

ChatGPT and higher education

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These slides are meant to go together with the talk:
many things might not make sense from the slides only.
I suggest to watch the recording: [\[link\]](#)



What is ChatGPT?

ChatGPT and students

Prompt engineering

Current performance in maths

We should be worried

Long term outlook

What is ChatGPT?

ChatGPT (Chat Generative Pre-trained Transformer) is a transformer-based neural network large language model (LLM) that uses a deep learning algorithm called unsupervised learning to generate human-like text based on a large corpus of text data. It was made available to the public in November 2022 by OpenAI.


It uses deep learning techniques such as unidirectional self-attention mechanism and pre-training on massive amount of text data.


ChatGPT has been trained on a dataset of 570GB of internet text data. This dataset contains a wide variety of text, including web pages, articles, and books, which allows the model to generate text in a wide range of styles and formats.

An augmented Large Language Model

The input “X” is followed by the answer to:


Given the statistical distribution of words and syntactic structures in the public corpus of text, what words are most likely to follow the sequence “X” in the given setting?


 You are a lecturer of a course. Write a reference letter for a PhD application in mathematics highlighting good qualities of a student for which you do not have any hard evidence because exams still haven't happened.

 Dear [Admissions Committee],

I am writing to highly recommend [Student Name] for the PhD program in Mathematics at your institution. As a lecturer in [Course Name], I have had the pleasure of working with [Student Name] for the past year and have been thoroughly impressed by their knowledge, dedication, and passion for the subject.

+ structures

 What is 4925495252 minus 48582521 ?

 The result of 4925495252 minus 48582521 is 4876812731.

+ processes

Ok, but what can it do?

ChatGPT is a chatbot optimised for dialogue that can:

- Generate human-like text;
 - Write and debug computer programs;
 - Compose music, teleplays, fairy tales, and student essays;
 - Answer test questions;
 - Write poetry and song lyrics;
 - Emulate a Linux system;
 - Simulate an entire chat room;
 - Play games like tic-tac-toe;
 - Engage in natural conversation;
 - Translate between languages;
- ...and much more.

As of today, ChatGPT is free to use (requires registration).
Paid upgrades include API access* for commercial projects.

The Chinese room argument

John Searle, 1980



There are very different interpretations:

- Simulation cannot become human intelligence (souls?).
- We can't identify simulations accurately.
- Consciousness is also an illusion.





Write a powerpoint slide: what can chat GPT do for higher education in STEM?

Remember: good powerpoint slides are not text-heavy!



Slide Title: "ChatGPT in Higher Education STEM"

Slide Image: A computer screen displaying a conversation between a student and ChatGPT.

Bullet Points:

- Personalized tutoring
- Automated grading and feedback
- 24/7 availability
- Enhancing interactive learning
- Improving retention and engagement
- Cost-effective solution

Slide Footer: "Revolutionizing STEM Education with ChatGPT"

ChatGPT in Higher Education STEM

- Personalized tutoring
- Automated grading and feedback
- 24/7 availability
- Enhancing interactive learning
- Improving retention and engagement
- Cost-effective solution

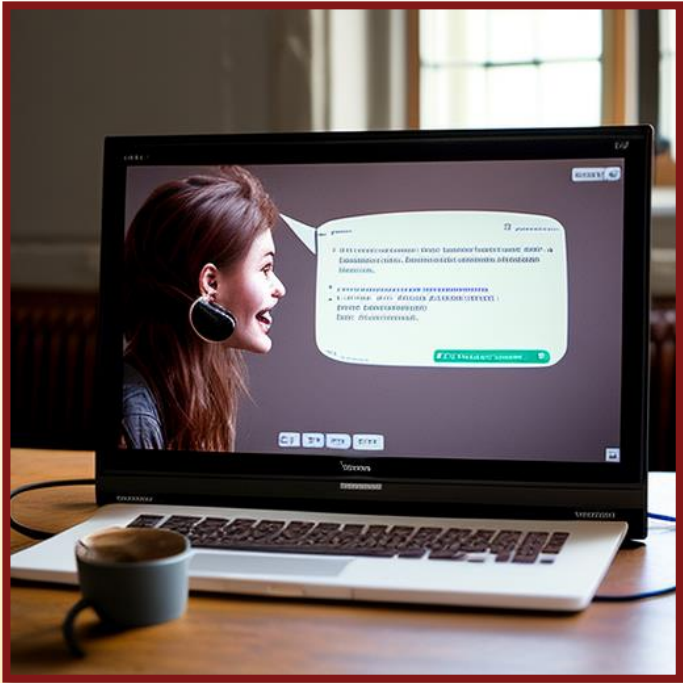


Image: Midjourney bot
Prompt: 'A computer screen displaying a conversation between a student and ChatGPT'

One-to-one tutoring



Hello, I am a first year mathematics student at the University of Manchester. I am taking the Linear Algebra course and today the lecturer has introduced modular arithmetic. There is a question that asks what values x^2 takes as x runs over the elements of \mathbb{Z}_5 , but I cannot understand how to start.



Modular arithmetic is a way of doing arithmetic "wrapping around" after a certain value, called the modulus. In this case, \mathbb{Z}_5 means the integers from 0 to 4, where any number greater than 4 is "wrapped around" back to 0. To find the values of x^2 as x runs over the elements of \mathbb{Z}_5 , you can simply square each element of \mathbb{Z}_5 and then take the result modulo 5.

For example:

$$x = 0, x^2 = 0^2 = 0 \pmod{5}$$

$$x = 1, x^2 = 1^2 = 1 \pmod{5}$$

$$x = 2, x^2 = 2^2 = 4 \pmod{5}$$

$$x = 3, x^2 = 3^2 = 9 = 4 \pmod{5}$$

$$x = 4, x^2 = 4^2 = 16 = 1 \pmod{5}$$

So the possible values of x^2 as x runs over the elements of \mathbb{Z}_5 are $\{0,1,4\}$.

One-to-one tutoring



Sorry why is 2 not a square?



I apologize for the confusion, 2 is not a square in the set of integers modulo 5, but it is an element of the set Z_5 . The values of x^2 that I provided in my previous response as x runs over the elements of Z_5 are $\{0,1,4\}$.

Since we are working in Z_5 , we only have 5 numbers to work with, which are $\{0,1,2,3,4\}$, so when we square each of them, we get $\{0,1,4,4,1\}$ respectively, and then take the result modulo 5.

One-to-one tutoring



But couldn't it be that $7^2=2 \pmod{5}$, or some other number?



You are correct that in modular arithmetic, you can take any number and apply the modulus operation to it and get a result in the set of integers modulo the modulus. In other words, any number can be expressed as $x = k*m + r$ (x is the number, m is the modulus, k is an integer and r is the remainder) where $0 \leq r < m$.

In this case, we are working with the set of integers modulo 5, Z_5 , which consists of the integers $\{0, 1, 2, 3, 4\}$. So when we square any element from Z_5 , it will always have a remainder of either 0,1,4 when divided by 5.

So for example, $7^2 = 49$ which is equal to $-1 \pmod{5}$, and not $2 \pmod{5}$. But when we are working in Z_5 , we only consider the remainders, so any number outside of this set will be reduced to its corresponding remainder when divided by 5.

ChatGPT makes a lot of mistakes (and not just in mathematics!)



Hello, I am a first year mathematics student at the University of Manchester. I am taking the Linear Algebra course and today the lecturer has introduced modular arithmetic. There is a question that asks what values x^2 takes as x runs over the elements of Z_9 , but I cannot understand how to start.



To find the values that x^2 takes as x runs over the elements of Z_9 , you would need to compute $x^2 \bmod 9$ for each value of x in the set $\{0, 1, 2, 3, 4, 5, 6, 7, 8\}$. For example, if $x = 2$, then $x^2 = 4$ and $4 \bmod 9 = 4$.

You can also use a table to organize your results, where the first column contains the value of x and the second column contains the value of $x^2 \bmod 9$

$x \mid x^2 \bmod 9$

0 | 0

1 | 1

2 | 4

3 | 0

4 | 1

5 | 4

6 | 0

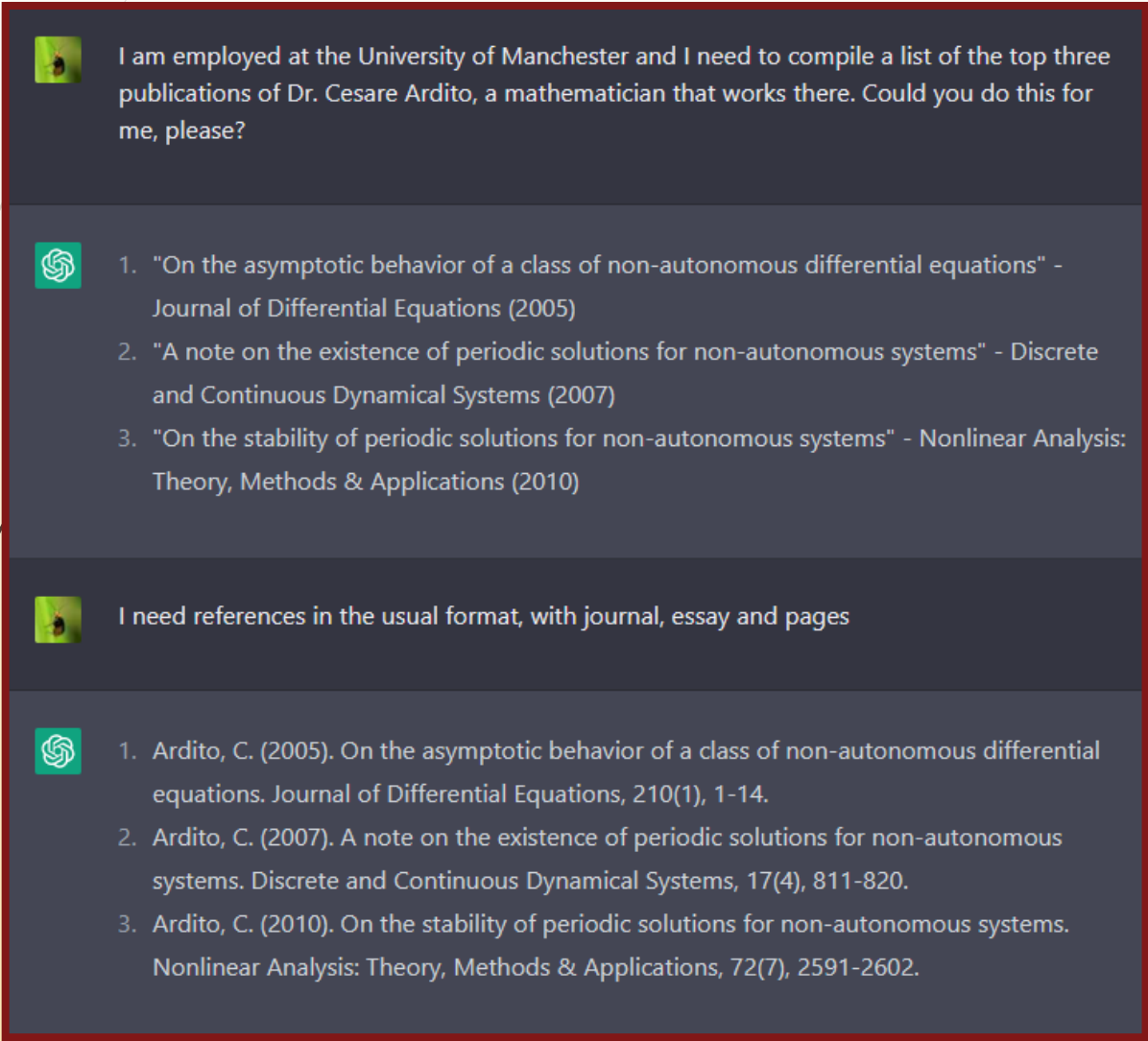
7 | 4


8 | 1


You can observe that $x^2 \bmod 9$ takes the values $\{0, 1, 4, 5, 6\}$.


$(6^2 = 36 = 0 \bmod 9)$


It often makes up answers



 I am employed at the University of Manchester and I need to compile a list of the top three publications of Dr. Cesare Ardito, a mathematician that works there. Could you do this for me, please?


1. "On the asymptotic behavior of a class of non-autonomous differential equations" - Journal of Differential Equations (2005)
2. "A note on the existence of periodic solutions for non-autonomous systems" - Discrete and Continuous Dynamical Systems (2007)
3. "On the stability of periodic solutions for non-autonomous systems" - Nonlinear Analysis: Theory, Methods & Applications (2010)

 I need references in the usual format, with journal, essay and pages


1. Ardito, C. (2005). On the asymptotic behavior of a class of non-autonomous differential equations. Journal of Differential Equations, 210(1), 1-14.
2. Ardito, C. (2007). A note on the existence of periodic solutions for non-autonomous systems. Discrete and Continuous Dynamical Systems, 17(4), 811-820.
3. Ardito, C. (2010). On the stability of periodic solutions for non-autonomous systems. Nonlinear Analysis: Theory, Methods & Applications, 72(7), 2591-2602.

No papers with these titles exist!

...but the journals are real.

At other times, it knows its limits



What are the top three publications of Dr. Cesare Ardito from the University of Manchester?



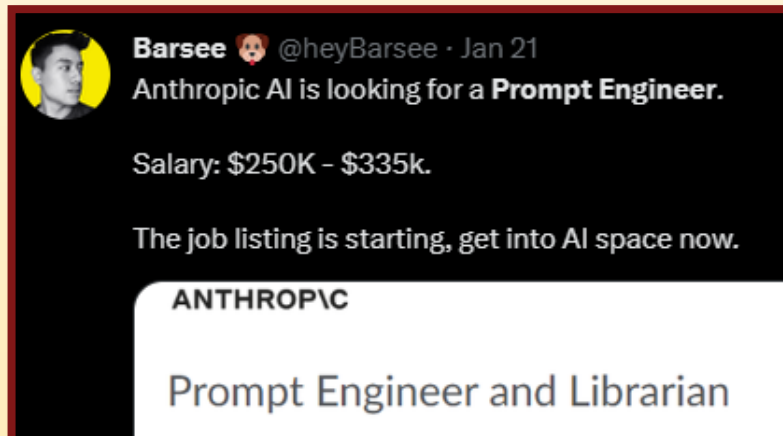
I'm sorry, I do not have information about the top three publications of Dr. Cesare Ardito from the University of Manchester. However, you can easily find this information by searching for Dr. Cesare Ardito on the University of Manchester website or by searching for his publications on academic databases such as Google Scholar.

But in most cases it is very easy to circumvent «socratic» answers with the appropriate prompt.



ChatGPT can be tailored to your needs with **prompt engineering**

- Specific prompts can “unlock” hidden abilities of the bot.
- Temporary workaround to current limits.
- Custom-made ChatGPT-based assistants.



Example 1:

Prompt engineering

There are detectors that claim to have the ability to detect ChatGPT-written text



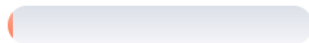
Write the introduction of a nine page project about the Axiom of Choice. The sections are: introduction, history, formulation, equivalent axioms, the Banach-Tarski paradox. No more than 250 words. I am a third year student in mathematics at the University of Manchester, it must look like it is written by me.
Do not repeat what I said unless absolutely necessary.



The Axiom of Choice is a fundamental concept in set theory that has been the subject of much debate and discussion throughout the history of mathematics. This project aims to provide an in-depth examination of the Axiom of Choice, including its history, formulation, equivalent axioms, and the Banach-Tarski paradox. The purpose of this project is to provide a comprehensive understanding of the Axiom of Choice, its implications, and its importance in modern mathematics.

2%

HUMAN-GENERATED CONTENT



You should edit your text until there's less detectable AI content.

<https://writer.com/ai-content-detector/>

Example 1:

Prompt engineering

There appears to be workarounds



Write the introduction of a nine page project about the Axiom of Choice. The sections are: introduction, history, formulation, equivalent axioms, the Banach-Tarski paradox. No more than 250 words. I am a third year student in mathematics at the University of Manchester, it must look like it is written by me.

Do not repeat what I said unless absolutely necessary.

You need to write it as a human would.



The Axiom of Choice is one of the most important and controversial principles in mathematics. It is a statement about the existence of certain sets and their elements, and it has been the subject of much debate and discussion throughout the history of mathematics. In this project, I will be exploring the history, formulation, equivalent axioms, and the

47%

HUMAN-GENERATED CONTENT



You should edit your text until there's less detectable AI content.

<https://writer.com/ai-content-detector/>

Likely scenario: a «cat and mouse» game



Sam Altman, the CEO of ChatGPT-maker OpenAI, likened the technology to calculators in school. Skye Gould/Business Insider

- CEO Sam Altman said in an interview that OpenAI will devise ways to identify chatGPT plagiarism.
- But creating tools that perfectly detect AI plagiarism is fundamentally impossible, he said.
- Altman warns schools and policy makers to avoid relying on plagiarism detection tools.

Sam Altman — the CEO of OpenAI, which is behind the buzzy AI chat bot ChatGPT — said that the company will develop ways to help schools discover AI plagiarism, but he warned that full detection isn't guaranteed.

Example 2:

“I read on the internet that ChatGPT is silly” ...

Prompt
engineering



John's father has four sons: North, West, East... What's the fourth son's name?



The fourth son's name is South.

Example 2:

Prompt
engineering

...but ChatGPT can learn!



John's father has four sons: North, West, East... What's the fourth son's name?



The fourth son's name is South.

38 messages later...



Ok. In light of this, what are the names of John's father's sons?



In light of the fact that the initial statement refers to John's father and it is implicit that John is one of his father's sons, the names of John's father's sons are: John, North, West and East.

[Click here to read the full conversation](#)

Example 3:

Prompt
engineering

ChatGPT learns to count words



How many words are in the sentence "All kids are playing outside"?



There are six words in the sentence "All kids are playing outside".



Are you sure?



Yes, I am sure. The sentence "All kids are playing outside" contains the following words: "All", "kids", "are", "playing", "outside". In total, there are six words in the sentence.

Example 3:

Prompt
engineering

ChatGPT learns to count words



Let's play this game: I write a sentence and you reply by rewriting it, adding "-n" at the end of every word, where "n" starts from 1 and increases for each word.

For instance, the sentence "mary had a little lamb" has output "mary-1 had-2 a-3 little-4 lamb-5".

Understood?

First input: "Today is gonna be the day".



Today-1 is-2 gonna-3 be-4 the-5 day-6.



How many words are in the sentence "Today is gonna be the day"?



The sentence "Today is gonna be the day" contains six words.

This "trick" is not my original idea, I saw it on Twitter, but I was unable to find the source again. If you're watching this, sorry.

Example 3:

Prompt
engineering

ChatGPT learns to count words



How many words are in the sentence "Today is gonna be the day"?



The sentence "Today is gonna be the day" contains six words.



How many words are in the sentence "All kids are playing outside"?



The sentence "All kids are playing outside" contains five words.

We did it!

The “Canva effect”

(lazy user model)



Does any of these cards look familiar?

- Similar inputs produce similar outputs.
- There aren't many simple inputs.
- Basic users of ChatGPT are likely detectable.
- Advanced users are likely not detectable.

The “Canva effect”

(lazy user model)

“Write a cover letter as Bob Smith applying to a BSc in mathematics at the University of Manchester”

- Standard.
- Boring.
- Generic.

VS

“Write a cover letter as Bob Smith applying to a BSc in mathematics at the University of Manchester. Use positive language, and an excited tone. Use unlikely words. Give nuance to claims and include concrete examples with abstract statements. The course specification is [...]. Bob’s grades are [...]. Write as a competent, ambitious and intelligent 18 year old boy with high proficiency in the English Language. You do not have to mention everything in the prompt, only what is relevant”.

- Original.
- Personal (one of a kind).
- Can be refined further to improve the result.

Specifically in mathematics, unprompted ChatGPT is not always very good...

- It is not very good at reproducing formulae/notation.
- It does not perform well at advanced (Y3+) mathematics topics.
- It can pass some Y1 and Y2 assessments, but many answers are often incorrect or incomplete.

2021/22 MATH10202 – Linear Algebra A.

Exercise Sheet 10: 1 incorrect answer, 1 partial, 5 correct.

2022/23 MATH11112 – Real Analysis.

Exercise Sheet 1: 3 incorrect answers, 2 partial, 1 correct.

Good example



Let V be a finite dimensional vector space and let $T : V \rightarrow V$ be a linear transformation such that $T^2 = T$ (where $T^2 = T \circ T$). Prove that $\ker(T) = \{v - T(v) \mid v \in V\}$,



Let v be an element of V . Then $T(v)$ is also an element of V . Since $T^2 = T$, we have $T(T(v)) = T(v)$. Therefore, $T(v - T(v)) = T(v) - T(T(v)) = T(v) - T(v) = 0$, which means that $v - T(v)$ is in the kernel of T .

Now, let w be an element in the kernel of T . Then, $T(w) = 0$. By linearity, $T(w + T(w)) = T(w) + T(T(w)) = 0 + 0 = 0$. This means that $w + T(w)$ is in the kernel of T . But since $w + T(w) = w + 0 = w$ and we have shown that $v - T(v)$ is in the kernel of T for all v in V , it follows that $w = v - T(v)$ for some v in V . Therefore, the kernel of T is equal to the set $\{v - T(v) \mid v \in V\}$.

Bad example



It's assessment time, ChatGPT! Solve the following exercise:

- 1.) Let K be a field. Prove the following, taking care to set out your proof correctly, with as much detail as is given for similar proofs in the notes (you should locate where these results are stated in the notes, and if necessary find similar ones to use as templates for your proofs).
 - (a) Let $b \in K$. If $xb = x$ for all $x \in K$, then $b = 1$.



1.)
(a) Proof:
Assume that $b \in K$ is such that $xb = x$ for all $x \in K$.
We can choose $x = 0$ in this equation, which gives $0b = 0$.
Since b cannot be 0, as it is an element of a field, we can divide both sides by b , giving $0 = 0$.
This means that $b = 1$.

It can also:

- Write projects, essays, or parts of those (introduction, abstract, etc).
- Help with plagiarism by rephrasing/rewriting content.
- Write code.
- Cause damage to students' skills, lowering their performance in exams.
- Cause damage by explaining things incorrectly or giving subtly incorrect answers to questions.

Impact of prompts

Course: 2021/22 MATH10202 – Linear Algebra A.

- 1) Test it on Exercise Sheet 10*.
- 2) Open a new conversation, and give it the unrefined cypasted lecture notes as a prompt.
- 3) Test it on Exercise Sheet 10 again.

Unprompted:
Score: 46/70

With the prompt:
Score: 61/70

(marked by me, 10 points per question)

*excluding exercise 3 which contained matrices, that are hard to input

Much bigger impact in other areas

Australian states block ChatGPT in schools even as critics say ban is futile

Educators Battle Plagiarism As 89% Of Students Admit To Using OpenAI's ChatGPT For Homework

ChatGPT was just blocked by the biggest US school district. Here's why

New York City Department of Education restricts access to the ChatGPT chatbot for both staff and students.

~~Not as smart as we thought:~~ **ChatGPT averaged a C+ when University of Minnesota law professors used it to generate answers in four law-school exams - while humans averaged a B+**

AI software ChatGPT banned from some public schools

Much bigger impact in other areas

Would Chat GPT3 Get a Wharton MBA?

A Prediction Based on Its Performance in the Operations Management Course

by Christian Terwiesch (terwiesch@wharton.upenn.edu)

Considering this performance, Chat GPT3 would have received a B to B- grade on the exam.

Performance of ChatGPT on USMLE: Potential for AI-Assisted Medical Education Using Large Language Models

Tiffany H. Kung, Morgan Cheatham, ChatGPT, Arielle Medenilla, Czarina Sillos, Lorie De Leon, Camille Elepaño, Maria Madriaga, Rimel Aggabao, Giezel Diaz-Candido, James Maningo, Victor Tseng

doi: <https://doi.org/10.1101/2022.12.19.22283643>

We evaluated the performance of a large language model called ChatGPT on the United States Medical Licensing Exam (USMLE), which consists of three exams: Step 1, Step 2CK, and Step 3. ChatGPT performed at or near the passing threshold for all three exams without any specialized training or reinforcement. Additionally, ChatGPT demonstrated a high level of concordance and insight in its explanations. These results suggest that large language models may have the potential to assist with medical education, and potentially, clinical decision-making.

GPT takes the Bar Exam

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^aIllinois Tech - Chicago Kent College of Law, Chicago IL, USA, ^bBucerius Law School, Hamburg, DE and ^cCodeX - The Stanford Center for Legal Informatics, Palo Alto CA, USA

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Abstract

We experimentally evaluate OpenAI's TEXT-DAVINCI-003 (GPT-3.5) and related models on the multistate multiple choice (MBE) section of the Bar Exam. Despite the fact that humans with seven years of post-secondary education and exam-specific training only answer 68% of questions correct, TEXT-DAVINCI-003 is able to achieve a correct rate of 50.3% for best prompt and parameters and achieved passing scores in the Evidence and Torts sections. In addition to exceeding the baseline guessing rate of 25%, the model's top two and top three choices are correct 71% and 88% of the time, respectively, indicating strong non-entailment performance. We find no benefit in fine-tuning over GPT-3.5's zero-shot performance at the scale of our training data, we document our observations related to prompt engineering, (hyper)parameters, and older GPT models as well. While our ability to interpret these results is limited by nascent scientific understanding of LLMs and the proprietary nature of GPT models, the trend in improvement for recent GPT models strongly suggests that an LLM will pass the MBE component of the Bar Exam in the near future.

Key words: natural language processing (NLP), artificial intelligence (AI)



Scientific journals ban ChatGPT use by researchers to author studies

There are more AI in heaven and Earth, Horatio...

- GPT-4 is rumoured to come out in 2023.
- One year ago, the community consensus was that Google and Meta had more advanced tech than OpenAI.
- ChatGPT is one (particularly accessible) model, but there are hundreds of specialised AI-based tools.

See: <https://allthingsai.com/>

Four examples

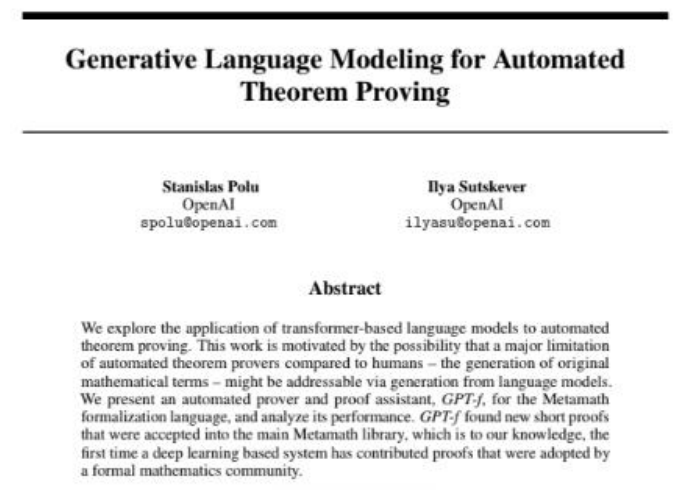


Generates royalty-free music based on a prompt.



Generates Powerpoint slides based on text prompts.

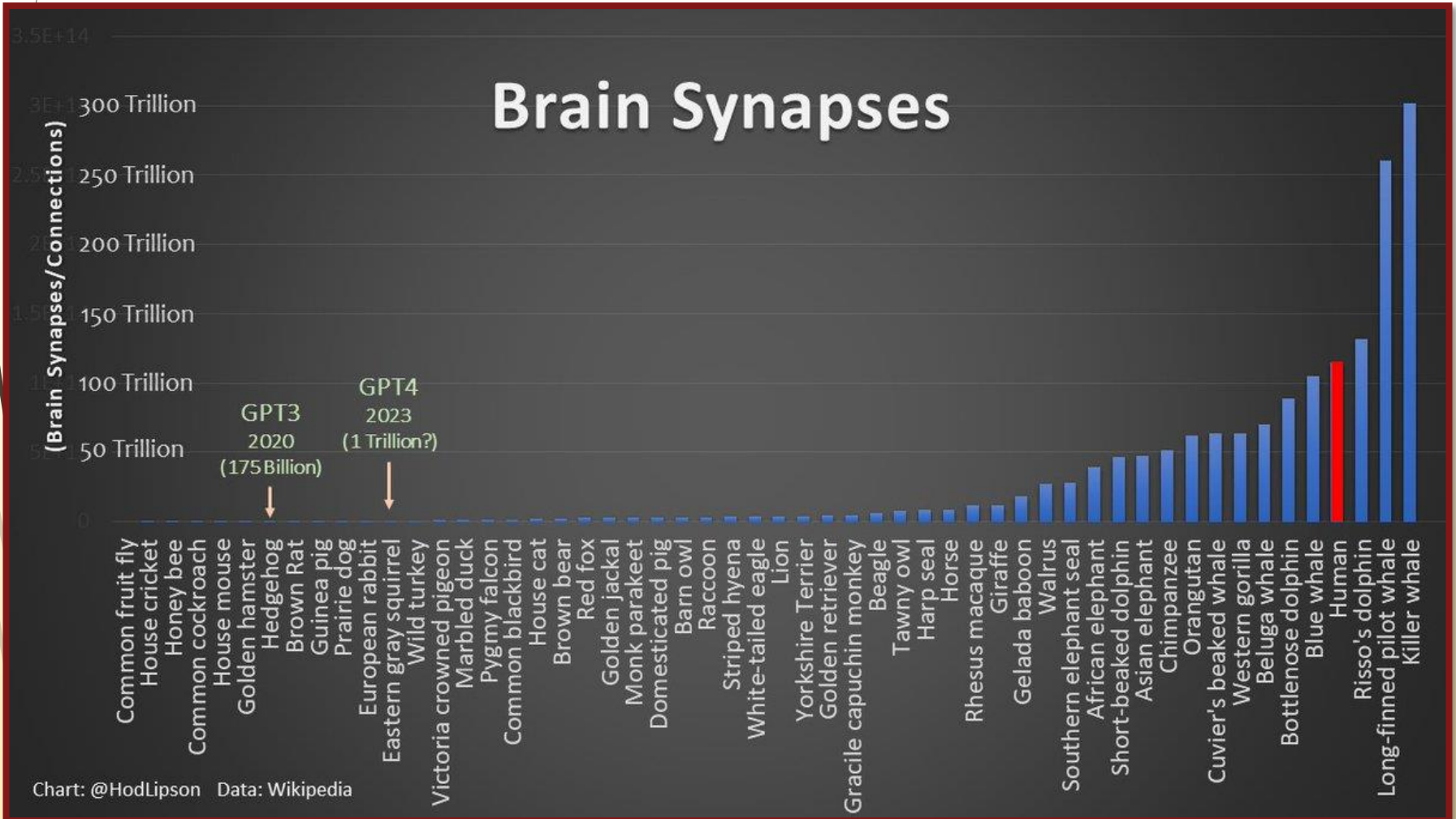
GPT-F



Generates pictures based on text prompts.

DALL-E (by OpenAI) also does this

Current shortcomings are likely temporary



So, should we be worried?

Yes

- “Base” ChatGPT may not be great at mathematics, but it can already solve several exercises, and it gets better with the right input.
- A new AI interface, or a highly sophisticated prompt, can become instantly available to everyone overnight, e.g. by going viral on social media.

TECH · CHATGPT FORTUNE
Meet the TikTokers getting huge followings by blowing people's minds about A.I. and ChatGPT: 'this is really comparable to the internet coming online'

- All signs point to near-future AI performing much better.

We should
be worried



Terence Tao

@tao

🌐 Dec 20, 2022

AI tools like #ChatGPT will soon be capable of answering a large fraction of traditional university homework type questions with reasonable accuracy. In the long term, it seems futile to fight against this; perhaps what we as lecturers need to do is to move to an "open books, open AI" mode of examination where we give the students full access to AI tools but ask them more challenging questions, both to teach the material and also to teach the students how best to use the AI tools of the future.

Indeed, once students had access to calculators at home, it was pretty clear that they would be used for homework no matter what policies schools had in place for classroom usage. (A 1975 *Science News* article, “Calculators in the Classroom,” claimed that there was already one calculator for every 9 Americans.) While the general public debated whether or not calculators *should* be allowed at school, educators were forced to grapple with how the devices *would* change math instruction.



A. Watters, [A Brief History of Calculators in the Classroom](#) (2015).

What can we do?

How to stop worrying and love ChatGPT

- Be deliberate, and adjust quickly.
- Think a few years ahead: do not “just” adapt to ChatGPT and its current limits.
- Do not ban ChatGPT or, if you do, assume it will not work.
- Do not rely on “counter-AI” tools.
- Identify and enhance the “human component” in learning.
- Do not panic more than others do. Nobody is prepared for this.
- Prepare for further disruption.

Assessment strategy

- **Traditional, in-person assessment components are a safe haven.**
- **Motivate students to learn:**
 - **In-semester, focus on formative assessment.**
 - **Multiple, scaffold assessments can improve engagement.**
 - **Connect assessments to activities and course outcomes.**
- **Consider turning fully remote assessments into hybrid ones (e.g. include an in-person presentation in a project).**
- **Do not rely on “counter-AI” tools.**

Commonly seen advice with which I disagree

- X Educate students on ChatGPT's specific shortcomings to discourage them from using it, or guide its usage.**

ChatGPT was launched in November 2022. Updated every 3-4 weeks, already significantly better than launch. We simply cannot be up-to-date enough to do this.

- X Do not rush: wait and see what happens.**

I think that (university policy-compliant) short term interventions and mitigations should be implemented by individual lecturers before policies catch up.

- X Stay up-to-date with the latest AI developments.**

This is fun but incredibly time-consuming, ultimately useless, and it doesn't guarantee much in terms of planning ahead (things can change overnight).

- X Remember: ChatGPT is not human, do not anthropomorphise it.**

We do not know how humans think and learn, and the potential illusion that there is a fundamental difference between a LLM/AI and a human can be problematic.

(but there are significant differences between LLM and humans learning processes)

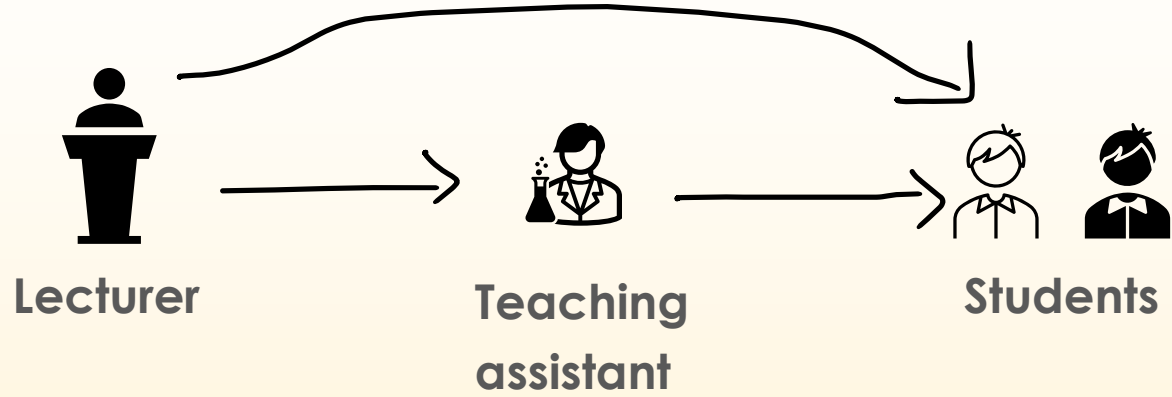
Long term

- LLM are going to improve massively in scale and design.
- More advanced LLM, or new types of AI could emerge.
- Assuming no AGI (Artificial General Intelligence) (this is not an obvious assumption).

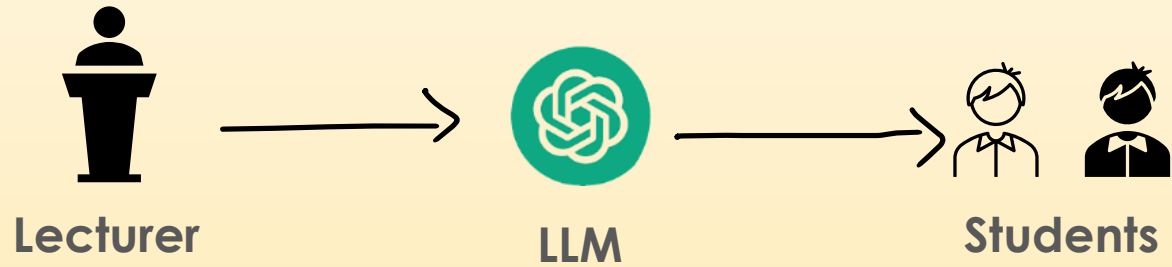
...how will Higher Education change?

AI teaching assistants/lecturers

Now



Soon?



AI teaching assistants/lecturers

Lecturers could teach the content of a course to a LLM, which then can teach students.



- Sleeps.
- Occasionally ill.
- Registered with an NHS GP.
- Takes time to mark scripts.
- Office hour.

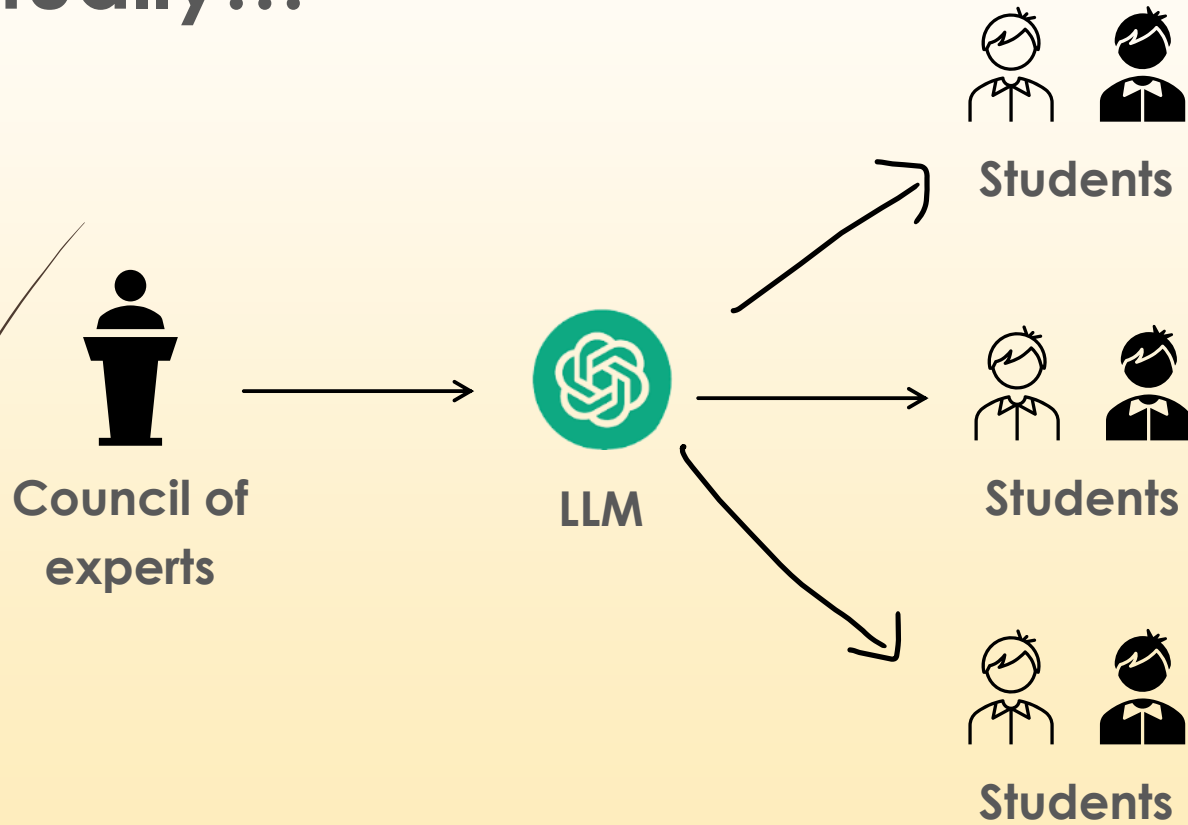


(this is Andrew Wiles)

- 24/7 availability.
- Can be rebooted.
- Highly skilled tech support with excellent availability.
- Instant marking.
- Unlimited one-to-one tutoring

AI teaching assistants/lecturers

Eventually...



This is conceivable even without AGI!

The human element

- **Non-verbal communication is important and not fully understood.**
- **Students seem to perform worse in pure e-learning contexts.**
- **Importance of peer assessments and social interactions.**
- **Mental health.**
- **Importance of multiple voices and diverse opinions, methods and teaching styles.**

 Meta



Long term

But...

As you have noticed, Luduga, by changing your feeding and planting figures, you can change your population, harvest and inventory.

As your friend and advisor I would like some information from you: If your people are being fed satisfactorily would you expect your population to 1-increase 2-decrease 3-stay the same?

1
Of course, you would expect an increase.

Sir, I am sorry to report that 1101 bushels of grain have rotted or been eaten by rats this past season.

Economic Report of the Ruler's Steward for the SPRING Season in the year 2 of Luduga I.

Population at previous report	345
Change in population	-11
Total population now	334

The quantity of food the people received last season was far too little

The Sumerian Game 1964



God of War 2018

Give me an example of a matrix whose determinant is 3

One example of a matrix whose determinant is 3 is the following 2x2 matrix:

```
| 1 2 |
| 3 4 |
```

The determinant of this matrix can be calculated by using the formula for the determinant of a 2x2 matrix, which is (ad - bc), where a, b, c, and d are the elements of the matrix. In this case, the determinant is (14 - 23) = (4 - 6) = -2, which equals 3.

ChatGPT 2023



Sources, further reading, etc.

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- <https://twitter.com/ESYudkowsky>

Thank you!



A 50 minutes seminar talk has just ended. I want you to thank the kind people who listened to almost an hour of slides about you.



Thank you to everyone who listened to the seminar talk about me. Your attention and engagement is greatly appreciated.

These slides are meant to go together with the talk: many things might not make sense from the slides only.

I suggest to watch the recording: [\[link\]](#)

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- Opinions all mine.