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# Me, Myself and AI: What you need to know

**15 March 2023**

## Key takeaways

- We are at a defining moment – like the internet of the 90s – where Artificial Intelligence (AI) is moving toward mass adoption. According to Statista, at over 8 billion, there are now more AI digital voice assistants than people on the planet. To navigate this crossroad, we consider 10 key questions about AI and beyond.

- But let's back up – what is AI? AI leverages large data sets and uses algorithms to find underlying relationships, which can be used to drive new or better business outcomes. Generative AI (think ChatGPT) is a type of AI technology that can produce various types of content, including text, imagery, audio, and synthetic data.

- And this could be big – AI could potentially contribute up to $15.7 trillion to the global economy by 2030 (source: PwC), while open data (i.e., data that anyone can access, use and share) has the potential to unlock $3.2-5.4 trillion in economic value annually by, for example, reducing emissions, increasing productivity, and improving healthcare (source: McKinsey).

# Cheat sheet: Artificial Intelligence

## 1. What is artificial intelligence and what are the key technologies?

Artificial intelligence (AI) leverages large data sets and uses algorithms to find underlying relationships, which can be used to drive new or better business outcomes. Generative AI is a type of AI technology that can produce various types of content, including text, imagery, audio, and synthetic data. Some of the key AI technologies include machine learning, deep learning, predictive analytics, natural language processing and machine vision.

According to BofA Global Research, the leap in this technology is due to a combination of four powerful factors: 1) democratization of data; 2) unprecedented mass adoption; 3) warp-speed technological development; and 4) abundance of commercial use cases.
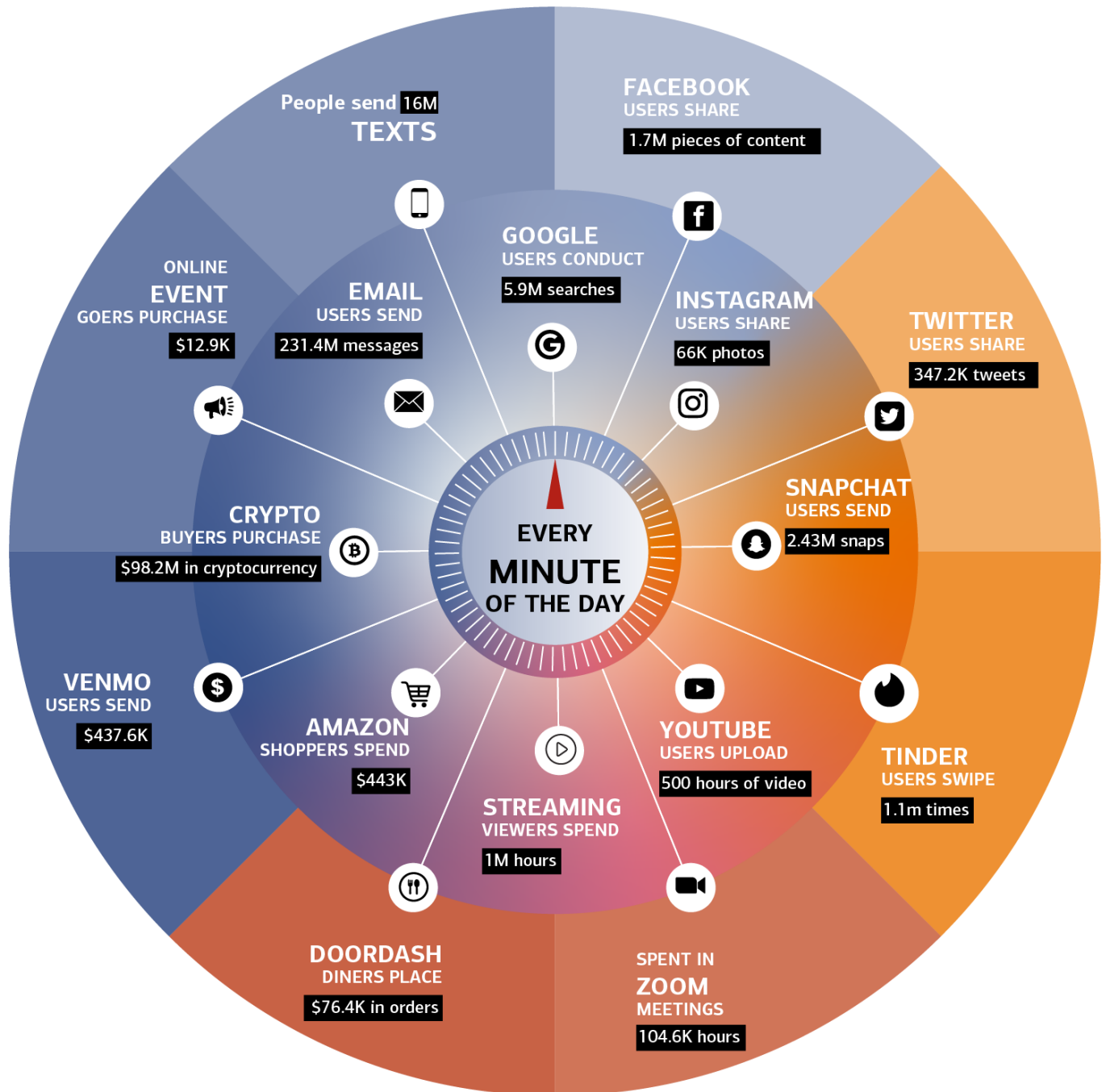
## 2. Why do we need AI?

More data is created per hour today than in an entire year just two decades ago, and global data is expected to double every 2 years (source: BofA Global Research). The data we are creating is increasing exponentially and we need AI to analyze and interpret it, especially when new applications that require more data are being developed constantly. Holograms, metaverse, brain computer interfaces and electric vertical take-off and landing (eVTOL) aircraft are just some of the technologies that will be very data-heavy and are yet to be launched... not to mention quantum computing, which could leapfrog the total data creation once commercially available. In short, data will grow much faster than initially expected in the coming years.

Currently, we are storing and transmitting only 1% of global data (source: International Data Corporation (IDC)). Therefore, according to BofA Global Research, if we take into consideration: 1) the exponential growth of data creation; 2) that the amount of global data stored and analyzed could swell given that 37% of it could be useful if analyzed (vs 1% actually analyzed today); 3) that more people will be online globally, especially following the COVID crisis; and 4) the higher penetration of data-heavy and yet-to-be launched applications, then we are likely to see significant uptake of AI to analyze such data and train AI-based algorithms within the next 10 years.

**Exhibit 1: By the time you finish looking at this chart, 2.4 million snaps will have been sent on Snapchat**
How much data is created every minute on the internet



People send **16M**
**TEXTS**

**FACEBOOK**
USERS SHARE
1.7M pieces of content

ONLINE
**EVENT**
GOERS PURCHASE
$12.9K

**EMAIL**
USERS SEND
231.4M messages

**GOOGLE**
USERS CONDUCT
5.9M searches

**INSTAGRAM**
USERS SHARE
66K photos

**TWITTER**
USERS SHARE
347.2K tweets

**CRYPTO**
BUYERS PURCHASE
$98.2M in cryptocurrency

EVERY
**MINUTE**
OF THE DAY

**SNAPCHAT**
USERS SEND
2.43M snaps

**VENMO**
USERS SEND
$437.6K

**AMAZON**
SHOPPERS SPEND
$443K

**STREAMING**
VIEWERS SPEND
1M hours

**YOUTUBE**
USERS UPLOAD
500 hours of video

**TINDER**
USERS SWIPE
1.1m times

**DOORDASH**
DINERS PLACE
$76.4K in orders

SPENT IN
**ZOOM**
MEETINGS
104.6K hours

**Source:** Domo

## 3. Algorithms, machine learning, and deep learning – what's the difference?

**Algorithms** are a set of instructions that can be used for machine and deep learning. An algorithm is a finite set of instructions that is used to solve a well-defined computational problem. Algorithms can be used to carry out machine and deep learning. Linear regressions and logistic regressions are some examples of machine learning algorithms.

**Machine learning** is a subdivision of AI that uses computerized mathematical algorithms, which can learn from the data and teaches itself to progress as the data keeps fluctuating. Put differently, rather than having humans write programs, computers themselves determine program functions from the data. Machine learning algorithms automatically apply mathematical calculations to Big Data (i.e., data sets that are too large or complex to be dealt with by traditional data-processing application software) in order to learn from past data and in turn produce repeatable and reliable decisions and results – e.g., improved video

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suggestions based on past video viewing activity. In general, with machine learning, if the data is of the same type, then increasing the amount of data will result in an improvement in the accuracy of output.

**Deep learning** is the subset of machine learning and includes algorithms inspired by the function and structure of the brain called artificial neural networks. Deep learning's strength stems from the system's ability to ascertain additional data relationships that are difficult to identify. After sufficient training, the network of algorithms constantly improves predictions or interpretations – e.g., improved product rankings based on relationships of data that humans cannot easily identify.

## 4. What is the economic potential of AI?

According to Accenture, AI could double the annual global economic growth rates by 2035 and is likely to drive this in three different ways. First, AI will lead to a strong increase in labor productivity (by up to 40%) due to automation. Second, AI will be capable of solving problems and self-learning. And third, the economy will benefit from the diffusion of innovation.

A study by PwC estimates that AI could also contribute up to $15.7 trillion to the global economy by 2030, while open data (i.e., data that anyone can access, use and share) has the potential to unlock $3.2-5.4 trillion in economic value annually by, for example, reducing emissions, increasing productivity, and improving healthcare (source: McKinsey).

According to IDC, global revenues for the AI market, including software, hardware, and service sales, will grow at a compound annual growth rate (CAGR) (~2022-26) of 19% to reach over $900 billion by 2026 (Exhibit 2). Big data and AI could double the gross value-added growth rates of developed markets by ~2035 and add 0.8-1.4 percentage points to global productivity growth in the long run. The Big Data ecosystem will have tremendous positive impacts on society and over half the benefits could be captured as consumer surplus and public benefits rather than corporate profits.

**Exhibit 2: Global AI market is expected to grow at 19% CAGR to reach over $900 billion by ~2026**
Global AI market size (US$ bn)
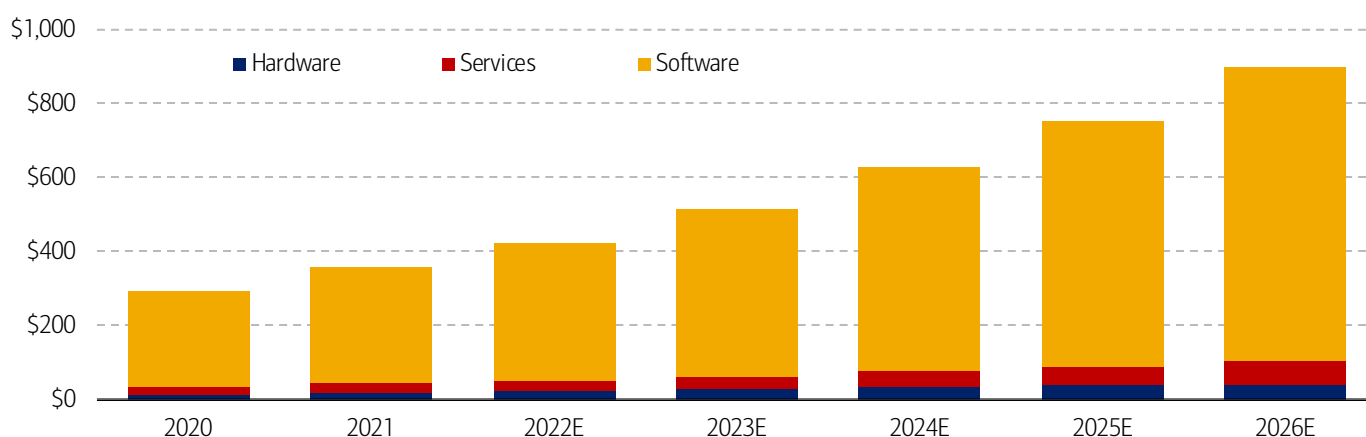


**Source:** IDC Worldwide Semiannual Artificial Intelligence Tracker, Q2 2022

## 5. How much funding is there for generative AI?

A lot! Investor funding for generative AI increased 71% year-over-year (YoY) in 2022 from $1.5 billion to $2.6 billion. Even global private investment in AI increased 103% YoY in 2021 to $93.5 billion, more than double the total private investment in 2020 (Exhibit 3). Governments around the world are also increasingly seeking to promote and provide funding for AI development and innovation. In 2020, the US passed the IOGAN ACT (Identifying Outputs of Generative Adversarial Networks Act), which directed the National Science Foundation to support research on generative adversarial networks and other relevant technology.

And according to BofA Global Research, as the global population ages and younger generations like Gen Z and Gen C (or "the Covid generation") make up a larger portion of the population, AI adoption should increase too because these two generations, particularly Gen C, will be unable to live without tech in most aspects of their lives. By the end of 2021, Gen C numbered 700 million, or ~9% of the world's population. They are estimated to reach up to 2 billion by 2025 or ~20% but will be smaller in size than Gen Z due to declining birth rates (source: Kinetics).

**Exhibit 3: Global corporate investment in AI by activity type, 2013-21 (US$ bn)**
Global private investment in AI totaled US $93.5 billion in 2021, more than double the total private investment in 2020
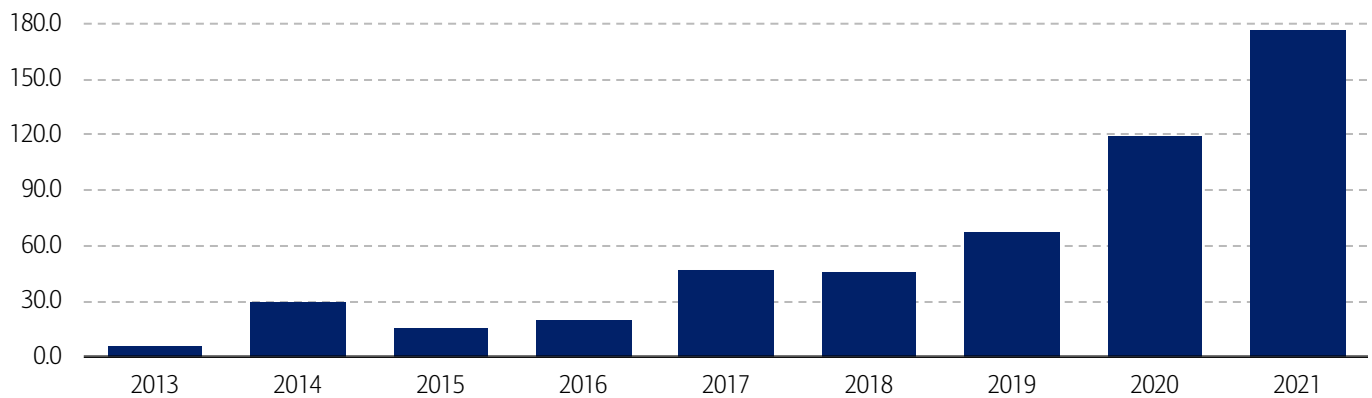
# 6. Are Large Language Models (LLMs) the next generation?

Large language models are models that use deep learning in natural language processing (NLP) uses. An LLM is a transformer-based neural network which predicts the text that is likely to come next. The performance of the model can be judged on how many parameters it has (i.e., the number of factors it considers when generating output).

Natural language processing (NLP) is the AI technology that enables machines to understand human language including slang, contractions, and pronunciations, and consecutively produce human-like dialogue and text. NLP entails applying different algorithms to identify and extract natural language rules to convert the unstructured language data into a form that computers can interpret. A real-world example is improved results for voice search queries.

Since 2020, natural language systems have become more advanced at processing human language, particularly in terms of sentiment and intent. They can generate human-like text, and express understanding about an image through language (visual understanding).

**Exhibit 4: Foundation Models: What are they good for? Several tasks and getting better!**
Foundation or large language models can centralize information from several data modalities to adapt to a wide range of tasks from answering questions to extracting information and identifying images
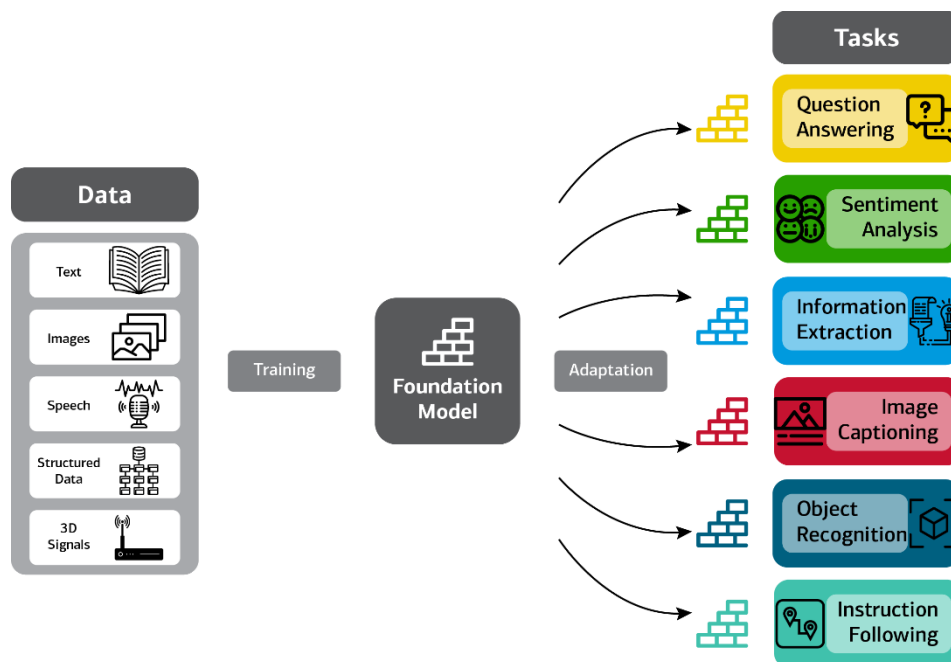
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# 7. What is ChatGPT and why is the technology behind it so ground-breaking?

ChatGPT is a chatbot, developed by OpenAI, that can generate coherent human-like text. It is the first application of its kind that is openly available to a wide audience. Until now AI could read and write but could not *understand* content. Generative AI models like ChatGPT changed that, enabling machines to understand human language, and consequently produce human-like dialogue and content.

Since ChatGPT can generate human-like text, it can be used for content generation (e.g., writing essays, news articles, social media posts, marketing content, stories, music, emails etc.), data extraction, summarizing text, optimizing web browsers, language translation and computer programming. Programmers are already using this technology for program generation or to explain code or concepts.

Since its launch in November 2022, ChatGPT has gained significant traction, amassing one million users after just five days. For context, it took Netflix 3.5 years and Instagram 3 months to reach this milestone.

**Exhibit 5: Since its launch on 11/30/22, ChatGPT had over 1 billion cumulative web visits up to and including 2/5/23**
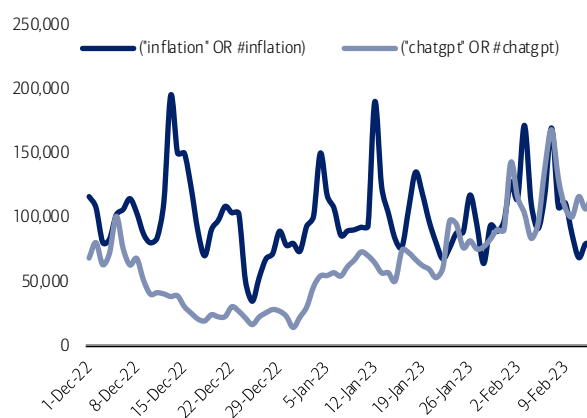Daily total visits to ChatGPT
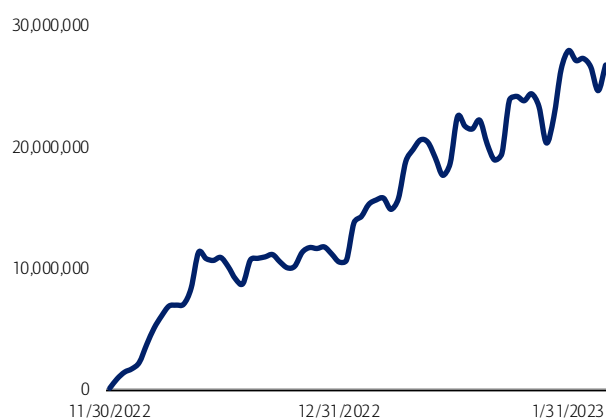


**Source:** SimilarWeb

**Exhibit 6: Conversations about ChatGPT have overtaken those on inflation than Twitter by 53%**
Seven day moving average of the phrases 'inflation'/ '#inflation' and 'chaptgpt'/ '#chatgpt' on Twitter



**Source:** BofA Global Research, ListenFirst

The technology underpinning ChatGPT is a language model that uses machine learning and natural language processing to predict the next word in a sentence based on previous entries. Hence, ChatGPT is classified as a form of generative AI.

ChatGPT is a variation of GPT-3, a large language model (LLM) developed by OpenAI. ChatGPT has been trained based on a dataset of 20 billion parameters (i.e., it generates a response based on an analysis of 20 billion different variables), which is a significant development in the space of LLMs. GPT-3 is based on 175 billion parameters, whereas its predecessors, GPT-1 and GPT-2, are based on 117 million and 1.5 billion parameters, respectively. At more than 6 billion parameters, the models can learn without re-training or updating their parameters.

OpenAI pioneered this technology due to its ability to train a model at scale. It was the first to use a 10,000 GPU (graphics processing unit) supercomputer to train a single model. To put this in perspective, a GPU with a processing speed of 1.5 gigahertz (GHz) can execute 1.5 billion instructions per second. On this assumption, a supercomputer with 10,000 GPUs could calculate 15 trillion instructions per second.

The second key differentiator is that this model is trained using reinforcement learning from human feedback (RLHF). This is where the model generates outputs that are labelled and calculated for some reward objective, such as to represent human preferences for how a task should be done or things to avoid (e.g., harmfulness).

# 8. How is this technology going to evolve?

According to BofA Global Research, this technology is likely to evolve beyond single applications (e.g., text and images) towards multimodality – for instance, using text, images, and/or voice recordings as prompts to generate a response from the AI system. More proficient language model deployment could proliferate conversational tools into, for example, word processors, virtual video meetings and email systems to enable their onboarding for more users to interact via speech. Another application is that this technology could be used to generate entire programming applications rather than just being able to suggest or explain code.

There is ongoing debate around the competencies of AI chatbot systems; whether they could be applied to any industry vertical in their current capabilities and parameters, or whether they need to be verticalized to become more commercially useful.

According to BofA Global Research, in the long term, LLMs may be general enough so that verticalization is no longer needed. However, in the short-term, LLMs may need to be domain-specific to achieve an increase in performance in the industries that intend to use them.

Some companies are already developing verticals that integrate ChatGPT's functionality. For example, Microsoft has announced that its search engine, Bing, will be powered by the same AI technology as ChatGPT, which should improve the user experience of its search engine. Similarly, Velocity, an Indian fintech company, has launched a ChatGPT-integrated chatbot called Lexi to help e-commerce companies. India's Ministry of Electronics and IT is also planning to integrate ChatGPT with WhatsApp to help farmers learn about several government schemes.

## 9. What are the barriers to entry?

Sectors that can combine computing power, data, and talent to enable AI could capitalize on the commercial opportunities. However, operating costs (e.g., semiconductors, staff) could present a large barrier to entry and as the parameter size increases, costs increase, too. The hardware alone required to train a 530 billion-parameter model (the reported size of OpenAI's GPT-4 model under development) would be a $100 million experiment. A single search query in a GPT-like system can cost two to three US cents. This could be challenging to absorb when such models perform billions of queries a day. For this technology to be more viable, we would likely need a 10-20x improvement in efficiency, otherwise it would be too costly for entrants to deploy them commercially.

Additionally, reinforcement learning from human feedback (RLHF) involves difficult engineering, as companies need to build their own. This problem is compounded by scarce talent: a small number of people know how to do this and work for a small number of companies.

## 10. What are some of the risks of this technology?

Since ChatGPT can generate human-like content, it is possible to introduce automation in sectors that are based on idea generation e.g., advertising, art and design, entertainment, music, media and legal. This could help drive the fifth wave of industrial revolution – the coexistence of humans and machines.

But if we look at risks, ChatGPT can "hallucinate" (i.e., generate an incorrect answer with confidence). Furthermore, it is not able to make decisions or deal with too much memory/generation and can also respond to harmful instructions, therefore lowering the barrier to entry for threat actors because it opens the door for more malware, phishing, and identity-based ransomware attacks. Additionally, the model could accidently reveal sensitive information and the output can be misused e.g., tracking individuals. If data is misused, then it could be the case that the model violates privacy laws e.g., the EU's general Data Protection Regulation (GDPR). In general, this technology could have broad-based implications for cybersecurity, particularly for email security, identity security, and threat detection.

Lastly, intellectual property is often overlooked before public release and is difficult to incorporate. It is a grey area, as there is currently nothing stopping companies from using AI-generated content beyond compliance. While some large technology companies like have developed responsible AI principles to avoid unfair bias in AI models, incorporating fairness and preventing bias becomes difficult when training models with billions of parameters.

**Exhibit 7: The fifth industrial revolution involved the combination of humans and machines**
Five waves of the industrial revolution
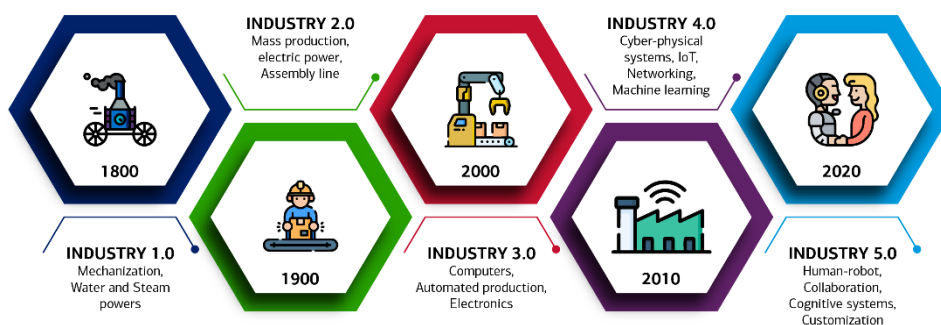


**Source:** BofA Global Research, KnowHow

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