

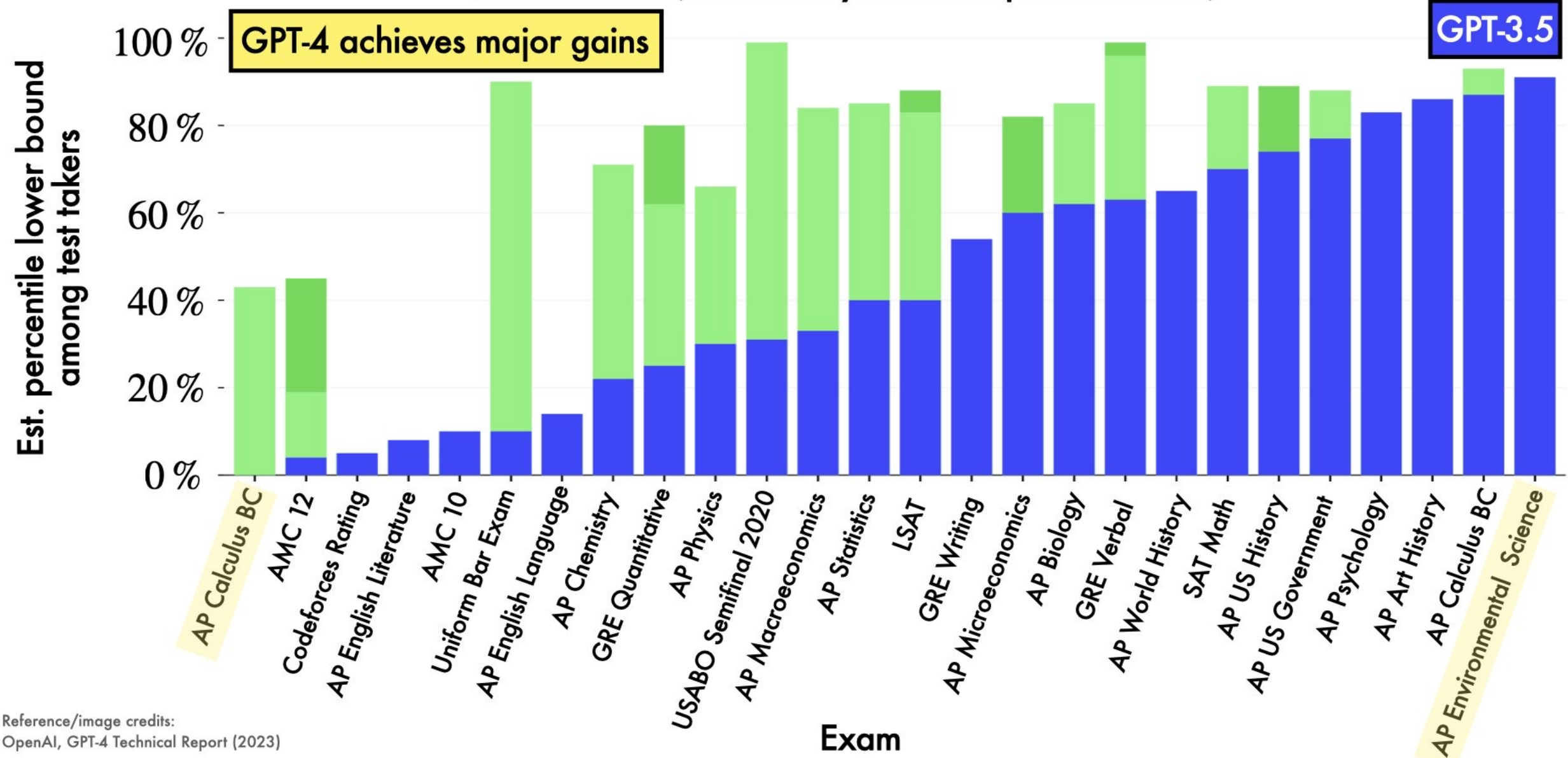
Generative Artificial Intelligence: Challenges and Opportunities for Education

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Exams

Exam results (ordered by GPT-3.5 performance)



Transformer-Based Deep Neural Networks

- models learn the probabilistic patterns in training data
 - text, images, other media
- they can generate new data with similar patterns



Source:

Théâtre D'opéra Spatial generated by Midjourney from prompt by Jason M. Allen

Pre-Trained Large Language Models

- trained to predict an element given some input
 - predict a missing word
 - *I ### to drink coffee* *###* \Rightarrow *like*
 - BERT, PaLM-2
 - predict the next word
 - *I like to drink ...* *...* \Rightarrow *coffee*
 - ChatGPT, GPT-4
- fine-tuned using human feedback



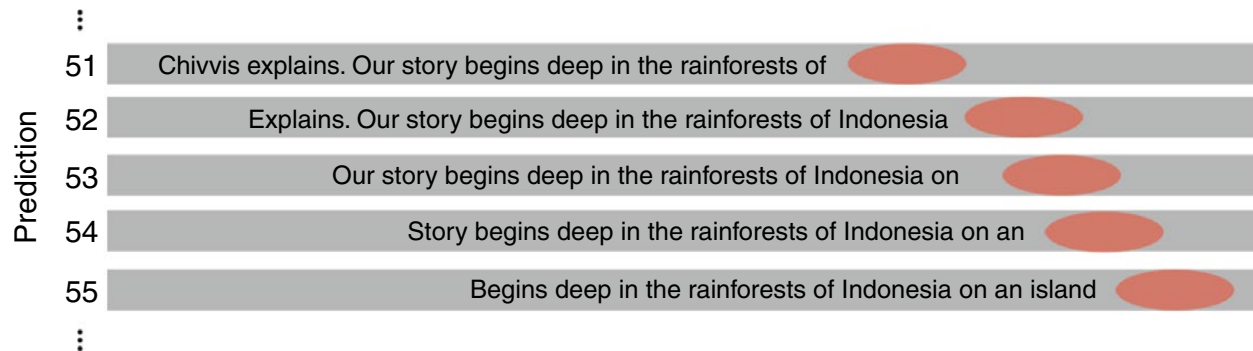
Next-Word Predictions by Humans and GPT-2

a Transcript

(Ira Glass) So there's some places where animals almost never go, places that are designed by humans for humans. This act ends up in a place like that, but it starts about as far from there as you can get. Dana Chivvis explains.

(Dana Chivvis) Our story begins deep in the rainforests of Indonesia on an island called Sulawesi. A few years ago, the photographer David Slater traveled there from his home in England to photograph a troop of monkeys.

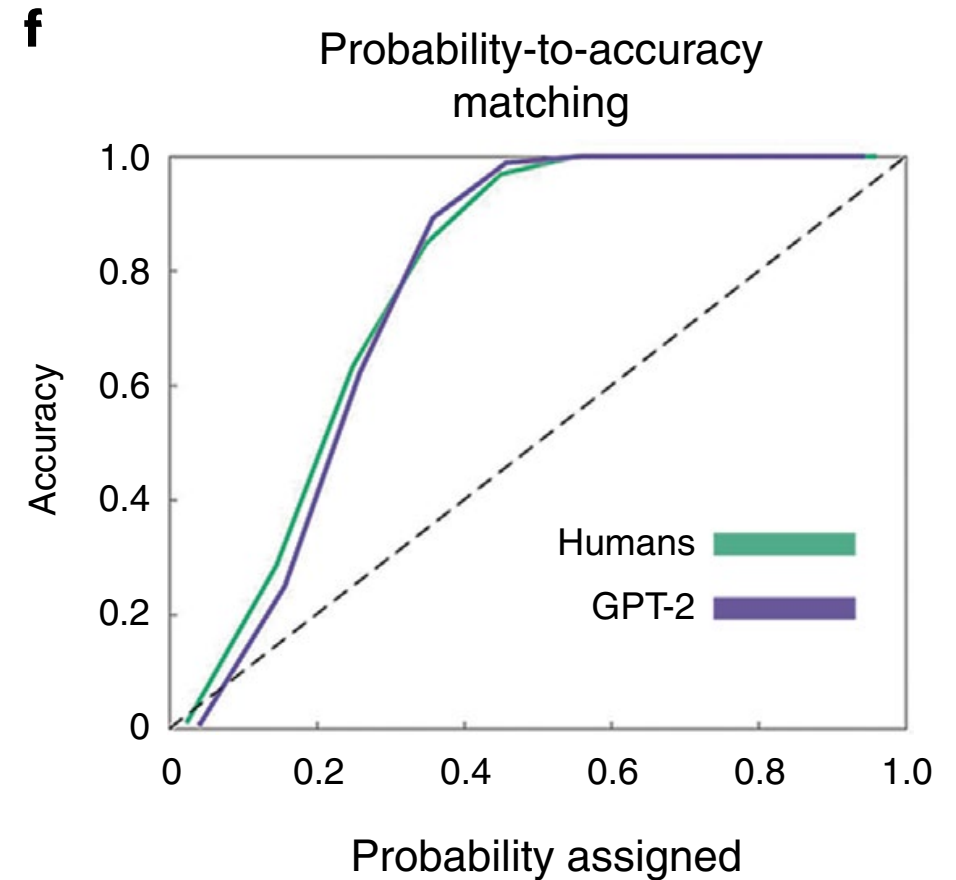
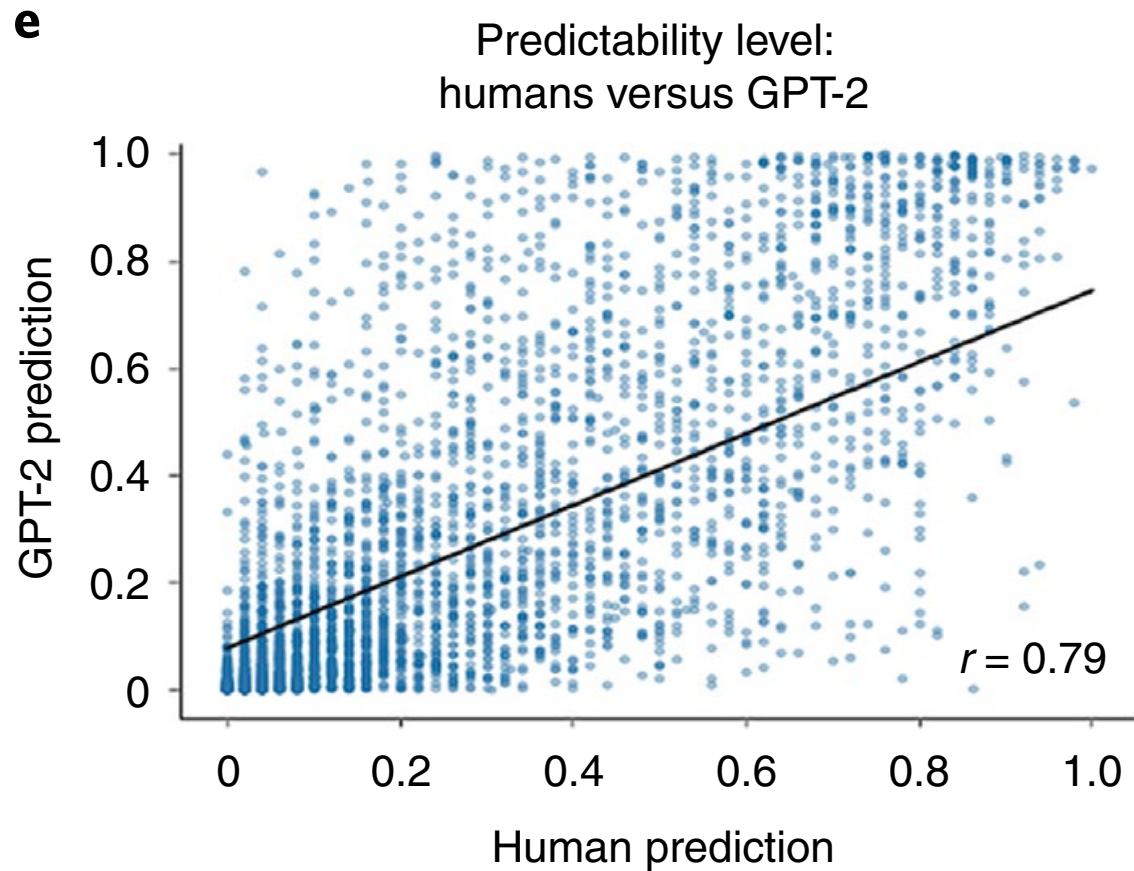
b Next-word prediction task



c Behavior

Target	Pt_1	Pt_2	Pt_3	Pt_50	Probability index	
					Human	DLM (GPT-2)
Indonesia	Brazil	far	amazon	... south	0.02	0.01
on	in	there	and	... where	0.06	0.003
an	the	an	a	... a	0.16	0.02
island	island	island	area	... island	0.62	0.43
called	where	called	full	... populated	0.1	0.23

Humans and GPT-2 Make Similar Predictions



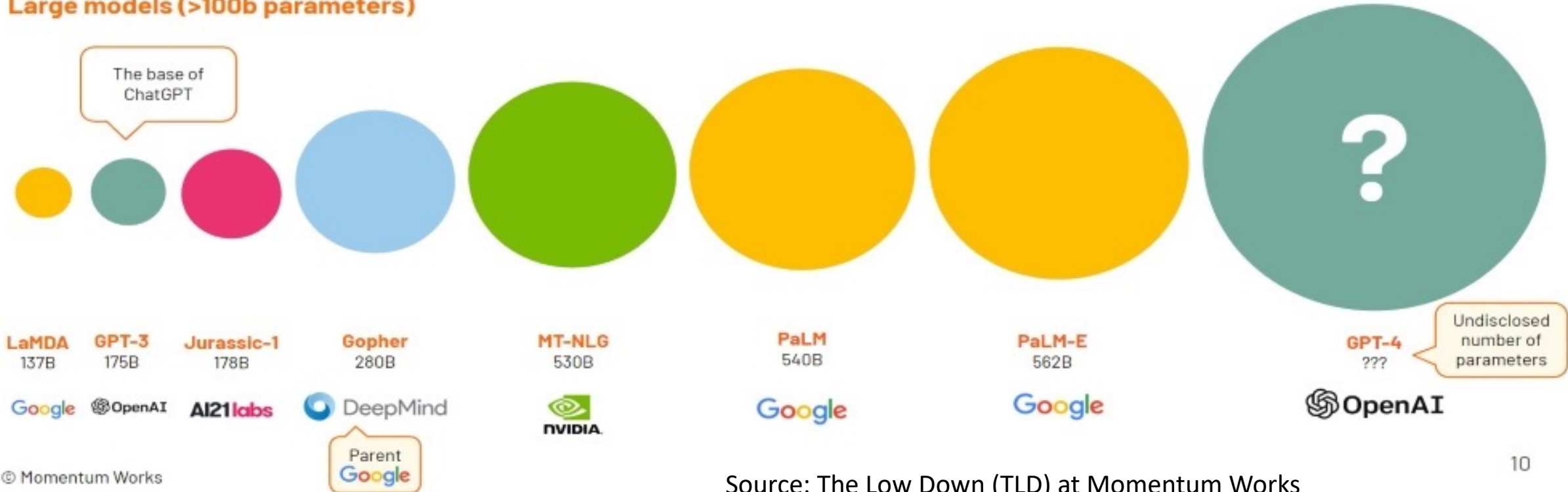
Source: Goldstein et al., *Nature Neuroscience*, 2022

Large Language Models Are Becoming Huge

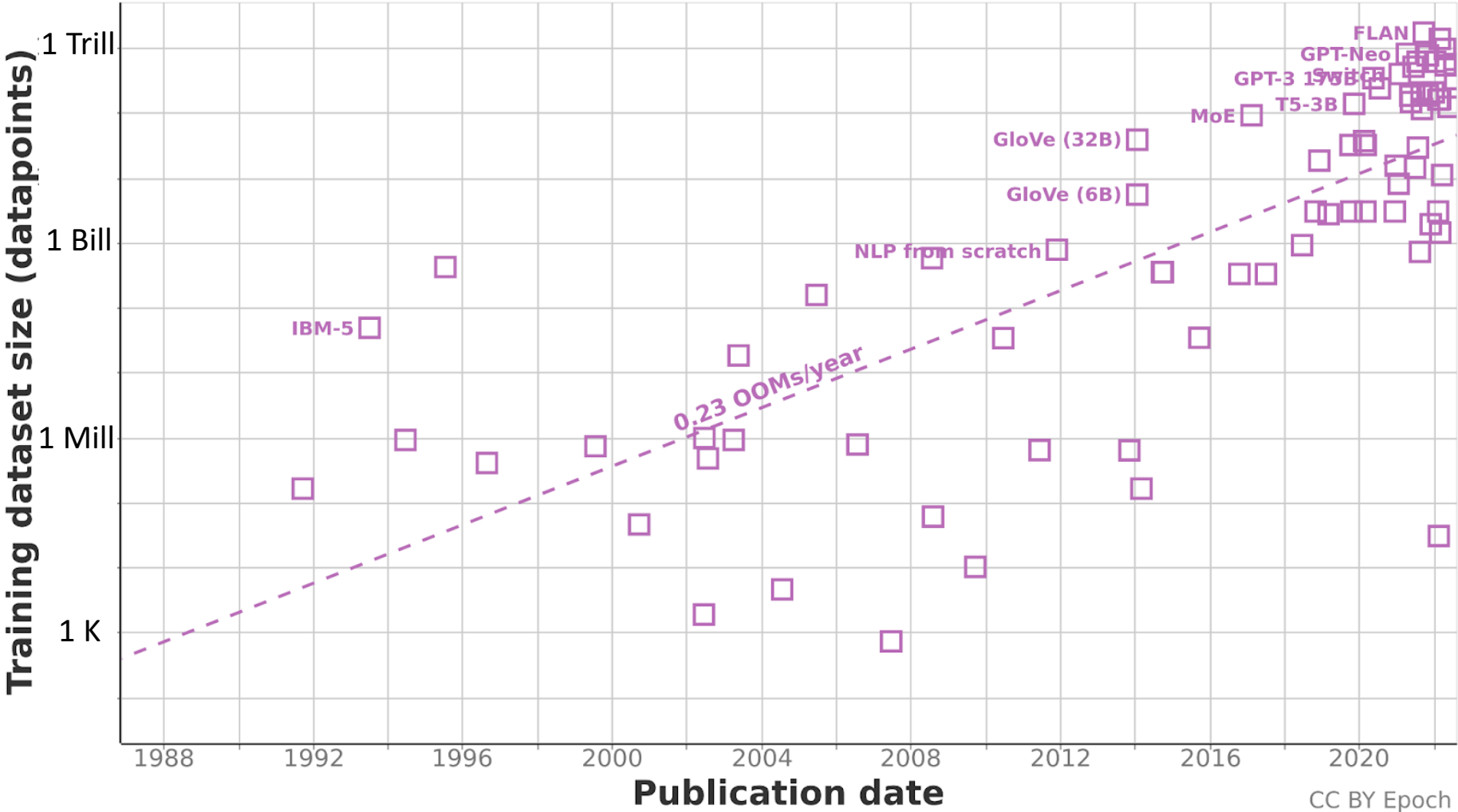
Small models (<= 100b parameters)



Large models (>100b parameters)

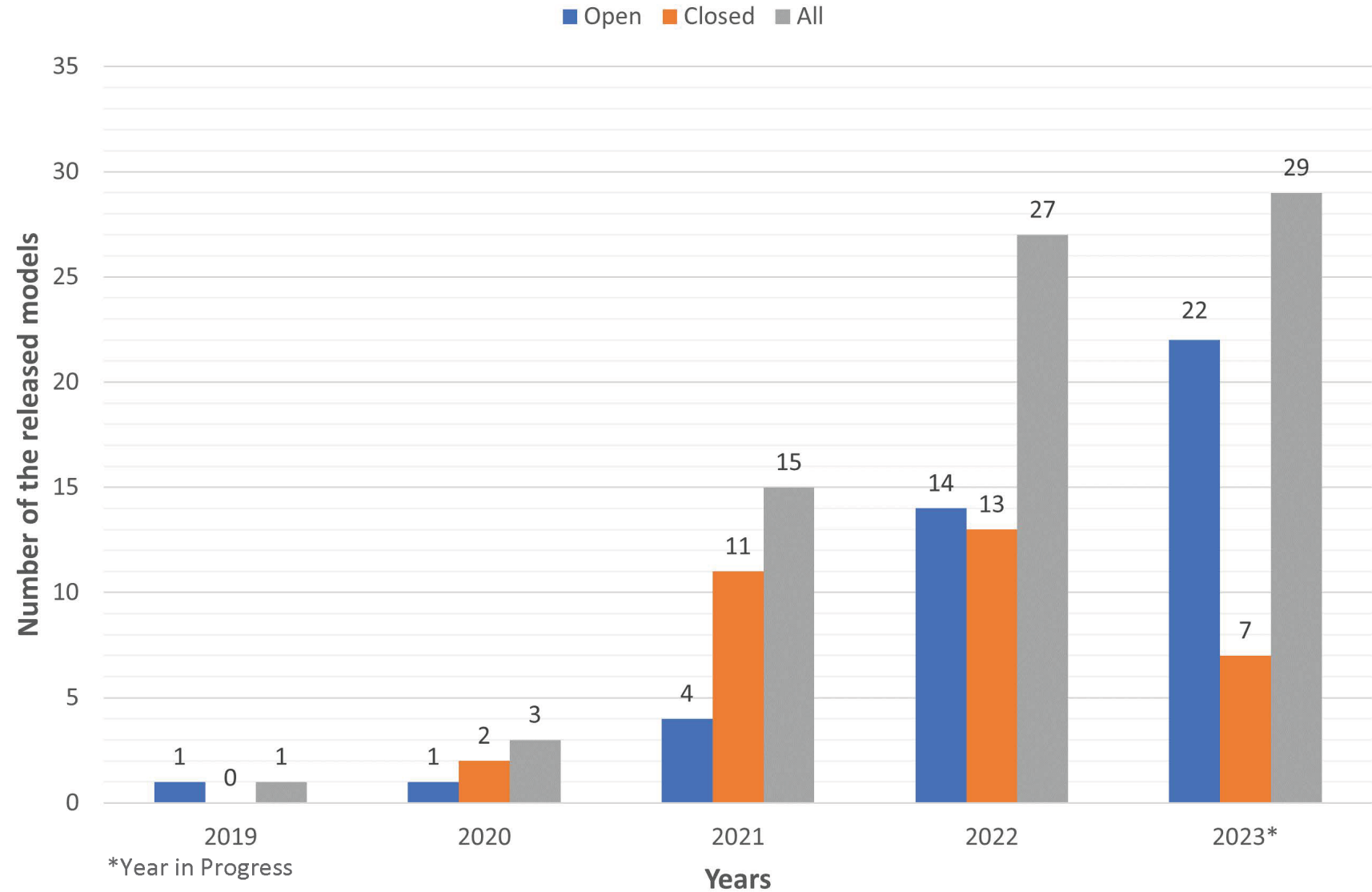


Training Datasets Are Becoming Ever Larger



Source:
<http://epochai.org>

Explosion of New Models



Source: Naveed et al.,
arXiv:2307.06435

Generative Artificial Intelligence for Education and Pedagogy

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Opportunities from Generative AI

- a customized learning experience
- increasing accessibility for students with learning disabilities
- allowing instructors to scale constructive critiques for iterative learning and improvement in writing
- assisting in tasks (e.g., coding, creative composition, etc.)

Challenges from Generative AI

- output can be biased and inaccurate
- might be used to circumvent the process of learning and assessment in classes
- lack of affordable access for all students could exacerbate systemic inequalities
- might atrophy students' ability and willingness to interact with others

Every instructor must deal with Generative AI

- rethink learning outcomes
- address safety and ethics
- explicitly state policies for use of Generative AI:
 - prohibit
 - allow with attribution
 - encourage

Prohibit Generative AI tools

- discuss why academic integrity is important
- use assignments less suited to Generative AI models
 - align assessments closely with class content
- in-class written paper test or oral exams
 - NB: may disproportionately impact students with disabilities
- don't use detection tools – they're not reliable
 - may penalize non-native speakers

Allow Generative AI tools with attribution

- educate students about risks
- consider privacy issues
- take intellectual property rights into account
- make sure there's equal access to generative AI tools

Encourage responsible Generative AI use

- Generative AI tools are part of the future workplace
- in class, Generative AI
 - can provide support for students with disabilities
 - do routine work, leading to critical thinking and analysis
 - be used for individualized practice, help, and tutoring
 - show how they used and their impact on a domain
 - provide practice in the use of Generative AI as a tool

Example 1: Editing Skills

- provide students with a short text
- ask students to:
 - edit the text on their own
 - run the text through a generative AI
 - have students compare their editing choices to the editing choices made by the generative AI
 - submit a final revised text
 - submit reflections on why they included the final edits

Example 2: Generative AI as peer editor

- ask students to:
 - have generative AI offer constructive feedback on their writing
 - review the feedback and edit their work
 - reflect on aspects of the feedback:
 - which suggestions were helpful/not helpful
 - are there patterns in the feedback in the suggestions?
 - did the generative AI miss something?
 - how can you use the feedback to improve future writing?

Example 3: Brainstorm ideas

- ask students to:
 - use generative AI to brainstorm ideas for an assignment
 - evaluate the ideas based on the assignment requirements and what has been learned in the course
 - further develop their favorite idea and write the assignment
 - reflect on the usefulness of generative AI in the brainstorming process

Using Generative AI to create course content

- Generative AI can create:
 - draft for course structure/syllabi
 - lecture structure and examples, figures and diagrams
 - generate sets of practice problems or test questions
- instructors should follow attribution guidelines
- can be used for some types of repetitive feedback
- should not be used for formal student evaluation

Recommendations for faculty

- be explicit about expectations regarding the use of Generative AI tools
 - prohibit/attribute/encourage
- discuss the importance of academic integrity
- integrate critique of current Generative AI practices/use, including ethical issues, into all stages of learning
- be a model of responsible Generative AI use

Recommendations for university administrators

- recognize the additional burden on instructors to adapt to the rapidly changing effects of Generative AI on education
- instructors should decide whether to **prohibit**/**attribute**/**encourage** Generative AI in their classes
- academic Integrity standards should be updated with clear and explicit language on the use of Generative AI
- in consultation with faculty and academic staff, develop best practices on assessments, given the growing tension between the need to ensure academic integrity and the need to ensure access and inclusion for marginalized students

Every instructor will have to deal with Generative AI!

- CU Committee Report: http://tiny.cc/CU_GAI
- UNESCO Report: http://tiny.cc/UNESCO_GAI
- ChatGPT & Education: http://tiny.cc/ChatGPT_Ed