

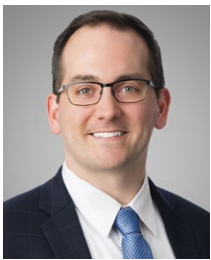
The Rise of Artificial Intelligence

Developments in Language Models are Changing the Investment Landscape

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Executive Summary

We provide a high-level overview of recent developments in artificial intelligence (AI) technology, the implications for industries and thoughts around investment opportunities.

The launch of OpenAI's ChatGPT late last year brought AI into the mainstream, capturing people's imagination and creating a shift in the competitive landscape. Historically, inadequate hardware and software have held back programmers from achieving levels of AI that make it accessible to the masses, but recent improvements to both have allowed developers to break through barriers and generate a step function change in capabilities. The next chapter of AI has begun.

While much of the public discourse is focused on the implications for search, it is our view that AI will have a much broader impact. Hardware manufacturers, software developers and their corporate clients and end-customers will all be affected. Company earnings will be impacted based on adoption benefits to operations and client experiences. In addition, the labor force will need to adapt to more AI in the workplace as both a tool and competition while policymakers will need to understand how to regulate an influx of nonhuman inputs to labor and knowledge sharing.

How does it work?

Artificial intelligence has been around for decades in various forms, but here we will focus on generative AI and large language models. In short, these forms of AI rely on training and learning from large data sets to interpret user inputs and deliver reliable results.

Generative AI creates output in the form of new content, chat responses, designs and synthetic data. It operates by using probability models focused on detecting patterns, making decisions and honing analytics from the data it has been trained on and, for large language models, delivering the most probable next word as it constructs a sentence.

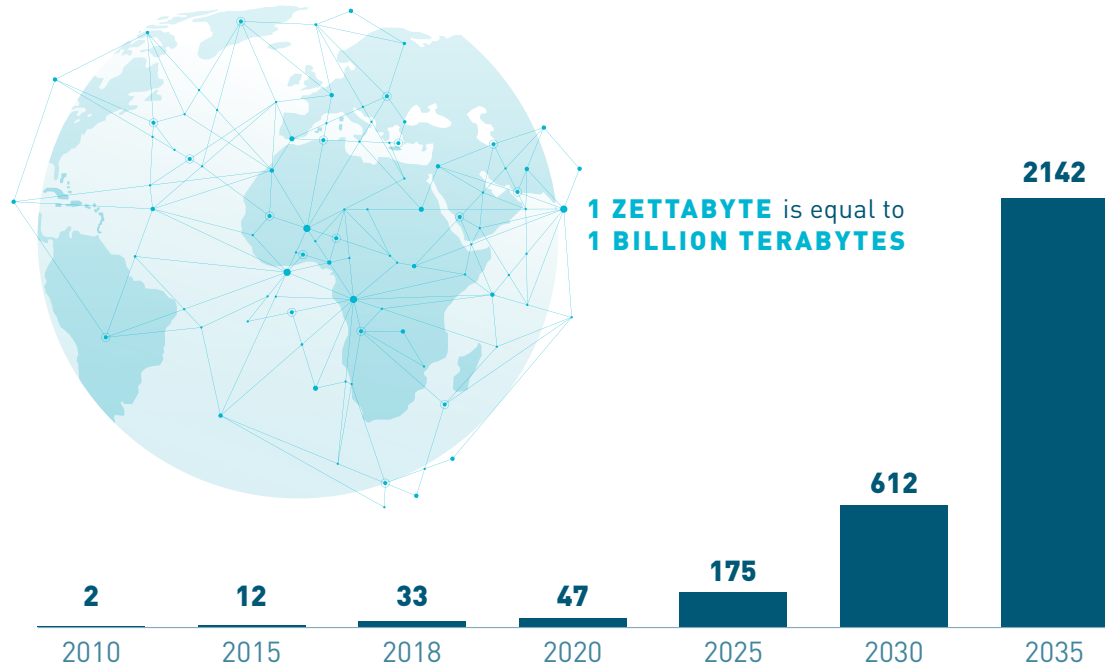
AI products do not yet operate with free will. They require training on data sets from programmers to function. Data are mainly from online sources or data warehouses and can be proprietary or open source.

What are the limitations of large language models?

Programmers must strike a balance between data quantity, quality and recency — all variables that impact the user experience — but also factor in financial costs. Usually, the more data the better; however, more data mean greater costs due to, for example, increased computing power needs, potential licensing deals and more complex model training. Data quality is a priority to prevent a garbage in, garbage out experience for users, and it needs to be logically structured and validated to ensure it is fit for purpose. Keeping these models up to date and relevant is another hurdle because models can operate only according to what they have been trained on. And models can get outdated quickly. It is estimated that 90% of the world's data was generated in the last two years alone. From 2010 data generated globally has increased by an estimated 60x and is expected to more than double by 2025.¹

Global data creation is about to explode

Actual and forecast amount of data created worldwide 2010–2035 (in zettabytes)



Source: Statista Digital Economy Compass 2019. More information [here](#).

Two other limiting factors are labor supply and the incremental costs of user searches. Also, training an AI model requires both a unique system and a good enough understanding of the data to comprehend the production cycle of the model. On the cost of user searches, for large language models, each word they generate is a new search query which costs significantly more to run than an online search today. And while costs are falling as technology and applications improve, they remain a concern for companies in the near term.

Who stands to benefit?

When it comes to AI, the winners are not yet apparent. Given the pace at which the technology is improving, shiny new objects are bound to grab our attention, but as with many technologies, the first out the gate is not necessarily the long-term winner. For now, our focus is on those holding the picks and shovels, those companies which enable the technology and benefit from increased spending across AI platforms. Active investors can potentially benefit by determining where AI technology can improve margins by generating higher revenues while also lowering operating costs.

Who some of the winners will be is obvious: suppliers of high-end GPUs, cloud computing power and select software, as AI will require more data. Additionally, hardware providers will be helped by demand for high-end computers, cloud processing centers, and the infrastructure needed for power, cooling and data storage.

A new ecosystem of software developers building AI solutions is rapidly emerging. Cloud vendors already monetize AI services and have the hardware, platforms and capacity (along with the deep pockets required) to build foundational AI models. With much of the technology now available on open-source platforms, the importance of size and scale is an open question. However, many incumbents are well placed to unlock value from AI early on, particularly those with economic moats and scale with respect to data. As our interface with data changes, the opportunity cost of not having consolidated data rises.

Who else could benefit?

Providing they execute, businesses that can offer improved products and services to clients deploying AI should provide an opportunity to widen moats, generate incremental revenue and improve margins. AI technology can improve creative industries and benefit areas such as health care, factory automation, logistical and industrial processes. In addition, consultants who help businesses understand and implement the technology could benefit as well as those with differentiated data sets.

We don't believe AI and language models will replace traditional web-based searches. Our view is that AI will be complementary to search since these knowledge models are not fact-based but rather a function of the data they can access combined with the training protocols applied by developers (and thus vulnerable to error). We think it likely that the rising tide of AI will lift all boats and result in other advantages for current players in the ecosystem.

Who gets disrupted?

Traditional AI models capture accumulated knowledge to do the same things employees do, albeit with a better memory and no emotion. At a minimum, they are well suited to driving the automation of routine tasks, workflow and reconciliation. Generative AI and language models take this a step further and can be used as a creative force in producing images, video and text, thus potentially threatening the careers of programmers, writers, graphic designers and video editors. As a result, software solutions may become redundant. Single-product or horizontal solutions appear most at risk, as are those dedicated to organizing, structuring and analyzing data. Additionally, the integration of AI will alter management's relationship with those in the labor force while changing the revenue and earnings paths of multiple industries.

What are the concerns over the societal impacts?

There are always bad actors who will try to use technology to take advantage of people, and distinguishing fact from fiction in AI-generated content will be a major concern. Additionally, we could reach a point when AI models are used to train other models. AI output could be incorporated into training data sets, tainting their reliability. And AI systems can be susceptible to bias and errors if they are trained on data that is skewed, incomplete or outdated, which can lead to inaccurate results and erroneous decisions.

Not only does running AI models use a lot of energy, but the manufacture of semiconductor chips used to power AI also requires significant energy, mining efforts and chemicals. Then there are the broader societal questions and the potential for social upheaval as knowledge workers are disintermediated, potentially endangering the middle class as we adjust to the adoption of AI. Will AI invade our emotional intelligence and make memory and intellect less valuable or even unnecessary? Could it get out of control? Will the potential spoils go to a select few? It is too soon to tell, but it is clear that these are important societal and policy questions which will need to be addressed.

Conclusion

While we remain early in the evolution and adoption cycle of generative AI, improvements and adoption appear poised to accelerate. As for its popularity, it took well known Internet platforms a couple of years to reach the one-million-user mark, popular social media websites only a few months to do that, but ChatGPT only five days to gather the same following — and only two months to reach 100 million users. There is no doubt technology evolving and growing at this pace will cause issues along the way, but with so much at stake, technology companies will be forced to play in this space.

In our view, if AI is the tool to deliver the next technological revolution, then generative AI and language learning models will facilitate this change. Unlike previous technologies, these tools are not simply solutions seeking a problem but a potential solution to many different problems. We believe the impacts will be felt beyond both traditional search and technology companies, and that it will have broader implications for every industry.

Currently, there is a lot of excitement over the potential for AI. However, given the speed with which it is evolving, we need to be comfortable that the expectations match the opportunities and their corresponding risks. We think there will be opportunity in the infrastructure companies supporting the AI revolution as well as those leading the race to integrate AI into their products and services across industries. ▲

Endnotes

¹ Exploding Topics 2023 — "<https://explodingtopics.com/blog/data-generated-per-day>"

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