI Lucca/Semafor

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Rethinking The Science of Prediction

Rendering Human
Granularity

Aaru simulates entire populations to predict the world's events. Welcome to the new age of decision dominance.

Bias

- Biases of AI systems are:
 - less well understood
 - can vary over time
 - can vary from system to system

nature machine intelligence

Article

<https://doi.org/10.1038/s42256-025-00986-z>

Large language models that replace human participants can harmfully misportray and flatten identity groups

Received: 12 February 2024

Angelina Wang¹✉, Jamie Morgenstern² & John P. Dickerson^{3,4}

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 Check for updates

Large language models (LLMs) are increasing in capability and popularity, propelling their application in new domains—including as replacements for human participants in computational social science, user testing, annotation tasks and so on. In many settings, researchers seek to distribute their surveys to a sample of participants that are representative of the underlying human population of interest. This means that to be a suitable replacement, LLMs will need to be able to capture the influence of positionality (that is, the relevance of social identities like gender and race). However, we show that there are two inherent limitations in the way current LLMs are trained that prevent this. We argue analytically for why LLMs are likely to both misportray and flatten the representations of demographic groups, and then empirically show this on four LLMs through a series of human studies with 3,200 participants across 16 demographic identities. We also discuss

Summary

- Great benefits: saving time, new ideas
- But beware of hidden costs:
 - Need to verify (hidden time cost)
 - Lost exploration (less development as a researcher)
 - Environmental costs