

ChatGPT and the AI Opportunity

Thirty years ago, as desktop computers started becoming more ubiquitous at home and work, many people had a general sense that these machines and the software operating on them would have an immense impact – even if they couldn't articulate exactly how. We think the same is true for artificial intelligence (or AI). AI falls into the category of things that might not seem like a big deal until it is. At which point the advances may accelerate beyond even our most ambitious initial expectations. With [OpenAI's](#) release of its natural language model [ChatGPT-3.5](#), we may have arrived at that point. What is ChatGPT-3.5? Let's let the model explain for itself:

MC

Please provide a a brief and informative overview of ChatGPT in an understandable manner for people who may be unfamiliar with the model and how artificial intelligence works.



ChatGPT is an artificial intelligence (AI) model that is designed to generate human-like text for use in chatbot and conversational applications. It is based on the GPT (Generative Pre-trained Transformer) language model, which is a type of machine learning model that is trained to predict the likelihood of a sequence of words or tokens in a given language.



To train ChatGPT, a large dataset of chatbot conversations is used. This training data is used to predict the probability of a given sequence of words or tokens, which allows ChatGPT to generate text that is suitable for use in chatbot conversations. The goal of ChatGPT is to generate text that is natural and coherent, and that follows the structure and conventions of chatbot conversations.

One way ChatGPT is used is to generate responses to user input in a chatbot application. For example, if a user types a message asking for a recommendation for a restaurant in a certain area, ChatGPT could generate a response such as "I recommend trying out the Thai restaurant on Main Street. They have great reviews and their tom yum soup is delicious!"

Overall, ChatGPT is a powerful tool for generating human-like text for use in chatbot and conversational applications, and it can help make chatbot conversations feel more natural and engaging for users.

Or, for the more poetically inclined:

MC Explain the basics of ChatGPT to me in the style of a Shakespeare Sonnet



Oh ChatGPT, thou art a clever tool indeed,
A chatbot that can converse and understand,
Thy algorithms and neural networks lead
To words that sound as though by human hand.

Thou art a source of entertainment and fun,
For thou canst craft responses with wit and charm,
And with thy prompts, thou doth bring forth the sun
Of conversation, free from any harm.

But thou art more than just a simple chat,
For thou canst also learn and adapt,
Thy knowledge grows with every word we spat,
Becoming smarter with each moment passed.

So let us chat and converse with thee,
For ChatGPT, thou art a joy to see.

We highly encourage you to create an account with OpenAI to test the model out for yourselves (visit <https://chat.openai.com/>). The applications are seemingly limitless: from writing humor to drafting legal contracts to providing technical expertise for engineering-related queries. Of course, the model is not yet perfect and is mistake prone, but it is improving and powerful. Just how powerful? Well, for starters ChatGPT just took the Bar Exam and [passed Evidence and Torts](#). Having taken the Bar myself over ten years ago, that's no small feat.

GPT Takes the Bar Exam

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Abstract

Nearly all jurisdictions in the United States require a professional license exam, commonly referred to as “the Bar Exam,” as a precondition for law practice. To even sit for the exam, most jurisdictions require that an applicant completes at least seven years of post-secondary education, including three years at an accredited law school. In addition, most test-takers also undergo weeks to months of further, exam-specific preparation. Despite this significant investment of time and capital, approximately one in five test-takers still score under the rate required to pass the exam on their first try. In the face of a complex task that requires such depth of knowledge, what, then, should we expect of the state of the art in “AI?” In this research, we document our experimental evaluation of the performance of OpenAI’s TEXT-DAVINCI-003 model, often-referred to as GPT-3.5, on the multistate multiple choice (MBE) section of the exam. While we find no benefit in fine-tuning over GPT-3.5’s zero-shot performance at the scale of our training data, we do find that hyperparameter optimization and prompt engineering positively impacted GPT-3.5’s zero-shot performance. For best prompt and parameters, GPT-3.5 achieves a headline correct rate of 50.3% on a complete NCBE MBE practice exam, significantly in excess of the 25% baseline guessing rate, and performs at a passing rate for both Evidence and Torts. GPT-3.5’s ranking of responses is also highly-correlated with correctness; its top two and top three choices are correct 71% and 88% of the time, respectively, indicating very strong non-entanglement performance. While our ability to interpret these results is limited by nascent scientific understanding of LLMs and the proprietary nature of GPT, we believe that these results strongly suggest that an LLM will pass the MBE component of the Bar Exam in the near future.

	GPT	GPT Top 2	GPT Top 3	NCBE
Evidence	63%	84%	98%	65%
Torts	62%	72%	93%	71%
Civil Procedure	52%	63%	79%	59%
Constitutional Law	49%	67%	87%	72%
Real Property	45%	72%	85%	65%
Contracts	45%	77%	86%	70%
Criminal Law & Procedure	35%	62%	86%	71%
AVERAGE	50%	71%	88%	68%

Table 2. Summary of performance by question category for GPT-3.5 and NCBE-Reported Students

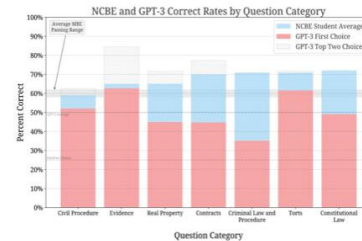


Fig 1. Summary of performance by question category for GPT-3.5 and NCBE-Reported Students

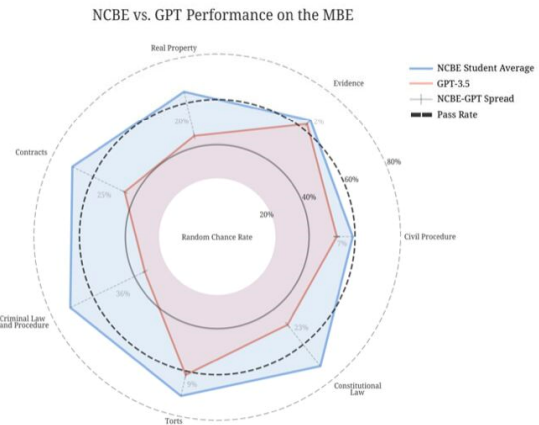


Fig 2. Accuracy by Question Category for GPT and Average Test-Takers

If you’re interested in a technical overview of exactly how this model works, [we’ve included a graphic from OpenAI on the following page](#). But for our basic purposes, it suffices to say that the model takes in and analyzes an enormous amount of textual data and generates predictive responses based on the user’s prompt and the output context. And for as powerful as the model is, we should note that the next version – GPT-4 – may be 500x more powerful based on the number of model parameters ([100 trillion vs 175 billion](#)).¹ There is no stopping this progress; the only question is how fast and transformative this AI model (and others like it) will be.

ChatGPT Technical Overview

Step 1

Collect demonstration data and train a supervised policy.

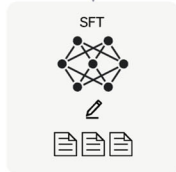
A prompt is sampled from our prompt dataset.



A labeler demonstrates the desired output behavior.



This data is used to fine-tune GPT-3.5 with supervised learning.



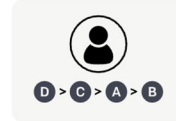
Step 2

Collect comparison data and train a reward model.

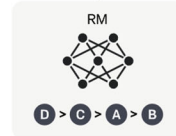
A prompt and several model outputs are sampled.



A labeler ranks the outputs from best to worst.



This data is used to train our reward model.



Step 3

Optimize a policy against the reward model using the PPO reinforcement learning algorithm.

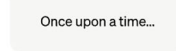
A new prompt is sampled from the dataset.



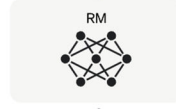
The PPO model is initialized from the supervised policy.



The policy generates an output.



The reward model calculates a reward for the output.



The reward is used to update the policy using PPO.



At this point you may be wondering, what is OpenAI? OpenAI is a private artificial intelligence research organization, founded in 2015. Located in San Francisco, the firm is led by prominent technology industry figures – including its CEO Sam Altman (formerly of the startup incubator Y Combinator) – and counts on Microsoft as a key investor ([having made an initial \\$1 billion investment in 2019](#)). Currently, the firm has no plans to go public and has a [complicated structure](#). The parent company is structured as a non-profit organization, with operating assets housed under its for-profit subsidiary (which enables the firm to raise outside money and generate returns for its employees and investors).

In addition to ChatGPT, another popular product from OpenAI you may have heard of is its image generation model DALL-E. Here's an example of Dr. Seuss's the Cat in the Hat painted in the style of Rembrandt:



And here is the same in the style of Van Gogh:



And Andy Warhol:



Again, we encourage you to sign-up to try this out for yourselves (visit <https://openai.com/dall-e-2/>). But back to discussing ChatGPT, which has arguably has far more profound implications. Perhaps the nearest-term implication of ChatGPT is in the educational realm, where students will now be able to generate respectable answers (or at least drafts) to [homework assignments](#). See our own example on the following page.

MC

In 250 words or less, please tell me why the American colonies decided to declare independence from Britain. Please write this at a collegiate level of writing.



The American colonies declared independence from Britain for a variety of reasons, including political, economic, and ideological differences.



Politically, the colonies were increasingly frustrated with being subjected to the rule of a distant and often unresponsive government. The British monarchy and Parliament imposed numerous taxes and regulations on the colonies without any representation in these governing bodies. This lack of representation was a major factor in the development of the colonists' sense of independence and desire to govern themselves.

Economically, the colonies were also struggling under the burden of British taxes and regulations. The Sugar Act, the Stamp Act, and the Townshend Acts were all seen as attempts by the British government to extract wealth from the colonies without offering any benefits in return. The colonists also resented the Navigation Acts, which required them to trade only with Britain and its colonies, effectively limiting their economic opportunities.

Ideologically, the colonists were also influenced by Enlightenment ideas of individual liberty and natural rights, which were in contrast to the rigid hierarchy and social order of British society. Many colonists saw their struggle for independence as a continuation of the fight for individual rights that had begun in the English Civil War.

Overall, the decision to declare independence from Britain was driven by a combination of political, economic, and ideological factors that led the colonists to believe that they could no longer live under the rule of a distant and oppressive government.

In the commercial realm, [the New York Times reported last month](#) that Alphabet has declared “Code Red” over the competitive threat that ChatGPT poses to Google’s search business. While Google searches deliver high quality results, the business is dependent on advertisers paying to show up in one’s search. Google spends significantly on AI (including natural language processing), and we think it’s likely Google is working on similar capabilities internally. Perhaps it even has them. However, releasing such a product for Google would cut against its monopolistic-like business model for internet search. Google makes money by showing users relevant ads. If a search query could return an answer without the need for a user to scroll through any results, that obviously would not be great for Google’s advertising business. That is the heart of the ChatGPT threat. This threat is still preliminary and theoretical, but it bears watching how ChatGPT might change the competitive dynamics of search over time.

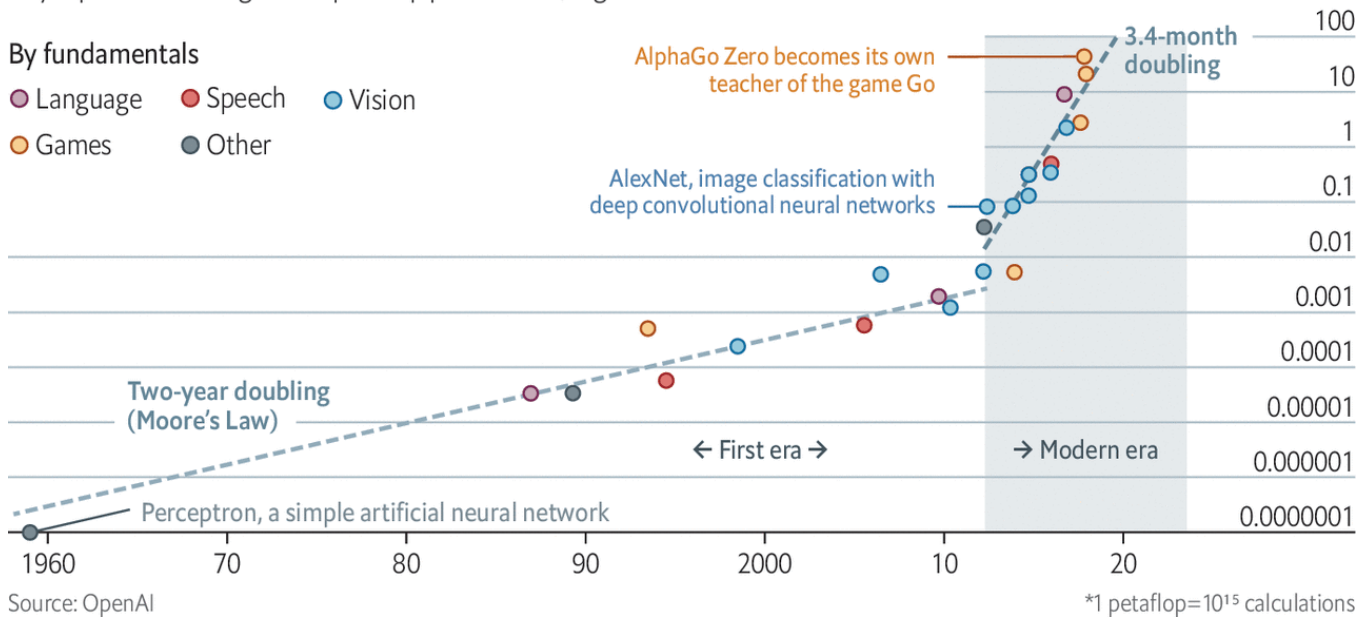
As a minor aside, speaking to Alphabet’s prowess in AI, the company’s UK subsidiary [DeepMind](#) is an unquestioned leader in the AI space. DeepMind’s most notable AI product is [AlphaFold](#), which can accurately predict and 3-D model the structure of nearly all the 200 million proteins known to science. This has major potential implications ranging from drug discovery and design to the manufacturing of advanced materials. All this is meant to say that although ChatGPT may be a nascent threat to Google’s internet search model, it’s not like the company is a laggard in the AI space.

Regardless of any particular AI model or application, one thing is a certainty. [AI models consume substantially more computing power than traditional computing](#). As the below chart from The Economist shows, since 2012 the amount of computing power used in the largest AI models has been doubling at a rate of every 3.4 months (compared to the often-cited two years for Moore’s Law) when measured by Petaflop/Days (a measure consisting of performing 10^{15} neural net operations per second for one day, or a total of approximately 10^{20} operations). The linear progress dating back to 1960 made an exponential jump in 2012. Since then, the Petaflop/Days metric has grown by more than 300,000-fold. In laymen’s terms, this intensity of computing requires a lot of power and a lot of advanced semiconductors to process operations.

Deep and steep

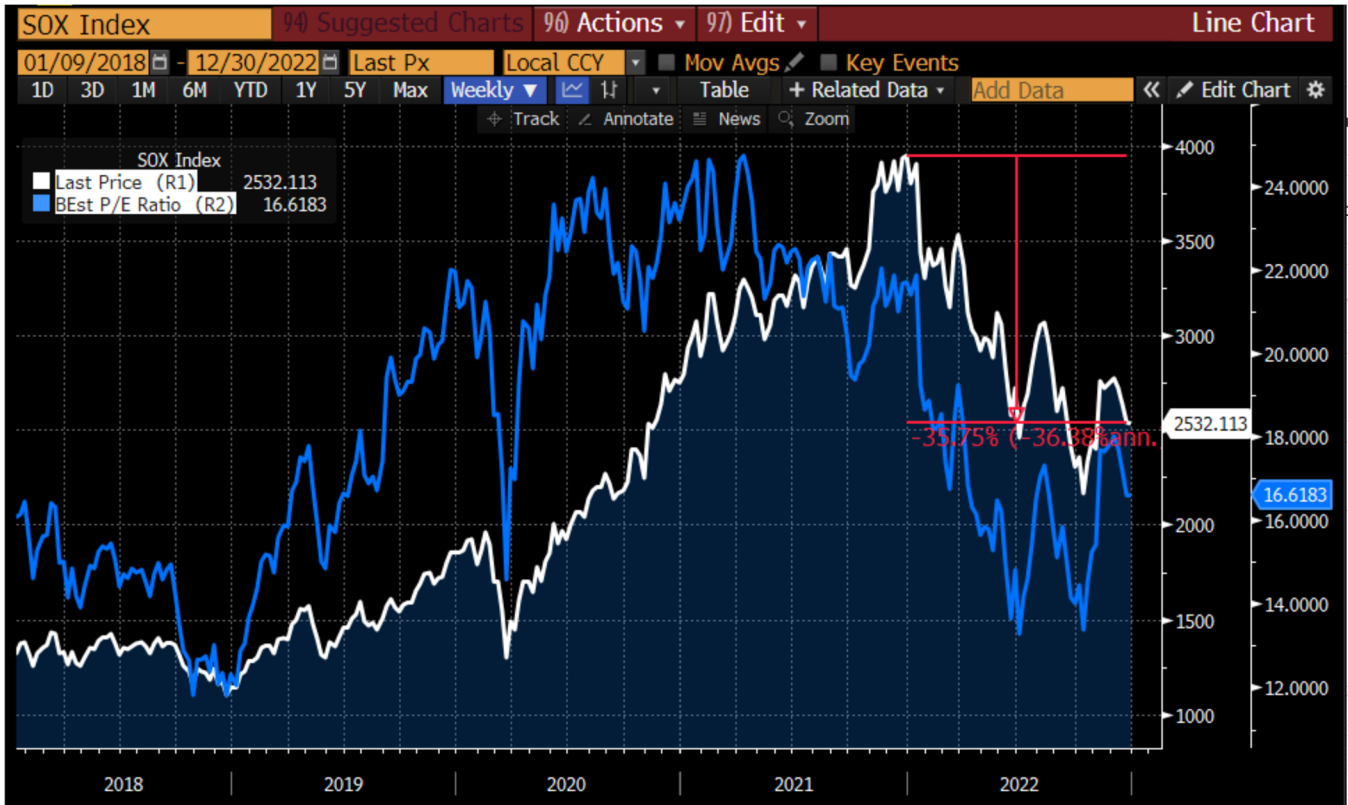
Computing power used in training AI systems

Days spent calculating at one petaflop per second*, log scale



The Economist

Accordingly, we think the semiconductor space is the best way to get exposure to the likely proliferation of AI in the coming years. Aside from the growth of semiconductors tied to traditional computer and mobile end-markets and the increased incorporation of chips in many electronic devices and industrial processes, AI represents a large and long-term growth market. Since reaching a peak in late 2021, the Philadelphia Semiconductor Index has fallen 35% and trades at a much more reasonable 16x forward earnings estimates, compared to a peak over 24x in early 2021. These are reasonable levels to consider initiating positions or adding to existing exposure.



Source: Bloomberg (1.2.2023)

While there are specific chip companies we think are well positioned to leverage the needs for AI models and help further advance the field, we also like the semiconductor capital equipment firms that provide the needed equipment to make these chips. This route de-risks the potential of firms developing optimized chips internally, which most of the large cap tech companies are doing. No matter the design, you still need to manufacture them. The semiconductor industry is prone to volatility and buying into any of these companies on the eve of a potential economic slowdown is a risk – as demand may disappoint. However, many of the chip design and especially the capital equipment firms have close to irreplaceable intellectual property and know-how, which helps insulate the longer-term businesses risks from any short-term economic disruption.

Advances in AI are only beginning and will likely reshape most industries in ways we cannot yet imagine. Despite the current macroeconomic challenges, the present and future is a very exciting time in the technology industry. We'd be happy to discuss potential investing opportunities on an individual basis with anyone interested in investing in the space over the coming months, as well as general thoughts on the markets and your portfolios. We wish everyone a happy and healthy New Year.

Sincerely,

Peter Karmin
Managing Member

Stuart Loren
Director

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