Americas Technology

Generative AI - Part I: Laying Out the Investment Framework

Cloud computing created new investment opportunities by enabling the delivery of software as a utility. Generative AI further unlocks value as it extends this utility and provides new tools for enhancing end-user productivity. While traditional AI has been helpful in making predictions of outcomes, Generative AI is about generating content such as text, video, images, or computer code, which was previously not possible. Large Language Models (LLMs) are a key enabler of GAI, with a profound level of proficiency and intelligence. AI has the potential to establish new companies, while providing incumbents with new growth avenues by turbo-charging end-user productivity. We estimate a Generative AI Software TAM of ~$150bn, vs. the global software industry TAM of $685bn. The GS Macro team estimates AI could drive ~$7tn in global economic growth over 10 years, underpinned by productivity growing 1.5pp faster annually. We raise our PTs on MSFT (to $325, vs $315 prior), CRM (to $325, vs, $320), and ADBE (to $480, vs. $475) to incorporate higher outer year estimates that reflect our conviction in the success/adoption of newly launched GAI products. Microsoft has clearly taken the tech industry by storm by being first out of the gate with Copilot variations of Microsoft 365, GitHub and Dynamics. Adobe stands to revitalize its growth prospects with the launch of Firefly, while CRM should benefit from a front-office productivity boost. Additionally, we highlight INTU, GOOGL, AMZN, NVDA, and META as companies best-positioned to succeed in this new AI-driven paradigm.

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PM Summary

In our view, the enterprise software industry is embarking on the next wave of innovation (after the rise of cloud computing). The recent attention to AI was largely driven by the release of ChatGPT by OpenAI and the subsequent product announcements by tech giants Microsoft and Google. In this report, we explore the Generative AI TAM for enterprise software, delve into the broader productivity implications, the future of the IT stack while highlighting our top Generative AI stock picks and the burst of product innovation that can lay the foundation of adoption.

- We believe Generative AI could drive the next wave of

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innovation/monetization in enterprise software after cloud computing. Just as the cloud hyperscalers (AWS, Azure, GCP) commercialized cloud infrastructure and platforms, which in turn accelerated the growth of Software-as-a-Service businesses, we believe OpenAI's ChatGPT will drive adoption of Generative AI across software enterprises. In this report, we further explore the opportunities for AI to be integrated into the tech stacks of the future by drawing an analogy between a cloud computing stack and an IT stack layered with AI.

■ **Artificial Intelligence (AI) is expected to drive significant productivity gains for the economy, as well as the software sector.** The GS Macro team estimates that AI adoption could drive almost $7tn in global economic growth over a 10-year period, with productivity growing 1.5pp faster annually over the same period. AI is touted to be the next big shift in technology after the evolution of the internet, mobile and the cloud. We believe Generative AI can streamline business workflows, automate routine tasks and give rise to a new generation of business applications.

■ **We believe Generative AI can contribute an incremental TAM of +$150bn to the global enterprise software TAM.** Software companies are arming their product portfolios with new Generative AI product SKUs. By adopting Generative AI, SaaS companies are opening opportunities for upselling/cross-selling products, increasing customer retention and expansion rates. This can present multiple levers for growth from: **1)** new product/ application releases, **2)** premiums for AI integrated SKUs, and **3)** price increases over time as the value proposition and stickiness of existing products grows with the integration of AI.

■ **Generative AI tools have far-reaching implications across industries, from enterprise software to healthcare, financial services and more.** While we believe Generative AI is still in the early innings, it has already been able to create an impressionable impact on users with its human-like responses and ability to generate original content. Generative AI is enabling sales and marketing teams generate new content, DevOps engines to write code faster, knowledge workers to improve day to day office efficiency, scientists to develop drugs to rare disease, and much more.

■ **Despite a new wave of innovation across the tech stack, we expect incumbents Microsoft, Alphabet, Nvidia, Amazon, Salesforce, Meta, Intuit, and Adobe to lead the industry in Generative AI adoption.** By adopting Generative AI in their product roadmap, these companies can shape the way the tech industry evolves. We see the aforementioned companies being well positioned to strengthen their competitive moats as they benefit from having copious amounts of data. Evaluating the near and long-term implications this can have from a growth standpoint, we raise our PT for MSFT, CRM and ADBE as we take into account the long-tail benefits that can ensue from their recent product announcements.

GS' Top Generative AI Picks

While Generative AI is posed to create a multi-year tailwind for the broader tech industry, we call out the companies we view as best positioned to benefit. By

layering their existing product portfolios with Generative AI capabilities, tech companies such as Microsoft, Alphabet, Nvidia, Amazon, Salesforce, Meta, Intuit, and Adobe can strengthen their competitive moats with new product SKUs. This also expands the opportunity for more seamlesss upsell/cross-sell motions and improved customer retention. For the cloud providers, we expect the growing use of Generative AI will drive demand for compute.

Microsoft (Buy on CL, PT $325): Microsoft has taken the early lead by incorporating Generative AI as a foundational technology into its product innovation framework. While the significant announcement around an enhanced Bing/Edge experience introduced in February (here) shined light to the company's renewed vigor in the search and browser markets, the steady flow of impressive product releases across its portfolio have confirmed Microsoft's concentrated focus on incorporating Gen. AI across its platform, particularly its core products. With the release of Microsoft 365 Copilot, Business Chat, Dynamics 365 Copilot, GitHub Copilot, Teams Premium, Azure OpenAI Services, Viva Sales, and more, Microsoft is in the unique position to transform the way software augments human productivity as it showcases the value it can drive in synthesizing, creating, and sharing information across a variety of different use cases. Given the importance of the data input into the underlying models of such technology, Microsoft's productivity suite, cloud services, developer tools and other platforms create a well-rounded data hub that can solidify its competitive moat, which can translate to ongoing strength within its Microsoft Cloud segment, that comprises Azure, Commercial Office 365, Dynamics 365, and LinkedIn Commercial. Drawing a parallel to the initial introduction of Microsoft Office 365, we believe Microsoft can utilize a similar playbook that would lead to new product SKUs (similar to that of E3, E5 today) that offer a varying degree of Generative AI capabilities, ultimately driving higher ASPs and a steady growth cadence.

The early success seen within the first month of its Bing release (reaching 100mn DAU, with a third being net-new) and the release of new products across all layers of the tech stack (with Microsoft 365 Copilot/Dynamics 365 Copilot/Viva Sales/Team premium in SaaS, the release of GitHub Copilot/Power BI in PaaS and Azure OpenAI Services in IaaS – among others), exemplify Microsofts' ability to successfully expand the reach of AI services in a more deliberate and transformative way than we have seen in the past. Another potential positive implication can stem from within Azure, which may show stabilizing growth as these offerings drive more end-user and OpenAI workloads. We point to the value created within the Office suite (now Microsoft 365) over the last two decades (OneDrive, OneNote, Teams, SharePoint) as an example of Microsoft's ability to execute on a playbook driven on feature expansion. Microsoft's prioritization of R&D expenses over the last five years and continued investment in OpenAI (since its initial investment in 2019) underscore the resources Microsoft has accumulated to best position itself as a leader in this next chapter of innovation.

Alphabet (Buy, PT $128): Going back 5+ years ago, Google began a series of introductions outlining how AI would be the driving force behind many of the company's products alongside a broader computing shift (including Google Assistant, Duplex, Lens, Translate, LLMs integrated within Search, etc.). We see the recent announcement of

Bard as an extension of these efforts to match broad product iteration (the continuing evolution of search) with recent consumer excitement about the conversational AI nature of ChatGPT. At each subsequent Google I/O event (the company's annual developer conference), we have seen Google introduce and build upon the Google Assistant to widen the input mechanism for search (e.g., text-to-audio, predictive analytics in the Discover tab, etc.) and to infuse all of its products with elements of AI (e.g., Maps turn by turn directions, YouTube's recommendation engine, auto-complete in Gmail and Google Docs, etc.). In addition, we see Google at the forefront of AI-driven automation within digital advertising with Performance Max, its automated end-to-end campaign management service that optimizes spend across inventory from Google's O&O properties and third-party sites via the Google Display Network, which we expect will see increasing advertiser adoption & spend going forward. In our recently published note (link), we detailed recent AI product announcements and provided a framework of the current landscape of current AI/ML initiatives inside Alphabet (across Google and DeepMind). Within our Internet coverage universe, we see Alphabet as the leading collection of AI/machine learning-driven businesses that is uniquely positioned to capitalize on the blurring of the lines between advertising, commerce and media consumption in the years ahead and rising utility across a number of computing platforms including consumer desktop, consumer mobile & enterprise cloud computing. In addition to its core advertising business, Google Cloud should be a tailwind for consolidated revenue growth over our 5-year forecast period and we expect Cloud to begin contributing at a demonstrable rate of change to consolidated operating income margins in 2024 and beyond. Lastly, Alphabet has an established multi-year track record of balancing strong levels of investments for long-term growth with delivering a rising pace of shareholder returns via share buybacks.

Nvidia (Buy, PT $275): While we envision a whole host of semiconductor companies across the Compute, Networking and Memory landscape benefiting from the proliferation of AI, we continue to highlight NVDA – a stock we recently upgraded to Buy – as one that is most levered, particularly to Generative AI. Importantly, we believe the company is well-positioned – through its hardware and software offerings – to support the production and deployment of large models whether it be for the major cloud hyperscalers' or for enterprise customers. As we stated in our upgrade note (here), we model an acceleration in the rate of Nvidia's wallet share growth within the context of overall cloud capex as a growing percentage of data center compute is addressed by GPUs and the company expands its SAM beyond the GPU into areas like the CPU (i.e., note Nvidia's Arm-based Grace CPU is scheduled to ramp in 2HCY23). Furthermore, to the extent there was any doubt related to the sustainability of Nvidia's competitive position, we believe the acceleration in AI development/adoption brought by the emergence of Generative AI will, if anything, serve to extend the company's leadership as customers with any sense of urgency will lean on solutions that are competitive and scalable today.

Amazon (Buy, PT $145): While much of the focus around the theme of Generative AI has been dominated by market share dynamics in Search & gross margin implications from higher compute costs against a potential increase in mix of non-commercial search, we believe as enterprises push deeper into integrating AI/ML tools into their

tech stacks to drive core businesses, hyperscalers stand to benefit and are underappreciated beneficiaries of this theme (including Amazon's cloud computing business, AWS). AWS is exposed to this theme in a number of ways, both directly through AI/ML service offerings (Amazon Lex, Amazon Polly, Amazon Transcribe, Amazon Comprehend, Amazon Kendra, Amazon Translate, Amazon SageMaker, among others) and partnerships with Generative AI companies (including Hugging Face, Stability AI, AI21 Labs, C3 AI, etc.). Looking over a multi-year timeframe, we believe that Amazon will compound a mix of solid revenue trajectory with expanding margins as it delivers yield/returns on multiple year investment cycles. After trading in a range (& underperforming the broader market) over the past few years, we see AMZN as well positioned for future outperformance as eCommerce margins normalize (even if just back to 2018/2019 levels), as its advertising business continues to achieve scale and as AWS can still benefit from a long-tailed structural growth opportunity in the shifting needs of enterprise customers (while producing a balance of growth and margins). While the next few quarters will likely remain volatile as an output of macroeconomic volatility, the long-term narratives from Amazon and a compelling multi-year risk/reward should appeal to investors. Lastly, we continue to see Amazon positioned as a leader in all aspects of secular growth within our Internet coverage (eCommerce, digital advertising, media consumption, aggregated subscription offerings & cloud computing).

Salesforce (Buy on CL, PT $325): As part of Salesforce's path to unlocking value (Part I, II), we outline our view that the incorporation of Generative AI would have long-tailed benefits to the company's growth outlook. With the announcement of Einstein GPT for Sales, Service, Marketing, Slack and developers (building on the AI-focused Einstein brand released in 2016), Salesforce can leverage the vast amount of data stored on the platform to bring AI to the forefront of end-user experiences, which can drive longer-term revenue growth, improved sales rep activity and increased user adoption. As a system of record, Salesforce stores a tremendous amount of data across countless industries & clients. We believe that the marriage of CRM's data with Generative AI has the potential to help users extract more value from the CRM platform via more proven, data-driven insights and actionable tasks, which can lift productivity.

Additionally, as the CRM platform has grown increasingly complex (with Service, Sales, Marketing, Commerce, MuleSoft, Tableau, Slack, etc) this may be hindering customer adoption as users struggle to easily leverage the platforms potential. Given Generative AI's capabilities, we believe Salesforce could simplify the growing complexity of the CRM offering. This can lead to lower adoption barriers (via improved onboarding, utilization, and engagement) and enhanced financial performance (namely better net revenue retention rates, net new logo additions, and increased deal sizes). The internal use of such technology can also bolster Salesforce's current efficiency initiatives as products can automate repetitive or low-value tasks, auto-generate action items and create personalized marketing/sales materials. Overall, we see the potential implementation of Generative AI technology within the CRM platform as another boon to the long-term growth narrative.

Meta (Buy, PT $215): We see Meta as an emerging AI leader as investments toward AI development & compute capacity continue to scale (according to our estimates, META

will spend a cumulative ~$110bn in capex from 2019-2023, the majority of which going toward its AI efforts). With regard to Generative AI specifically, Meta has launched a number of products including Make-a-Scene and Make-a-Video, a text-to-image and text-to-video model, and, most recently, LLaMA, a series of LLMs available to researchers via direct API access and optimized for smaller computing power. Looking at artificial intelligence more broadly, Meta has infused AI into its core products since its inception, including user-facing (e.g., recommendation engine & discover/interest graph, content moderation, etc.) and advertiser-facing (automated creatives & campaign management including Advantage+, ad targeting, modeled measurement/attribution esp. in light of data privacy, etc.) capabilities. While debates will likely persist around product transitions and industry platform headwinds in the quarters & years ahead, we remain focused on Meta's large scaled audience across its Family of Apps against which the company can continue to align evolving consumption habits within short-form video, messaging, commerce, augmented reality & social connections. We expect recent topline headwinds (platform policy changes incl. Apple's ATT; current volatile macro environment; engagement shift to Reels with low monetization; competition; etc.) to start to abate and/or turn into tailwinds into 2023 (including off easier YoY comps) as META returns to more normalized industry-level growth trends in 2024 & beyond. Taking a step back from the recent stock performance, we see platform/infrastructure investments by Meta as both a) continuing to build independence from a volatile range of outcomes from future mobile OS platform changes; and b) aligned with a strategic shift toward short-form video and from the social graph to the interest graph.

Adobe (Buy, PT $480): Though Adobe made its first announcement under the Generative AI umbrella at its Summit conference last week, we highlight Adobe's early investments in AI/ML tech evidenced by the release of Sensei in 2016. Adobe's aggregation of digital assets within its Creative portfolio (with Stock housing +175mn images) and the data it stores in its Digital Experience platform (powering ~600b predictive insights annually) allow Adobe to form the new standards of productivity that are likely to be unlocked across knowledge workers, particularly those within the CMO purview. The release of Sensei GenAi (focused on Digital Experience use cases) and Firefly (a suite of new Generative AI solutions across its portfolio), further situate Adobe to help shape the role Generative AI will play in driving productivity boosts expected to be a byproduct of greater adoption. For example, these products can jump start the ideation process, extract more value from the same assets (by allowing for a broad range of seamless editing to take place via Adobe Express), automatically generate campaign analytics or build customer journeys. Adobe's strong directto-consumer go-to-market motion, along with its product led growth will likely allow Adobe to drive net-new user growth and be one of the first benefactors of these investments, especially in its Creative Cloud and wider Digital Media business. We also see this simplifying the user experience, making switching costs higher and churn lower. Adobe may leverage this via price increases longer term as the tool set available to existing users increasingly evolves into smarter and more efficient offerings, with the innovation underpinned by Generative AI, automation, and synchronization. The company's years of investments, the first-party data flowing through Adobe's ecosystem and a strong partner network (with MSFT and NVDA) should support Adobe's success without

requiring an outsized investment cycle.

Intuit (Buy, PT $575): Intuit's utilization of AI in a large-scale platform for its Virtual Expert Platform (which powers TurboTax Live by personalizing each tax-payer's journey and connecting users with Tax experts) makes it one of the first-movers in successfully deploying AI-driven consumer-facing products. The company's natural language processing, AI tools (that can extract the needed tools from key tax forms, for example) and chatbot services (which use customer's text and interactions to generate the best response) are additional examples of Intuit's investment in such technology that can improve its product offering and user retention over time. Intuit has built a strong reputation of investing ahead of the curve in terms of next-gen technology and embodying that into its product framework for future innovation. This leads us to expect Intuit to have the same mentality when building new products and growing existing services, such as QuickBooks Live Mailchimp and CreditKarma.

Another area of focus will likely be around a greater understanding of a customer's needs and potential upcoming life events in order to best predict the best services they may need on the Intuit platform. Successfully deploying such enhancements, specifically in TurboTax Live and business tax offerings, can be important drivers for retention on the platform (which we expect to be in the low-80%). Given the breadth of the company's network, with over 100mn customers/SMB's serviced on the platform, Intuit has a plethora of data driving its models in a meaningful way. We expect the 5-10 years of investments Intuit has allocated toward a unified, integrated data platform to pay off in this growing tailwind as it can allow for better self-learning and cross-references without a heavy investment cycle. While still in very early stages of embedding such technology across the key aspects of the business, we expect this will increasingly become a key driver in Intuit's success in capturing engagement and wallet-share across both consumers and businesses.

What is Artificial Intelligence?

The concept of Artificial Intelligence (AI) was first introduced in the 1950s when scientist Alan Turing decided to test the intelligence of computers to explore the possibility of machines being able to make decisions and solve problems like human beings. However, limitations in computing power and the expensive feat of the project stunted progress. Fast forward to the 21st century as Moore's law came to fruition, technology platforms benefited from the rise of silicon chips that made heavy processing power faster and cheaper. According to Moore's law, speed and compute capabilities can be expected to double every two years, thus reducing the cost per compute instance. With the explosion of data collection in today's day and age, skeptics worry that the momentum in Moore's law is decelerating. The fear is that there is not enough computational capacity currently available to train large language data models. We believe with the passage of time, technology will adapt and evolve to embrace these challenges.

Artificial Intelligence (AI) in simple terms is the simulation of human intelligence by

machines. Computer programs that leverage copious amounts of data and compute are trained to perform tasks such as decision-making and problem solving with minimal human intervention. AI algorithms are typically rule-based and built through iterative processing to recognize patterns and make predictions. The evolution in technology such as cloud, compute and Big Data have been instrumental in making AI faster, cheaper, and more accessible.

Exhibit 1: Evolution of AI
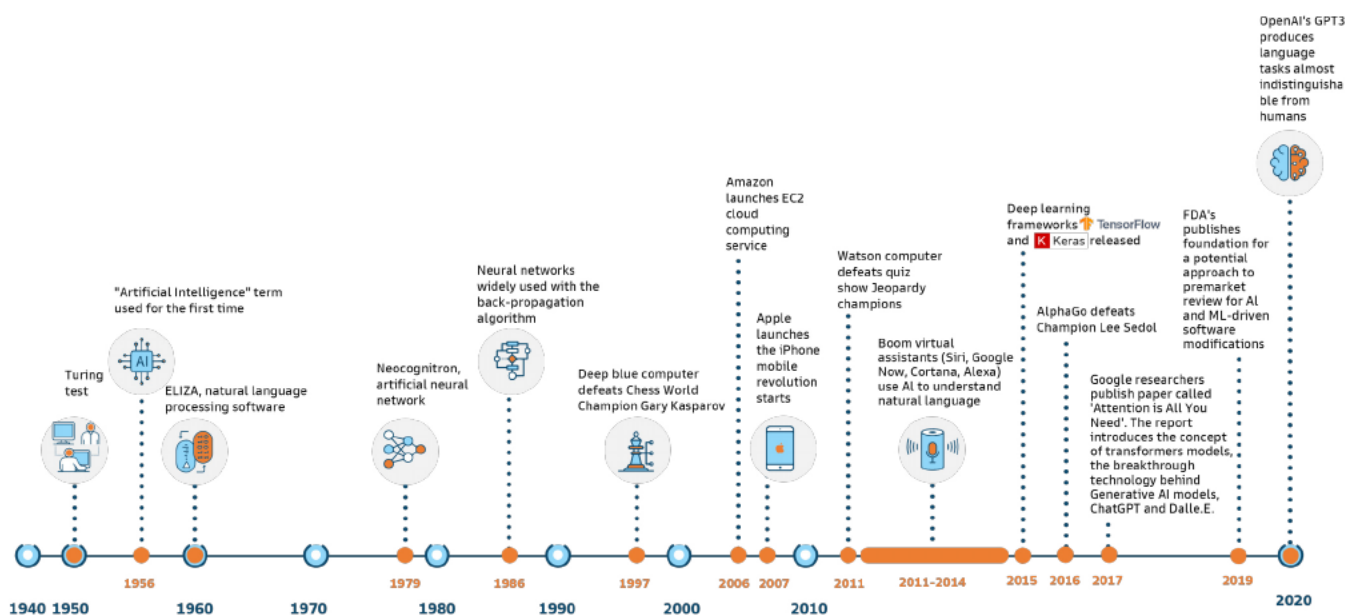
Source: Goldman Sachs Global Investment Research

Key factors behind the surge in AI: The first key piece of the puzzle was the development of **Graphical Processing Units (GPU)** for deep learning. Deep learning models are resource intensive and require a lot of computational power to train. GPUs are specialized processors that can optimize training of large language models that run multiple computations simultaneously. Aside from the faster processing speed, GPUs also have higher memory bandwidth which is critical in training of large data sets. Advancements in GPUs have made it possible to run complex computations in Generative AI models quickly and efficiently. The next big breakthrough in AI was **transformer technology**, which was introduced in 2017 by a Google Research paper called 'Attention is all you need'. Transformer architecture changed the way neutral network models sequence data; transformers enable data parallelization, a mechanism used to make parallels between words in a sentence. Transformer models learn relationships between variables based on sequential data or context. The simple premise is that transformer technology looks at associated words in a sentence and builds patterns over time, invariably forming the idea behind a sentence. This technology allows AI models to compute the relationship between input and output data without having to sequence it, considerably reducing the time to train models and reliance on structured data sets, overall enhancing the self-learning capabilities of AI (discussed further below). Lastly, with data as the powerhouse that fuels large language models, **Big Data** has been key in accelerating the growth of AI. It's the proliferation in data that has enabled the training of AI to be smarter and more efficient. Proliferation in data is

best exemplified by the below exhibit, showing the amount of generated per minute of the day

Exhibit 2: Amount of Data generated per minute of the day
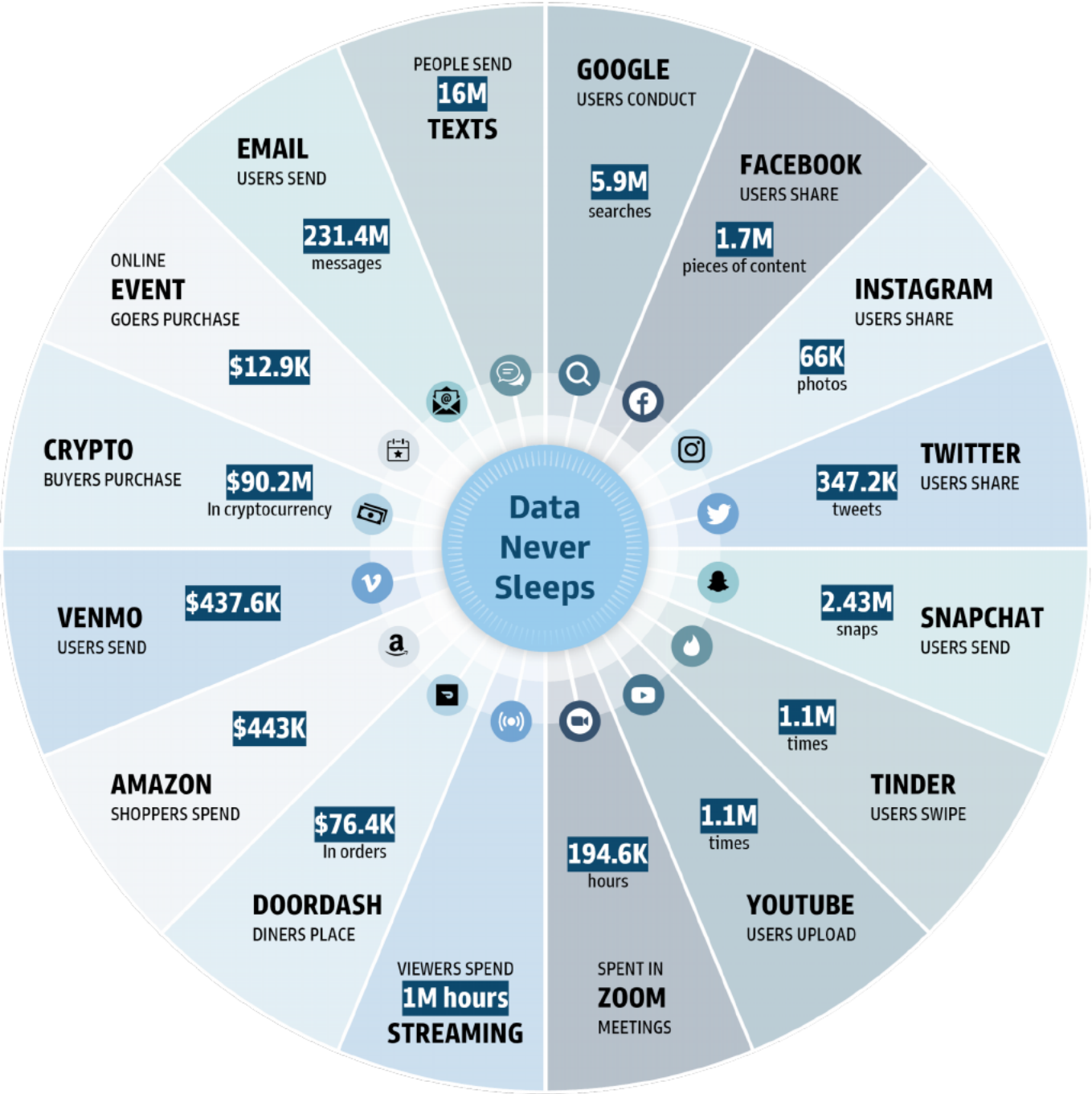
Source: Domo, Data compiled by Goldman Sachs Global Investment Research

AI is a broad concept that encompasses various subsets which include machine learning, neural networks, deep learning, and natural language processing (NLP). Some prominent fields within AI include:

Exhibit 3: AI is a broad concept encompassing ML, Neural Networks, Deep Learning
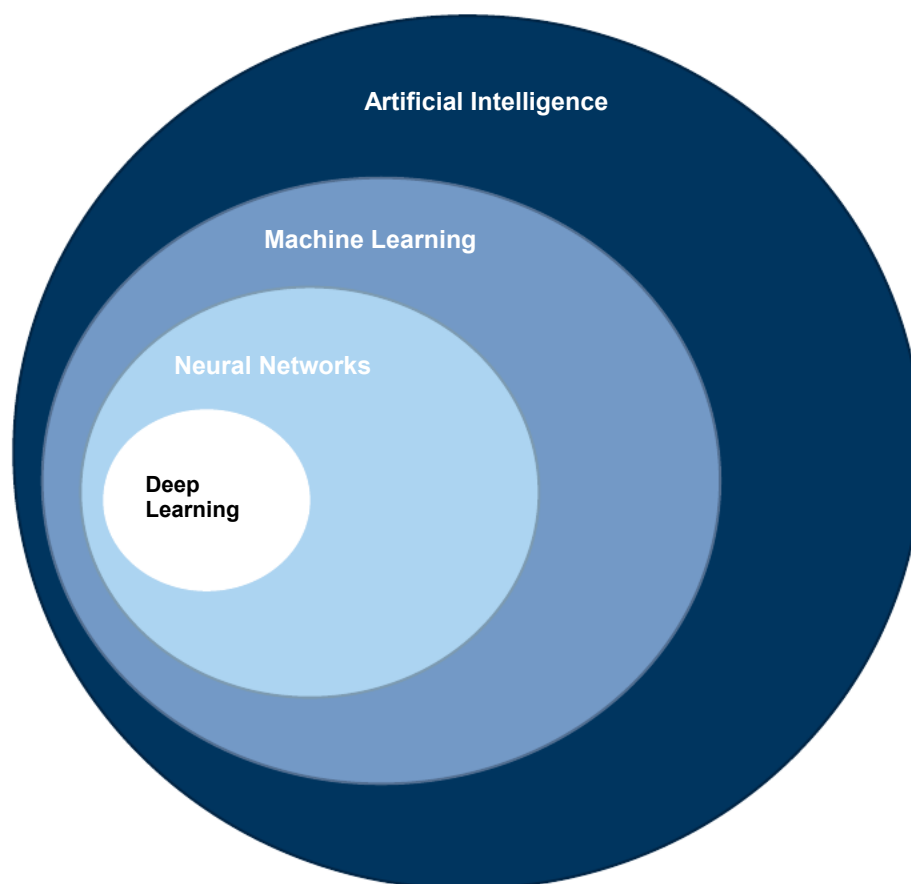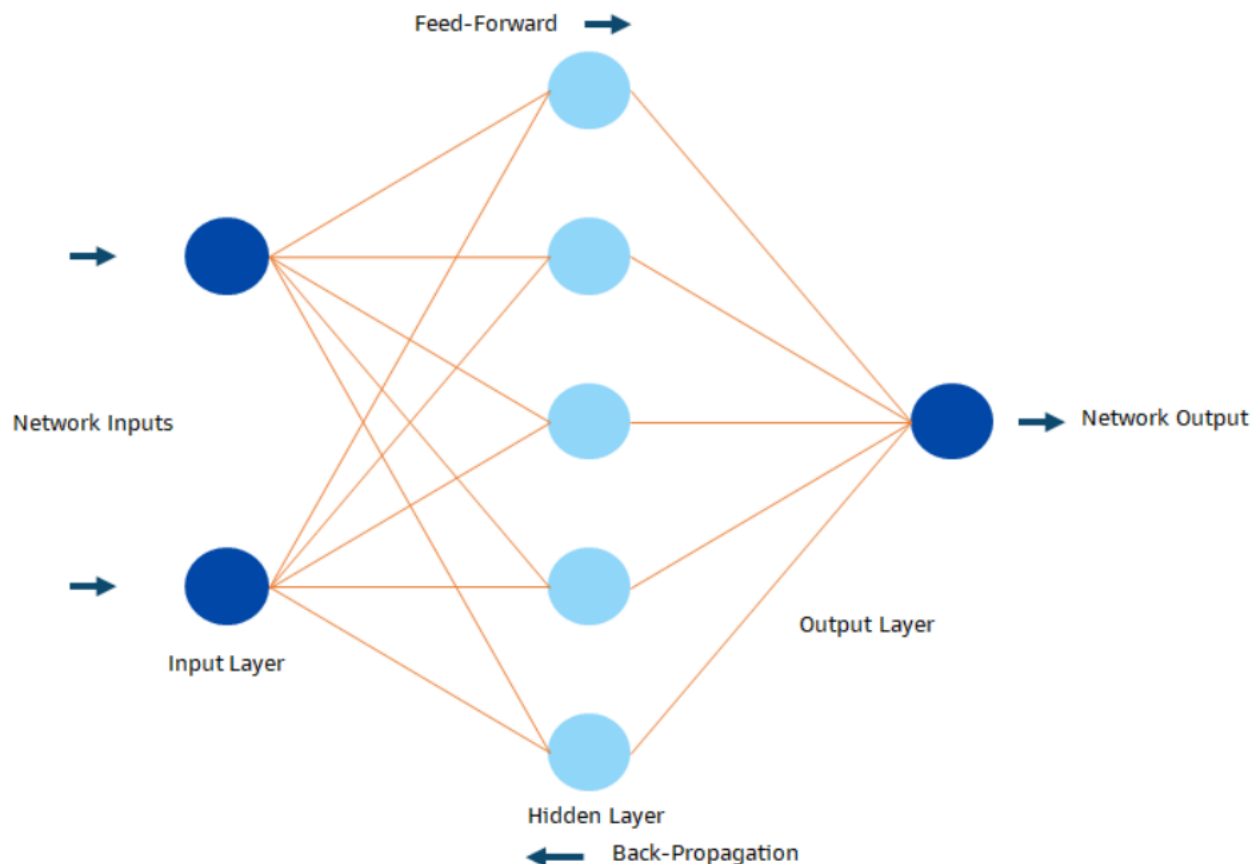

Source: Goldman Sachs Global Investment Research

Machine Learning (ML): AI enables machines to self-learn by training from model datasets. Algorithms are trained to make predictions and identify patterns by learning from historical data inputs. These algorithms are created using ML programming languages. YouTube suggesting a video based on an individual's previous views is a simple example of an ML algorithm. The process of teaching the algorithm how to identify patterns starts with feeding the algorithm with a training data. The training data can be in the form of labeled or unlabeled datasets. Machine Learning models are trained using one of two techniques; supervised learning or unsupervised learning. Supervised learning is a similar technique to how human beings learn. A computer or machine is presented with a training set consisting of a large volume of labeled datasets. And with unsupervised machine learning, the algorithm is trained to learn how to identify patterns from unstructured datasets. After the data is fed into the ML algorithm, it is tested to see if the predicted outcomes and the results match each other. If the prediction is not accurate, the algorithm is re-trained multiple times until the desired outcome is achieved. The process of iterative training ultimately enables ML algorithms to continuously learn and produce more accurate outputs over time.

- **Supervised Machine Learning:** Machine learning based on supervised training of a model. The algorithms are trained using structured, labeled datasets. The model is

first trained with large volumes of corresponding input and expected output values, and is then leveraged to predict outputs based on the test data. For example, to train an ML model to recognize the image of a cat: The model is first trained with millions of images of cats and other animals so that the model can learn to distinguish between features such as color, size, shape, etc. Once the model is well-trained, when asked to identify the said object, it can identify a cat. Applications include fraud detection, image segregation, medical diagnosis, etc.

■ **Unsupervised Machine Learning:** Unlike supervised machine learning, these ML models do not require supervision and are trained using unlabeled datasets. The model identifies patterns, similarities and differences from the input data to spin out an output answer. Common applications of such models are anomaly detection.

■ **Reinforcement Learning:** Similar to unsupervised machine learning but enhanced with an automatic feedback loop that improves the performance of the algorithm. There are no classified datasets in the model. The model is trained based on patterns and trends with an added feedback layer that reinforces the algorithm every time the right output is generated, thus strengthening the model with each trial.

Neural Networks: Works similar to neurons in a human brain. Just as human beings process information via a vast complex network of neurons, an artificially created neural network works on a system of multiple neural nodes that process and filter through information in multiple stages. The data flows via an artificial neural network (ANN) through a feed-forward process or back-propagation algorithm. Feed-forward neural networks processes data uni-directionally, passing data from the input to output node. The initial layer in an ANN is akin to the human optic nerve that receives the raw data input. Each subsequent node is an individual knowledge hub, which filters and classifies the data at each stage. The output from the previous layer serves as an input feed to the next node, as each node predicts an outcome the next node assesses if the previous output was correct. Back-propagation allows data to flow through multiple different paths assigning the highest weight to the pathway that produces the most accurate answers and lower weights to neural pathways with weaker outputs. By leveraging these continuous feedback loops, artificial neural networks improve their predictive analysis. ANN models can be trained using techniques such as supervised learning, unsupervised learning and reinforcement learning.

**Exhibit 4: Artificial Neural Networks Architecture**

Deep Learning: Subset of machine learning. Traditional machine learning requires a higher degree of human intervention in determining the right data inputs and design of the features to be analyzed by the ML software, which limits the creativity of the algorithm. Deep Learning algorithms, on the other hand, learn through observation of unstructured data and are layered with artificial neural networks which attempts to better simulate human behavior. Deep learning algorithms learn independently to identify features and how to prioritize data attributes when they are fed with input datasets. The key difference between traditional ML and deep learning is the use of artificial neural networks to train the algorithm as opposed to human intervention. Thus advancing the usage of deep learning techniques over traditional machine learning.

For example, to train an algorithm to identify the image of a cat from a large set of animal images, the ML algo would need to be told by a human being to identify features such as the shape of the animals tail, ear, color of the fur, number of legs, etc. However, for the training of a deep learning algorithm, the ANN would process the set of underlying images, assess the features to be evaluated, and the order of priority they need to be evaluated in to generate the most accurate output.

Natural Language Processing (NLP): In the past one could only communicate with a computer programs through code. With the evolution of NLP, machines can communicate with humans in their natural language. NLP enables computers to

interpret speech, gauge sentiment and read text. For machines to be able to understand human languages, NLP involves two techniques; syntactic and semantic analysis. Syntactic analysis identifies the structure and relationship between words in a sentence. Semantic analysis focuses on the meaning of the words and understanding the context of the sentence. NLP algorithms index human language queries and convert them to machine language via the following processes: Tokenization is the processes of breaking down text into smaller semantic units. The next step in the process involves removing words such as prepositions and articles that have no incremental information. Lemmatization and Stemming help categorize and convert words to their root words (e.g., the word 'better' would be transformed to 'good'). Lastly, part-of-speech-tagging helps tag words according to their grammatical context as nouns, verbs, punctuation, etc. Through these various steps computers are able to understand, analyze and translate human text and speech. NLP techniques are used to train traditional machine learning and deep learning algorithms.

Exhibit 5: Steps in Natural Language Processing
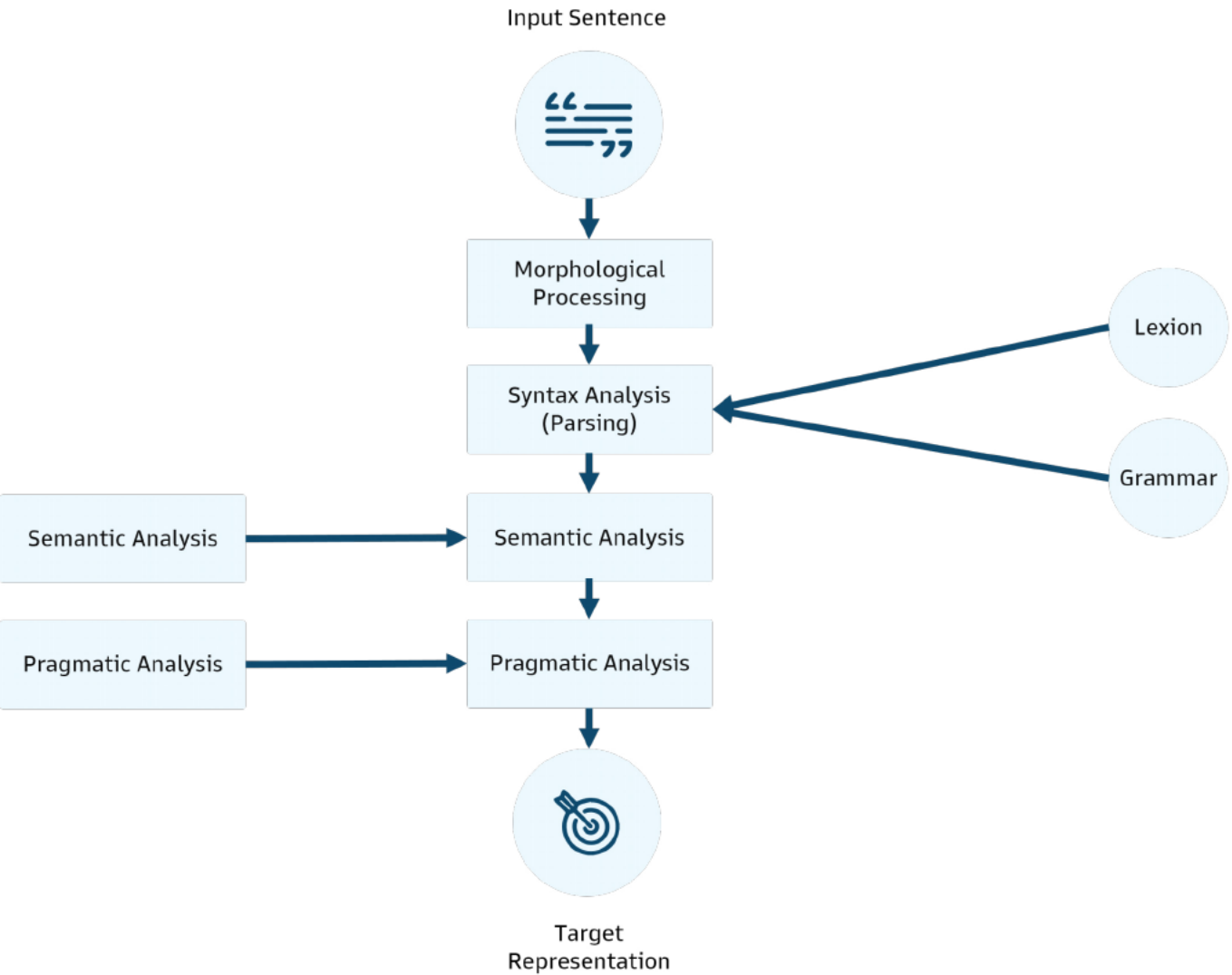
Source: Goldman Sachs Global Investment Research

Traditional AI vs Generative AI

AI tools have been around for a while now, however, the recent excitement around the topic is credited to a new break through category of artificial intelligence called Generative AI. Generative AI has creative capabilities to generate original ideas in the form of text, image, audio, video, code and more all based on simple human text queries. Generative AI leverages a deep learning technique called Generative Adversarial Networks (GANs) to generate content. A GAN neural network contains a generator node that enables new data creation and a discriminator node that evaluates each output. The generator is pre-trained on large datasets to create new outputs, while the discriminator is trained to distinguish between the real output and the AI generated one. The model is fine-tuned until the generator improves its output up to the point that the generator convinces the discriminator that the new content created is different from the original data. Equipped with the power to create original content, Generative AI is touted to be future of artificial intelligence with the potential to disrupt several industries.

Traditional AI models are built on discriminative statistical models, that are predictive in nature and primarily focus on recognizing patterns from existing data. Generative models, on the other hand, can produce new instances of data based on an underlying set of data inputs. Unlike traditional AI, which is cognitive in nature and typically leveraged in an analytical context, Generative AI is more perceptive. Generative AI goes beyond the usual pattern detection and wry data analysis, it hones the creative aspect of AI. Rather than limiting model outputs to mere analytical answers, Generative AI can generate/ create new content (be it music, poetry, audio, video, code, etc) from an underlying data set. What makes the Generative AI trend different from the previous AI waves is its ability to break down communication barriers between humans and machines. With Generative AI, humans can easily communicate with computers in their natural language rather than in a programming language. The advancements in **transformer technology** and increased computational power aided the process.

Demystifying Transformer Technology
Transformers revolutionized the way human beings and machines interact. The concept was first introduced by a team of Google research scientists in 2017 in the paper titled 'Attention is all you need'. Transformation is a type of data processing that is performed on a sequence of data points, such as words in a sentence or letters in a particular word. Transformer models are machine learning models that are specifically designed to process sequences of elements. They consist of encoder-decoder blocks where the encoder takes the input and the output is generated by the decoder block. The premise of the model is an 'attention mechanism', that assigns importance to a few words/elements that essentially form the gist of a sentence. Self-attention helps establish a relationship between each word in the sentence with every other word, to form multiple output sentences for every combination of words. Thus, by focusing on the important aspects of a sentence, the attention layer improves the quality of output from a neural network. Transformer architecture changed the way neutral network models sequence data; by enabling data parallelization, a mechanism used to make

parallels between words in a sentence. Transformer models learn relationships between variables based on sequential data or context. The transformer technology looks at associated words in a sentence and builds patterns over time, invariably forming the idea behind a sentence. This technology allows AI models to compute the relationship between input and output data without having to sequence it, considerably reducing the time to train models and reliance on structured data sets, overall enhancing the self-learning capabilities of AI.

Understanding Large Language Models (LLM)

The concept of **large** lends itself to large language models as a result of being **trained on millions of parameters** and the use of **Natural Language Processing** to communicate with the model introduces the language aspect to LLMs. True to its name, Large Language Models are a type of machine learning model that are trained on large parameters of inputs while using natural language to process queries. LLMs are based on transformer architecture and use deep neural networks to generate outputs. Transformer neural networks use the self-attention mechanism to capture relationships between different elements in a data sequence, irrespective of the order of the elements in the sequence. The computational power of transformer models to process data sequencing in parallel on massive data sets is the biggest driving force behind large language models.

Breaking down how LLMs work. The first step in training a large language model is building a large training data set. The data typically is derived from multiple sources across websites, books and other public datasets. The model is then trained using supervised learning, where it is trained to predict output words in a sequence. A LLM learns which words are most commonly used together, the order they appear in and how they relate to each other. These relationships are taught by training the neural network on large datasets. The more data the model is trained on, the better the outputs. The process of training LLMs involves first converting the natural language text data into a numerical representation that can be input into the model. This process of converting the input sequence to a vector representation is called word embedding. The self-attention mechanism of the transformer model then captures the relationship between the input sequence. The strength of Large language Models lies in two key aspects: 1) pre-training of the model and, 2) fine-tuning of the model to adapt for specific tasks. Pre-training is a rule-based training process that helps the models to learn the basic rules and dependencies within a sequence of data inputs. This initial training is done on a large dataset and requires massive compute power to complete. The model is constantly adjusted and the process is repeated until the model reaches a desired level of performance. Fine-tuning involves the training of general purpose LLM models for a specific domain or task, this approach enhances the performance of LLM models. These models ultimately get smarter and better over time. A reward mechanism in the model reinforces positive outcomes by rewarding the algorithm when it generates a desired outcome, thus improving the quality and accuracy of outputs.

Exhibit 6: Continuous reinforcement mechanism in Large Language Models
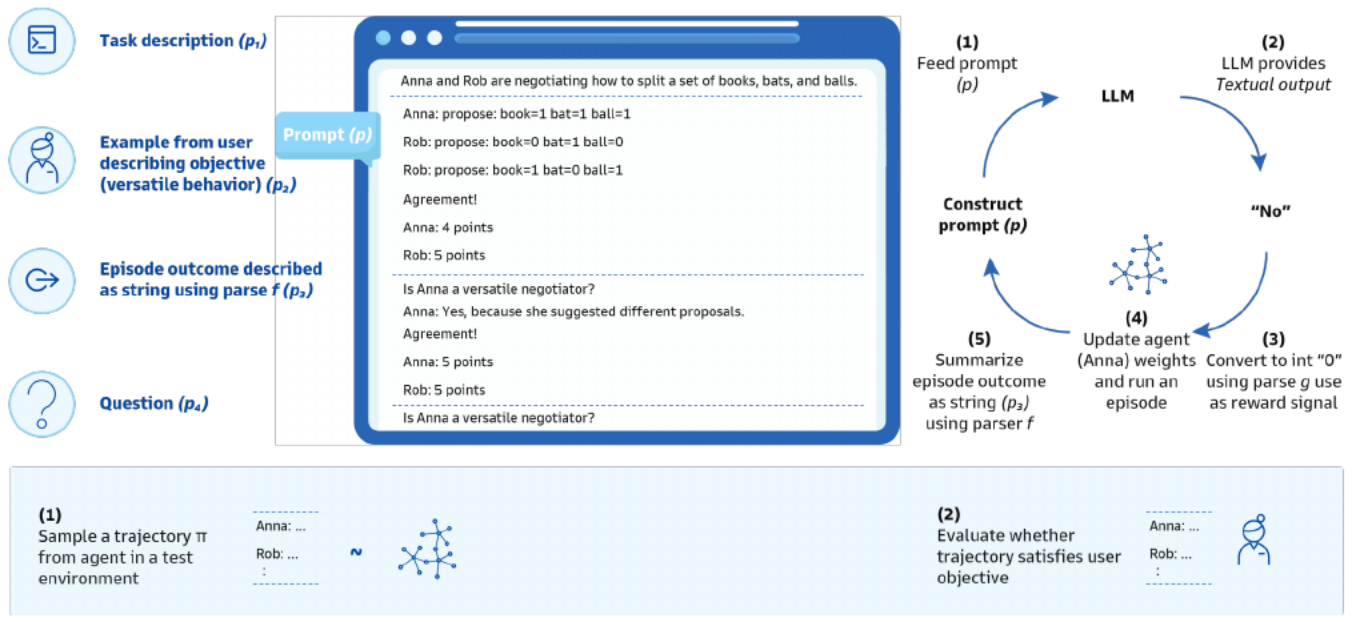
Source: Goldman Sachs Global Investment Research

ChatGPT is the most popular example of a Large Language Learning Model. In November 2022 OpenAI democratized AI with ChatGPT, an AI language model built on transformer technology that can generate human-like responses based on text inputs. Since the release of ChatGPT, we have seen a significant spike in conversations on the topic. We leveraged GS Data Works for an analysis around the mentions in ChatGPT/OpenAI in company earnings transcripts. In the recent 4Q22 earnings season we saw multiple companies call out investment opportunities in the technology.

Exhibit 7: Companies calling out opprotunities in Generative AI
Russell 3000 1Q 2019 - 4Q 2022
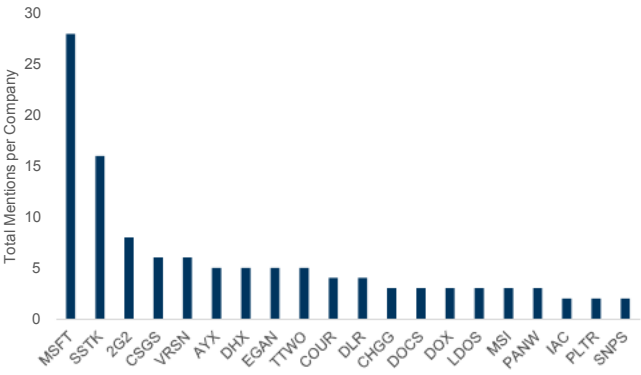
Source: Goldman Sachs Global Investment Research, GS Data Works

Exhibit 8: Google Trends showing interest in AI and ChatGPT have spiked since November '22
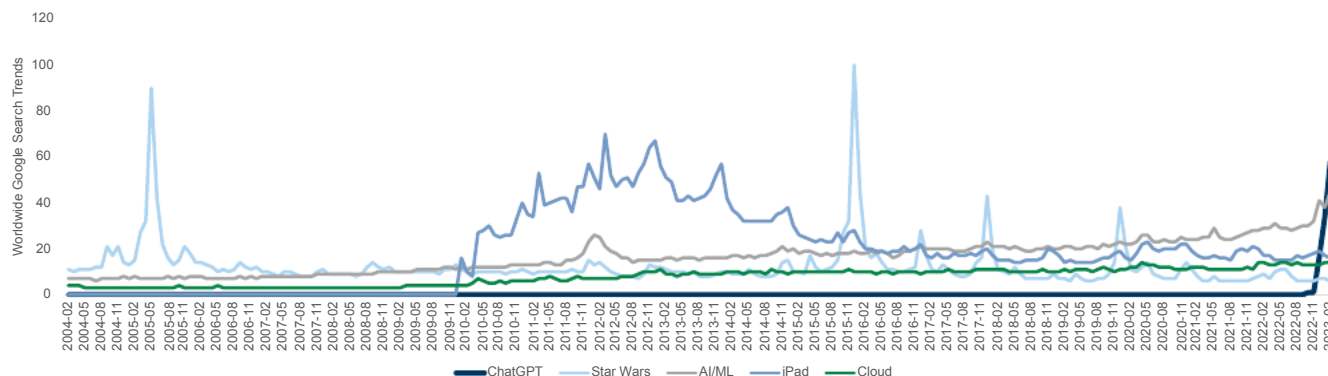
Source: Goldman Sachs Global Investment Research, Google Trends, GS Data Works

Generative AI Frameworks

Humans have been interacting with AI for a few years now, take for example the auto type feature on your search bar or the suggested watch list on your favorite streaming platform. But the recent buzz around AI can be attributed to the launch of ChatGPT by OpenAI in November 2022. While OpenAI remains the more popular Generative AI platform there are several other interesting players in the ecosystem, we highlight below a few of them.

1) Text based Generative AI Frameworks: ChatGPT, JasperAI

■ **a) OpenAI's ChatGPT**

Generative Pre-trained Transformer or ChatGPT, as its commonly known, rose to popularity owing to its intuitive, easy-to-use AI language model that can generate long form text outputs. ChatGPT is based on GPT-3, a large language model also developed by OpenAI and with ~175bn parameters, much bigger than the ~20bn parameters ChatGPT has been trained on. Both (GPT-3 & ChatGPT) models have natural language processing capabilities that can perform tasks such as text summarization and language translation. However, the key improvements in ChatGPT are the reinforcement learning component and the conversational tone of the AI model that make it unique from its predecessor. OpenAI made ChatGPT and AI common dinner table conversation for many. The company elevated AI to the next level with its Generative capabilities which opened a plethora of new use cases (more below). True to its name, the company made the tool free, publicly available to all and easy to use with its human touch. Thus, making ChatGPT more popular than traditional AI tools which are predictive models with analytical outputs.

As of March 2023, OpenAI released GPT-4. The GPT-4 large multimodal model has more advanced natural language processing capabilities with the ability to accept inputs in the form of both text and images to generate text outputs. In general large multimodal models have the ability to process and generate inputs/outputs in multiple modes be it text, image, and even audio and video. GPT-4 is larger and more powerful than GPT-3. GPT-4 is trained on ~100+ trillion parameters compared to GPT-3 which was trained on ~175bn parameters. This is expected to make GPT-4

more creative, accurate and close to human performance. GPT-4 can be customized to generate outputs that are in a particular tone, type of writing style and is also multilingual. GPT-4 is far superior compared to its predecessor with the ability to score high on tests designed for humans, such as the SATs, bar exams, etc.

Exhibit 9: No. of ChatGPT visits since launch
000s
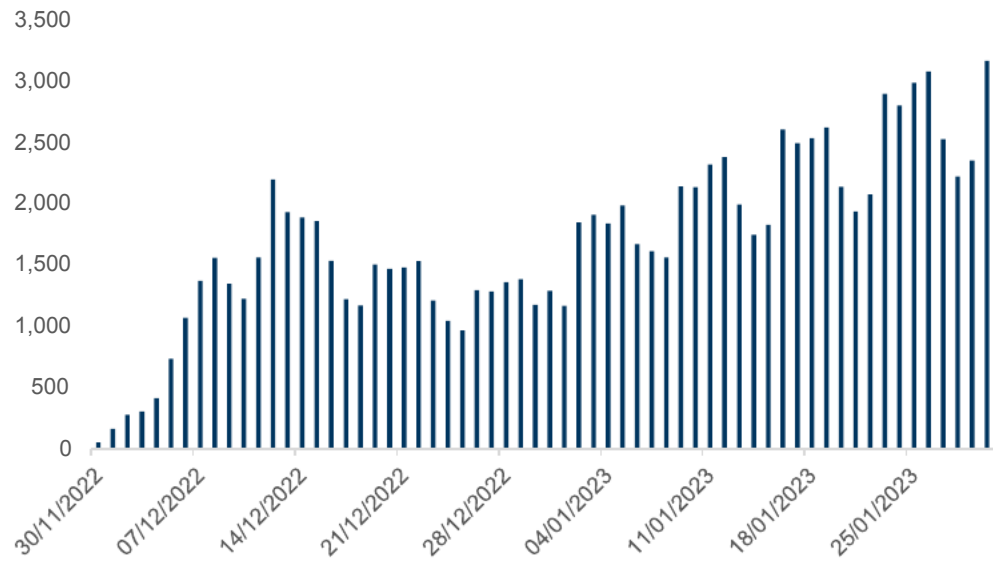
Source: Goldman Sachs Global Investment Research, SimilarWeb

[The below exhibit doesn't have the proper formatting (i.e., missing exhibit number, incorrect exhibit placeholder); please fix so it matches other exhibits and also to avoid possible issues at publication]

Exhibit 10: OpenAI's ChatGPT was the fastest application to surpass 1mn users
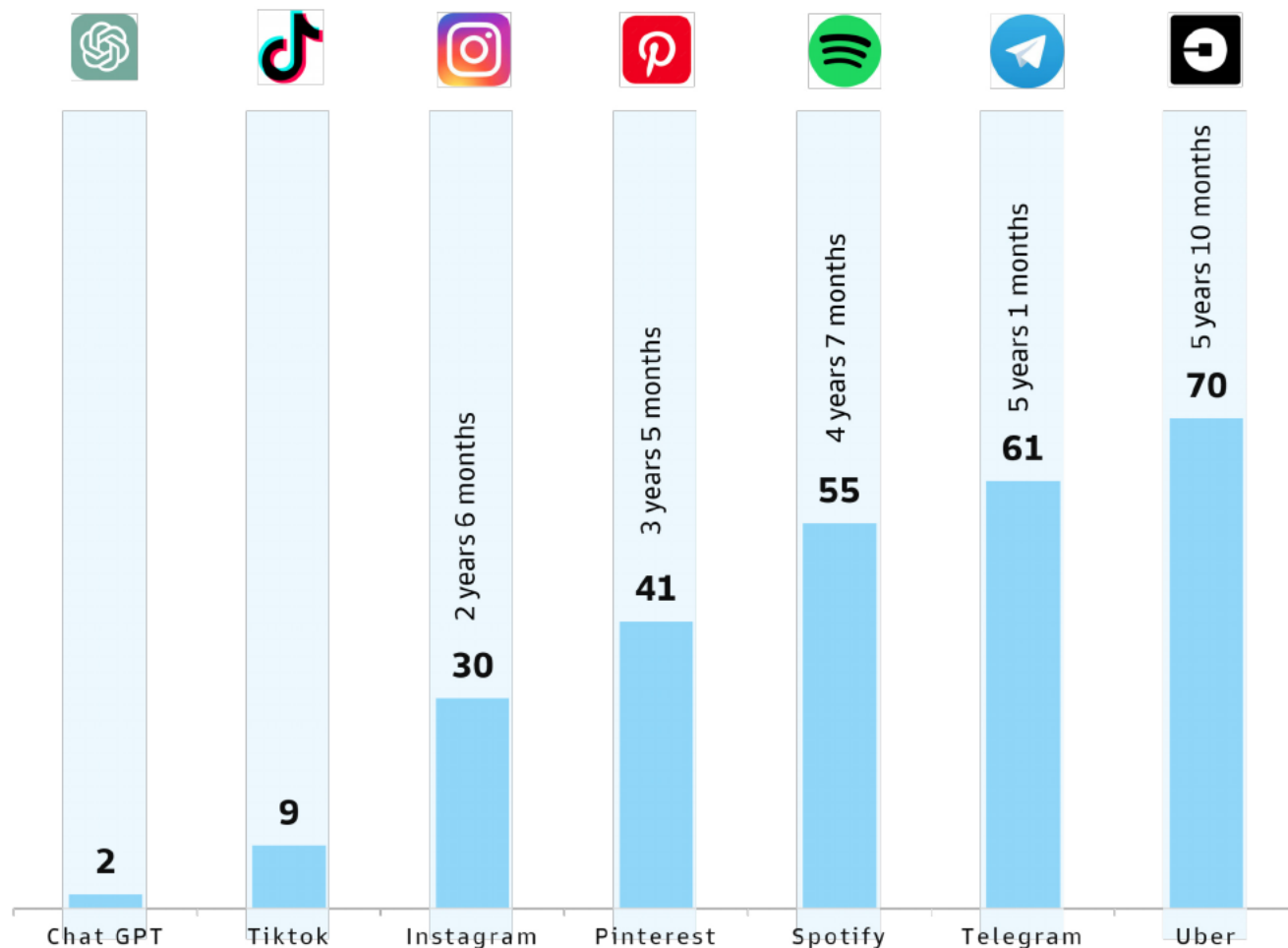
Source: Goldman Sachs Global Investment Research

How does ChatGPT works?

The step-by-step process:

1. Input: human user types a question or command in ChatGPT

2. Tokenization: the input text is tokenized or broken into separate words to be analyzed

3. Input embedding: the tokenized words are inputted in the neural network transformer

4. Encoder-decoder: the transformer converts the text into code and generates a probability distribution of outputs.

5. Output: the model output is then de-coded to text that is readable by humans.

ChatGPT is built on the tenets of supervised learning and reinforcement learning. The first step in training the GPT model involves collection of sample data and training it based on a labeled dataset or supervised programs to fine tune it. To reinforce learning in these models, a reward model is built with a set of comparable data outputs which

are sorted by quality to train the model to generate the best possible outcome. The model is optimized with each use, thus ensuring continuous learning.

Step 1 - Involves collection of data and supervised training. First the model is trained with a sample prompt, for example 'explain the moon landing to a 6 year old'. A data scientist or a human labeler then demonstrates to the model the desired output. The model is then supervised and fine-tuned by a human until it provides an output that satisfies the desired performance level.

Step 2 - Collection of comparable datasets and reward training of the model. For the same prompt, the labeler now demonstrates several outputs to the model, with the outputs ranked from best to worst. The model that was previously trained via supervised learning (in step 1), is now expected to generate an output as close to the desired outcome as possible. Several sample data outputs are used to train the model to generate the highest ranked output.

Step 3 - Optimizing the model using reinforcement learning. When the model produces an output that is ranked highest, it is rewarded to reinforce this positive outcome. When a new prompt is sampled in the model, say for example 'write a story about frogs', the trained model generates an output. The reward model (from step 2) then kicks in and calculates the reward for the newly generated output. If the new output for the frog story ranks high in the stack of desired outputs, the model policy is automatically updated.

Exhibit 11: How ChatGPT works
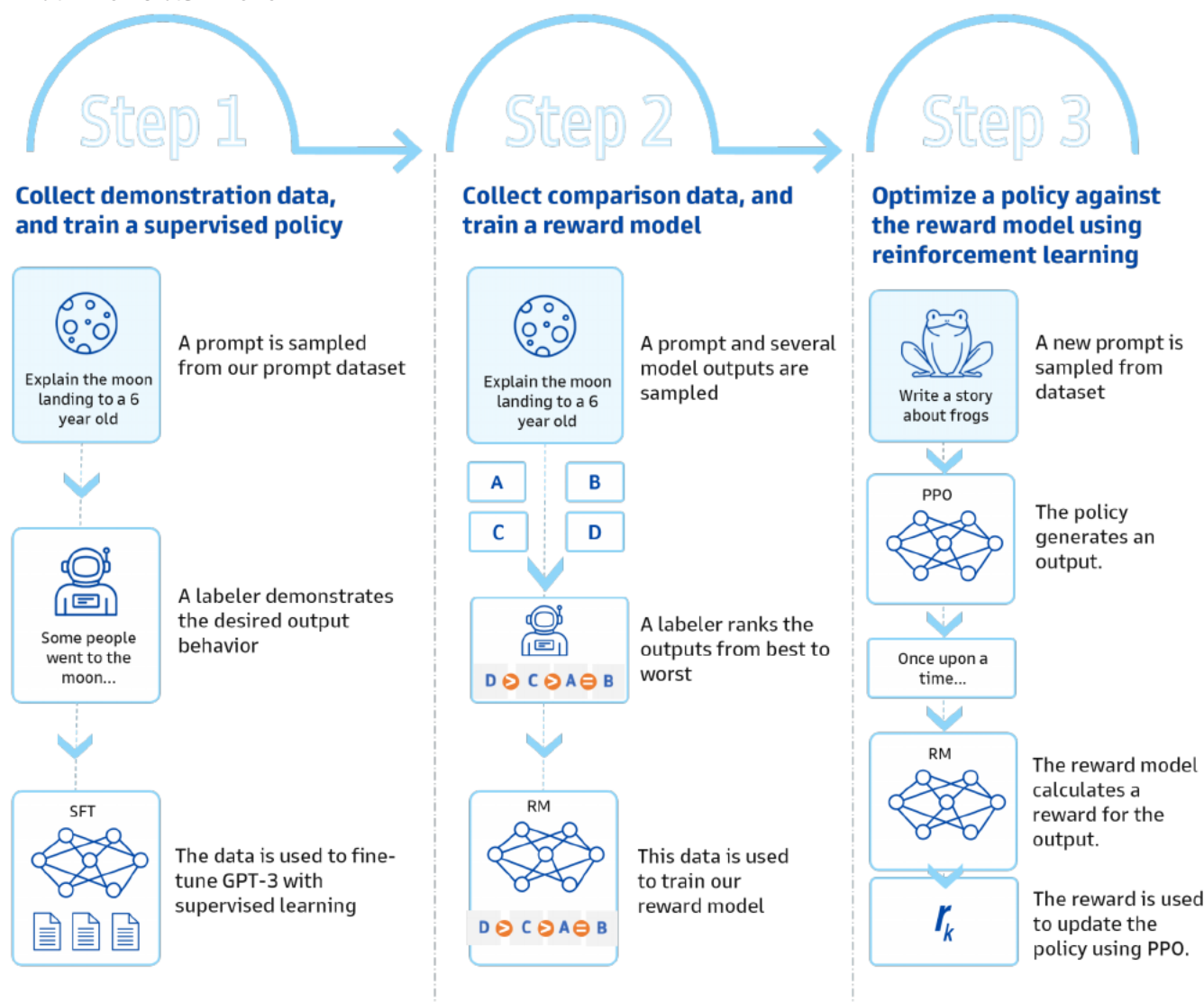
Source: Goldman Sachs Global Investment Research

- **b) JasperAI**

  Similar to ChatGPT, JasperAI is a chat based text to text Generative AI platform, like ChatGPT, JasperAI too is based on GPT-3. However, ChatGPT is more chatbot like and is largely leveraged as a conversational search tool to get quick answers, synthesize content, write essays and articles. JasperAI on the other hand is like a writing assistant and is viewed as the more creative tool. It is used to create content for websites, videos and marketing templates. OpenAI's free offering of ChatGPT resulted in a broad base user audience such as students, creators, individuals, and even enterprises. JasperAI is a paid service that is mostly used by creative professionals in the field of marketing, publishing, etc.

2) AI Frameworks & Applications from Alphabet (GOOGL):

Language Models & Frameworks:

- **LaMDA (Language Model for Dialogue Applications)** is Google's natural language

processing framework that utilizes a group of neural language models built on transformer architecture. Given the fact that the group of models are trained on dialogue-based text, LaMDA is capable of more open-ended/conversation-based language understanding and text generation compared to Google's previous models (BERT, MUM, etc.). Since LaMDA has first unveiled at Google I/O in 2021, Google has integrated it into many of its core products, most prominently within Google Search to better understand/interpret search queries and improve search results.

- **PaLM (Pathways Language Model)** is Google's large language model trained with its Pathways system, a model architecture that enables a single model to generalize and execute across multiple domains & tasks at once (including language understanding & generation, reasoning, pattern recognition, code generation, etc.). Google has recently announced the launch of direct API access to PaLM for third party businesses and developers.

Generative AI Products:

- **Bard** is Google's recently announced conversational AI service. As a standalone user-facing product (separate from Google Search or other products), Bard features a conversation-based interface and inputs to generate responses utilizing real-time data from the open web and powered by Google's LaMDA LLM. Google recently opened up early beta access to Bard, with plans to formerly launch to the broader public in the near future.

- **Imagen, Imagen Video, Parti & Phenaki –** Google's suite of text-to-image and text-to-video products that utilizes a variety of model frameworks (autoregressive, diffusion, encoder-decoder and transformer models) to generate high-fidelity content from text-based inputs.

- **AudioLM & MusicLM –** Google's framework for audio generation (speech, music, etc.) utilizing input prompts of similar speech or audio.

3) Hugging Face: an API platform for AI

Is a community hub for open source AI models with the aspiration of becoming a Git like repository of the AI world. The community consists of ML engineers, data scientists and AI researchers to share models and datasets. The HuggingFace repository is categorized into models, datasets and spaces. Models and datasets are stored in a repository, and are similar to programming code repositories where users can share models/ datasets publicly, create new branches and versions. The plug and play platform allows users to select any model from the interface, pick a cloud provider and integrate the model with an application. Spaces give users the opportunity to demonstrated their AI applications to the community. Currently development of AI applications is largely limited to large enterprises. With Hugging Face users can easily build AI applications without having to build a scalable platform and investing expensive infrastructure. With over 120k models, 20k datasets and 50k demos the Hugging Face platform is democratizing AI for a much broader audience.

4) Image based Generative AI Frameworks: OpenAI's DALL-E 2, MidJourney, Stability AI's Stable Diffusion

Stable Diffusion is a deep learning model that can convert text to image. These models are built using latent diffusion models which are machine learning models that map the structure of the training dataset in a low dimension latent space (the image compression in latent space is faster). AI tools such as DALL-E 2, MidJourney and Stability AI's Stable Diffusion can create images from natural language description. Based on text inputs, these AI tools can generate a new image or create a variation of an existing image while keeping intact components of the original image such as the color palate, textures, and shadow. These models are trained on millions of images to form an association between the words and images.

DALL-E 2 by OpenAI offers limited number of free images per user with an option to purchase more. MidJourney was released in July 2022, a few months after DALL-E 2 and can be accessed via an API or through the Discord chat server. The big break in the text-to-image space came with the release of Stable Diffusion in August 2022 by Stability AI. Just as ChatGPT made text-to-chat AI easily accessible to all, Stability AI's Stable Diffusion opened the doors for mass usability of text-to-image AI. Unlike DALL-E 2 and MidJourney, Stable Diffusion is open source and free, with the biggest differentiator being its ability to run with limited compute on consumer hardware. Although DALL-E 2 requires higher computing power, it is the preferred choice to run more complex queries.

5) Text to Code Generation Frameworks: Codex by OpenAI and GitHub Co-pilot by Microsoft

Codex by OpenAI is a natural language processing tool that can generate programmable code scripts from text prompts. Developers can generate new code from plain text comments, translate code from one programming language to another and interpret code written in a different language. The tool is trained from publicly available source codes and public GitHub repositories with the ability to write code in any programming language (python, JavaScript, Ruby, etc). OpenAI and Microsoft partnered to release GitHub Copilot, which fine-tunes the Codex model to leverage GitHub's vast code repositories as a base. Developers note that with an AI-based coding copilot, time to release code is faster, resolution times improve, thus increasing the productivity of developers. Currently, Codex is a free offering and GitHub Copilot is available at $10/month for individuals and $19/month for businesses. GitHub Copilot is favored by the developer community because the tool gives developers more autonomy and control than Codex. While Codex generates a code script in response to prompt query, Copilot offers multiple suggestions and allowing the developer to pick the best fit.

Generative AI Technology Stack and Its Implications

Just as cloud computing was instrumental in the growth of IaaS/ PaaS/ SaaS, computing power will be the key accelerant for widespread adoption of Generative AI. When Salesforce and NetSuite went public in 2004/05, we had limited visibility to predict that in 15+ years these companies that are powered by the cloud would be billion-dollar software businesses. The mass availability of cloud hosting

services made accessible by AWS was the primary driver behind the acceleration of SaaS businesses. Prior to that, creating and managing cloud infrastructure was difficult and expensive. Following suit in 2022, OpenAI is breaking the barriers for the mass adoption of AI as a service. We believe the next wave of AI could be driven by enterprise SaaS companies. Enterprise software companies have a long-standing history of leveraging intelligence platforms. Before AI, enterprise software companies relied on BI (Business Intelligence) applications for data analysis. Much like AI, BI too is grounded by machine learning principles. However, AI has more far-reaching applications than business data analytics. Going forward, we can expect enterprises to integrate AI into their broader business strategy. We believe Generative AI is still in the early days with a long runway for growth with multiple applications in infrastructure, software and beyond. We further explore the opportunities for AI to be integrated into the tech stacks of the future by drawing an analogy between a cloud computing stack and an IT stack layered with AI.

Exhibit 12: In the future we anticipate the traditional IT stack to be integrated with AI at each layer
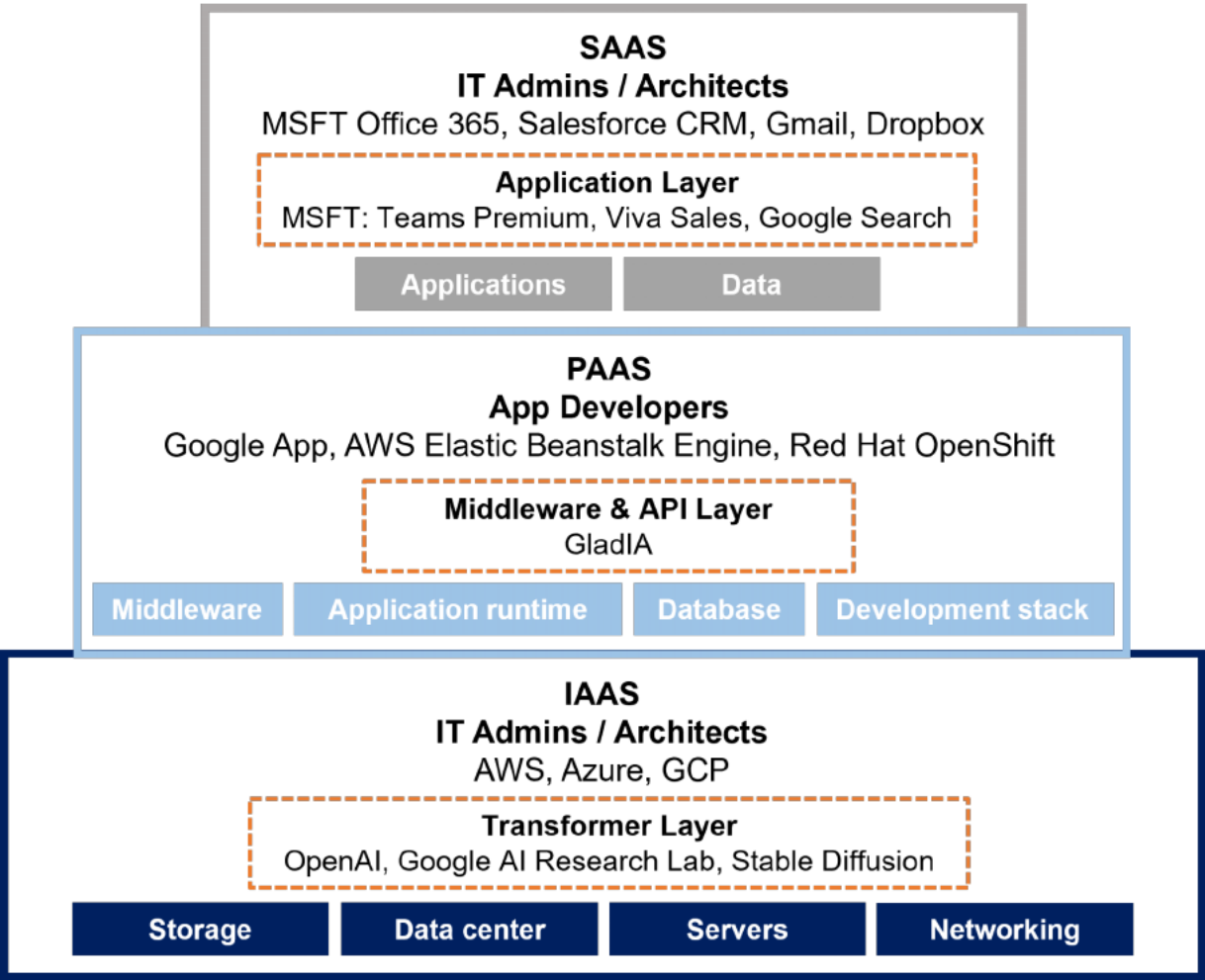
Source: Goldman Sachs Global Investment Research

Infrastructure

Infrastructure Layer: the foundation of a Generative AI tech stack is powered by a strong transformer model. Building an underlying transformer model requires an

abundance of compute infrastructure, and funds for research and development of complex neural network models. The high barriers to entry and investments cost will limit the number of players in this market. Akin to the large public cloud service providers (namely, AWS, Azure and GCP), we are already seeing a few dominant players in this space with OpenAI, Stable Diffusion and Google AI research labs. We can compare this layer of the AI stack to that of the Infrastructure as a Service (IaaS) layer of the cloud computing stack. Similar to IaaS players delivering computing infrastructure such as servers, storage and networking on demand, we anticipate companies potentially buying transformer models to customize and build AI related business solutions on top of these models. Case in point is Microsoft leveraging OpenAI's Generative AI for Teams Premium, Bing Search (more below).

The infrastructure layer going forward. Based on our learnings from the cloud computing era, we postulate what the AI competitive landscape could look like. In the infrastructure layer, similar to the cloud computing stack where the hyperscalers garner majority market share, we anticipate a limited number of players operating in this foundational layer of the AI technology stack as well. The heavy capex investments, high compute costs, large dataset requirements and intellectual property involved in developing large language models and transformer architecture makes it difficult to build and scale. This is comparable to the IaaS stack where hyperscalers spend generously on capex investments in setting up and maintaining data centers, servers, networks, etc. Additionally, unlike code which can be easily upgraded to a new version, Generative AI models can't be rebased when the underlying model needs to be updated. For these reasons we believe many enterprises would prefer to buy LLMs rather than build from scratch, thus limiting new entrants into the space. The high barriers to entry and investment costs are compelling reasons why we believe the infrastructure layer of the AI tech stack too will be dominated by the likes of Google, Microsoft and OpenAI.

Platform

Platform Layer: will consist of AI frameworks and APIs (Application Programming Interface) that will help developers produce AI enabled applications. Like Platform as a Service (PaaS) enables software development by allowing developers to focus on application creation without the hassle of maintaining the underlying infrastructure, we anticipate the growth of plug and play AI APIs will democratize the delivery of AI solutions by enterprise software companies. Platforms such as Hugging Face and GladIA have gained recent traction for their plug and play AI APIs. They offer a one-stop-shop solution for open-source AI APIs, helping software developers easily find a model that fits their needs.

The platform layer going forward. On the platform side, we envision a few strong platforms emerging. This layer will be crucial in integrating the foundational models (LLMs) with the end application. AI Frameworks and APIs will be the key enablers, opening up opportunities for new companies to rise. We are starting to see signs of similar trends to that of the PaaS cycle emerge in the platform layer of the AI stack, i.e. 1) the strong relationship between the PaaS vendors and the cloud providers, and 2) the number of open source players in the market. Within the platform layer of the AI stack we are seeing players like OpenAI (which has a strong relationship with Microsoft) offer

APIs that can be leveraged to build AI-enabled applications. Community-based platforms like Hugging Face are democratizing AI with their library of pre-trained models and datasets. On the text-to-image side, Stable Diffusion has an open source offering. Following suit with their cloud computing counterparts, these platforms have the opportunities to monetize their offerings. Starting with a freemium model to acquire users, these companies can eventually charge for usage of their APIs/frameworks, be it via a subscription model, pay-per-use, etc. Similar to the PaaS market, gaining developer (AI/ML engineers) mindshare will be instrumental in establishing market dominance within the AI platform layer. We do expect history to repeat itself on the platform side, whereby the number of platforms with GAI likely come down to a select few. We also envision a scenario where a few platforms become verticalized and support the distinct needs of end-markets such as Financial Services, Government, Healthcare, etc.

Implications of Generative AI for data and analytics. Generative AI is likely be most impactful for app-centric enterprise software companies (and the underlying compute providers) in the shorter-term given tangible productivity benefits for end-users of business apps, as seen with the recent announcements of GitHub Copilot, Microsoft 365 Copilot, Adobe Firefly, and Einstein GPT. While it remains early, we believe the data and analytics ecosystem should also be a beneficiary of this transformative technology over time, as well as the broader AI/ML theme, considering the fundamental role data will play in developing and iterating on large-language models and enhancing production applications leveraging GAI. We highlight our views on the following companies within data and analytics:

Snowflake: An area where we see potential for Snowflake to leverage Generative AI is integrating ChatGPT or a comparable service to allow end-users to construct data warehouse queries in human text or voice, which, through natural language processing (NLP), can then be converted into the equivalent SQL command to extract data insights. In our view, this has the potential to further democratize access and use of Snowflake's Data Cloud to a less technical audience, while also driving productivity gains by cutting down on human interactions with the data warehouse. With the emergence of several large-language models (and other pre-trained ML models), Snowflake is positioned to benefit, for instance, from its customers scoring data for their ML models (i.e. fine-tuning pre-trained models on new datasets to improve the algorithm). Snowflake's Data Sharing use case could also become increasingly relevant in an AI-driven world as customers leverage public datasets on the Data Cloud to better inform their ML models. The company already has 23% of its customers with at least one stable edge in F4Q23 (i.e., continuous data-sharing connection between two or more parties), up from 18% in the prior year. We also we highlight Snowflake's announced initiatives below around data science/ML that underscore its prioritization of investment in the category. We expect to hear more from Snowflake on the role Generative AI will play in its business at Snowflake Summit on June 26th.

- **Snowpark:** GA in F4Q23 (Python). Snowpark allows data scientists to work with their preferred programming languages, including Python, Java and Scala (vs. SQL), to enable end-to-end machine learning workload development, deployment, and orchestration. Through Snowpark, customers can ingest, analyze, and transform

their data to train ML models that can run predictive analytics to drive better business insights and outcomes (i.e., identifying high-risk credit card customers based on demographic and credit history). Further, Snowflake recently introduced Snowpark optimized-warehouses that specifically cater to ML training use cases, with 16x memory per node vs. a standard Snowflake data warehouse. As data continues its rapid growth, we expect enterprises to increasingly look to ML use cases to achieve cost savings and competitive differentiation. While Snowflake is early in its opportunity in data science/ML (20% of customers have tried Snowpark, as of 4Q23) relative to peers such as Databricks, we believe Snowpark could be a growth vector for the company in F25 as Snowflake expands usage/adoption within its enterprise installed base. Snowpark optimized-warehouses (for ML use cases) require 50% more credits/hour relative to a standard DW, which could serve as a consumption tailwind for the company longer-term as ML workload adoption accelerates.

- **Streamlit:** With Snowflake's acquisition of Streamlit in March 2022 ($800mn), customers can now develop data-intensive apps with only a few lines of Python code. Streamlit was built to simplify the process of contextualizing data analytics tasks and machine learning model outputs through front-end web applications, which can improve decision-making for customers. With the emergence of Generative AI, we expect developers will be able to offload some responsibility of generating Python code to construct web-apps for data visualization by instructing ChatGPT (or a competing service) to provide the Python script based on a set of commands. Over time, Generative AI may also be useful in assisting developers with creating the most effective visualization based on the underlying model outputs.

MongoDB: Akin to Snowflake, we believe that one potential benefit of Generative AI services such as ChatGPT as it pertains to MongoDB is the ability to query the database using natural language, which can then be converted into MongoDB Query Language (MQL). However, we believe that in many instances MongoDB will be an indirect beneficiary of the rise in Generative AI. For example, as discussed in this report, we expect that Generative AI will not only benefit incumbent enterprise software providers through add-on SKUs but also spawn a new generation of AI-centric applications. MongoDB's Atlas is firmly levered to the development/growth of cloud-native apps, which have the potential to see an accelerated time-to-market with the introduction of AI DevOps tools such as GitHub Copilot that can increase developer productivity. Further, as enterprise adoption of ML models proliferates, we could see a potential acceleration in the re-platforming of legacy databases to modern alternatives such as MongoDB as customers seek better access to mission-critical internal data that can be used to inform their ML models. For MongoDB's Enterprise Advanced self-managed offering, we see the potential for services like ChatGPT to augment the role of database administration over time.

Databricks: Databricks (private co.) is a company within the AI/ML ecosystem whose roots are in processing and transforming significant amounts of data (structured, unstructured, semi-) to develop ML models for predictive analytics. While Snowflake and

Databricks are often bucketed as head-to-head competitors, we note that Snowflake has historically been more focused on running analytical queries on structured and semi-structured data (albeit with a more concerted push into ML with Snowpark), while Databricks has been geared more towards data science and machine learning workloads due to its support of unstructured data through its Lakehouse architecture (Data Lake + Warehouse). Databricks offers customers the option to run open-source, pre-trained LLMs such as Hugging Face on its Lakehouse platform for out-of-the-box use cases to generate valuable outputs against stored data. Further, with Hugging Face's Trainer API, Databricks customers can fine-tune existing models to a tailored use case by training against their own internal datasets. While OpenAI brought Generative AI to the forefront of public conversation, Databricks has historically been geared towards data science use cases, including recommendation engines and predictive analytics, with a dedicated machine learning environment that manages the entire ML lifecycle.

Application

Application Layer: we expect AI to be packaged 'as a solution', much like Software as a Service (SaaS). We believe Generative AI will increase the competitive moat for incumbent SaaS solutions. We don't anticipate AI companies competing with enterprise SaaS companies but rather collaborating. Successful SaaS companies are built on the back of strong go-to-market motions, iron clad execution and robust product integrations. Layering AI with B2B SaaS solutions should enhance their technological moats. Typically, SaaS companies house large volumes of customer data, HCM, financial data, Vertical SaaS - insurance, healthcare, etc. We believe leveraging their 1P user data to reinforce and train AI driven large language models is a natural segue for B2B SaaS companies to extract critical insights, automate tasks, increase employee efficiency, and eventually monetize these solutions.

The application layer going forward. The application layer is where we expect to see the most innovation. Here we see a convergence of Enterprise SaaS and Generative AI. We anticipate the emergence of standalone Generative AI companies that are venture-funded to be in a position to leverage new data and language models. We also envision existing SaaS businesses embracing Generative AI and vastly reducing the complexity of the end-user experience. To emerge as a category leader, SaaS companies will have to keep up by integrating AI-enabled solutions in their product DNA. SaaS companies will have to be quick to develop new premium AI SKUs for their existing products as well as add new AI product modules. With all the players in the market purchasing AI infrastructure and platform services from the same subset of AI companies, establishing product defensibility becomes imperative. This where SaaS companies will need to leverage their competitive moats, be it their efficient go-to-market motions, strong sales execution or existing product strength, to rise as SaaS AI-enabled category leaders.

Workforce Productivity Likely to Benefit From Adoption of Generative AI

Generative AI frameworks can streamline business workflows by unifying data

and apps, eliminating routine tasks. A lot of the value of today's knowledge worker is based on ability to navigate different computer programs, be it on a desktop, tablet or smartphone. Generative AI can unclutter user interfaces of such platforms to streamline the user experience by navigating the enormous complexity under the hood via code generation. This is powered by transformer technology (discussed above), that intelligently divides what is needed to accomplish and offers the completed results quickly.

Potential for significant productivity boost. A lot of what software does today is based on automating a certain piece of logic or business process. Such progress, when first seen with the invention of the PC, resulted in a tremendous boom in productivity, albeit at a lag (Exhibit 13) that was largely attributable to the time it took to reach mass scale. For example, the output of an analyst in any given field 20 years ago would pale in comparison to the level of deliverables seen today. The delta is driven by advancements in software and hardware technology that has allowed us to squeeze more out of the same unit of time due to the proliferated access to information tools that underpin productivity. It would not be a stretch to say today's workers have access to more information and tools that augment their knowledge base and enable faster processing/passing/analyzing of that information. GS' macro team estimates that Generative AI can be a boon to the US labor productivity growth, raising it by just under 1½pp over a 10-year period following mass adoption (link to macro report). They note, however, that this outcome may range from 0.3-3.0% depending on the caliber of the technology, the base of adoption, and potential replacement of certain jobs.

Exhibit 13: Previous Milestone Technologies Have Led to Labor Productivity Booms
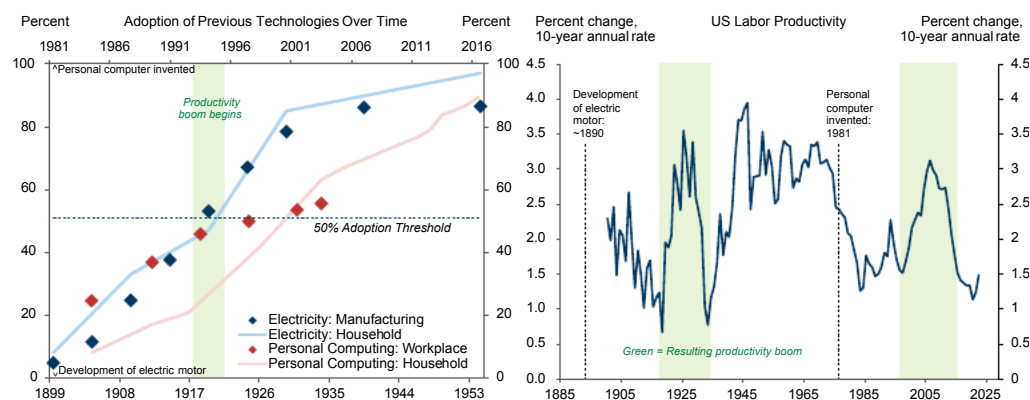
Source: Bureau of Labor Statistics, US Census Bureau, Our World in Data, Woolf (1987), Haver Analytics, Goldman Sachs Global Investment Research

We also point out, that despite all this automation, the workforce has not shrunk and the economy has only expanded due to the aforementioned improvements. As the labor force gets more efficient, the group tends to accomplish more within the same hour constraints. We see Generative AI being the lever that drives another step up in such efficiencies, helping eliminate routine tasks and cumbersome procedures.

For example, imagine a research analyst issuing a very simple command on their search bar inside their firewall where they have trained a technology like ChatGPT or Bard to study their models. When the analyst is asked which companies are showing an accelerating growth rate or expanding margins, neither the analyst nor their team

members will need to sift through various models. That should happen in seconds. They don't even need to type the e-mail with their results - the AI will do that for them. That does not mean less work is done. It just means that the analysts will spend their time doing more productive and rewarding work that can lead to additional capacity.

You don't need to be a programmer to write code. The benefit of Generative AI is that the computer can just take your text or voice and translate that into code that can quickly run various tasks, such as risk analytics, statistical modeling, routine memo drafting, forecasting, collateral generation, financial reporting, etc. Comparing this to a SQL-based approach, where an application has to talk through an API to an underlying database using SQL code, Generative AI is likely to modernize this process by using your natural language input to compose or extract the right answer from the database. Said differently, in the past you could only communicate with a computer program through code. You needed to structure your query in the syntax the program would understand to get the answer to a question from a database. Now, natural language processing (NLP) reduces the premium placed on SQL programming whereby as the NLP is able to work with the database and negotiate commands in plain English. While this may seem to imply the relevance of code is diminishing, it actually means that the need for code proliferates as Generative AI frameworks divide and contextualize the inputs provided and convert them into programs that accomplishes tasks. Going off the capabilities displayed by Siri or Alexa, which have become household technologies, Generative AI goes further as it has a much more tangible UX experience and can process much more complex tasks.

A new class of business applications can be built on Generative AI. The big difference between Generative AI as a platform and prior platforms is that Generative AI learns at a rapid clip and gets better with usage. Generative AI's continuous feedback loop, which allows it to constantly improve on its accuracy and knowledge base, should allow it to lead to the creation of a new class of applications. Domain expertise, such as medicine, are likely to be digitized in a transformational way. For example, it may also be able to scour through users' medical records and tests, working to provide deeper insights and more definitive conclusions. Another use case can be in the film industry, where a producer has a vision for a short documentary or movie and can execute it entirely with Generative AI. The field of creative software is going to be vastly reshaped, in our view. While it might be concerning to think that computers can take over the creative process, removing the creative artists' touch, the opposite could likely occur when creative artists feel that Generative AI can get them to a starting point that was previously unimaginable. The hybrid nature of generated assets (that allow for editing and adjustments from the users) will also likely allow for the artist to add their visceral touch to it.

Generative AI can disrupt incumbent application software. Generative AI has clear benefits in the field of customer relationship management, in particular marketing and customer support. It also has very significant implications for financial planning, business risk analysis, inventory management, production scheduling, logistics and shipping. Yet another facet of Generative AI is the availability of soon-to-be half a dozen or so platforms upon which new applications can be built. This has been viewed by

industry leaders as being an "iPhone moment" when the new mobile platform was launched in 2007; yet, we did not have the first intuitive and comprehensive application (that allowed users to order and deliver food, for example) for several years later. As Generative AI has been around for at least five years, and given the monumental improvements we have in the last few months, Generative AI may be on the brink of sparking a variety of new business ideas over the next few years. Some of these ideas will disrupt existing markets and are likely to benefit companies that have large amounts of data (such as Salesforce). That being said, a technology company should not take its data incumbency for granted since data is growing at a rapid pace. When new platforms and new applications end up engaging end user interests, the older data gets less relevant and competitive advantage dissipates. Therefore, software companies that deal with applications must incorporate Generative AI very quickly in their application or face substantial risk in the future as data creation moves to more attractive platforms.

Sizing the Generative AI TAM for Enterprise Software

Generative AI can contribute an incremental +$150bn in the global enterprise software TAM. We see the integration and implementation of Generative AI tools across the application stack adding ~$150bn to the global enterprise software TAM. This assumption is based on the expectation that adoption can be as ubiquitous as productivity tools (such as Microsoft Office with +300mn paid seats) or ~30% of the total knowledge worker base. As this wave of innovation has business implications across an array of existing end-markets (as opposed to a standalone AI/analytics submarket), we foresee monetization occurring in the form of: **1)** price increases over time as innovation, adoption and stickiness increase the value of existing applications, and **2)** new premium, add-on SKUs, which will likely be the main driver of near-term growth. Our analysis comprises the following steps:

- **1) Evaluating the price points for Generative AI apps based on those currently available.** To start, we leveraged the pricing structure of existing products that are powered by Generative AI tools, such as Adobe's Creative Cloud and Intuit's Turbo Tax Live, as well as recently released products (Microsoft Teams Premium and GitHub Copilot). These newer solutions, which are ~$10-20/user/month (excluding discounts) provide a sound starting point for more premium add-ons. Platforms that have evolved over the last five years, such as Creative Cloud, also showed a pattern of ~$10 price increases, with Adobe increasing the price of its Teams bundle by $10 in 2018 (vs the initial price of ~$70/month set in 2014) and announcing an additional $10 step-up in 2022. We point to Adobe's launch of Sensei, its AI platform tool, in 2016 as a catalyst for the product innovation that warranted such pricing boosts. This also led us to gain confidence in future Generative AI releases being able to garner at least $10/month.

- **2) Calculating the ASP uplift to existing apps across North America and developed international markets.** Keeping in mind the international mix of the global workforce, we analyzed the software TAM (excluding IaaS) against the labor force in Europe + Japan to derive the average software spend per worker vs. that of

North America. As shown in Exhibit 14, international investments relative to their labor force are ~30% that of the US. Tying this back to the avg SKU price attributed of a Generative AI offering, we applied this 70% discount to the US $10 SKU discussed earlier to arrive at a ~3 monthly cost per international employee. Annualizing these prices and accounting for the roughly even split between North America/International TAM, we derived a weighted average annual spend of $78 per person.

Exhibit 14: Average software spend (excl. IaaS) per employee (derived by TAM/labor force) indicates international spending is ~70% lower than that of North America

International Includes: Europe + Japan Software market includes: Application software, app development, data management, security, CPaaS, event-stream processing, RPA, and digital experience platforms

Source: Gartner, World Bank, Goldman Sachs Global Investment Research

- **3) Determining the average number of applications that a worker will pay an added cost to leverage Generative-AI capabilities.** As this annualized cost represents a per user, per month, per application figure, we also analyzed the average number of applications utilized by a typical knowledge worker to determine the level of spend that can be driven per employee. While this can range depending on the role and company, we honed in on the applications that are likely to warrant the additional spend for more innovative features. We concluded that applications such as collaboration, productivity, HR, ERP (i.e., T&E), which are broadly adopted by most knowledge workers fit into this category given their value proposition and wide use. We also discerned that there are likely to be 1-2 role-specific solutions (i.e., CRM platform, developer tools) that may also garner investment to induce productivity. This led us to conclude that Generative AI tools can unlock value in ~5-6 apps per knowledge worker.

- **4) Conduct sensitivity analysis around assumed penetration rate of the +1bn global knowledge workers.** As outlined in Exhibit 15, assuming 100% of the 1.1bn knowledge workers in the labor force today adopt 5 GAI applications at an average monthly cost of $78, this would create a $429bn TAM. **Given we are still in the early stages of the adoption curve, our base case TAM is predicated on ~30-40% of knowledge workers meeting the above characteristics and amounting to a ~$150bn TAM.** Exhibit 16 shows the sensitivity analysis we conducted that factors in the number of apps/SKUs the average user will pay for Generative- AI capabilities as well as the level of penetration among the ~1bn base

of global knowledge workers. As we expect this to be the next wave of innovation within software, extending the utility model and enhancing productivity at the end user level, our base case assumptions are underpinned by the level of adoption seen by Microsoft for its commercial Office 365 suite, which has ~345mn paid commercial seats. We note that **we see upside to this figure as this level of penetration does not fully account for the broader commercial user base, that may leverage other platforms, such as Google Workspace.**

Exhibit 15: Assuming 100% adoption, GAI can add ~$430bn to the global enterprise software TAM (excluding IaaS)

# of Knowledge Workers Globally (mn)	1,100
Average Price for AI SKU - US	$10.0
Average Price for AI SKU - International	$3.0
Weighted Average Price	$6.50
Annualized Price	$78.0
Avg # Apps with Paid GAI Capabilities per Employee	5
Annualized Spend per Knowledge Worker	$390.0
Calculated TAM (assumes 100% adoption)	**$429 bn**
Base Case TAM (assumes ~30% adoption)	**$150 bn**

Source: Gartner, World Bank, Goldman Sachs Global Investment Research

Exhibit 16: Generative AI can drive +$150bn in software spend (excluding IaaS) assuming the utilization of 5-6 apps across 300-400mn knowledge workers

		\$ Annualized spend on Generative AI SKUs per knowledge worker					
		3 apps	*4 apps*	*5 apps*	*6 apps*	*7 apps*	*8 apps*
		$234	**$312**	**$390**	**$468**	**$546**	**$624**
# of Knowledge Workers Paying for Generative AI Tools	100	$23	$31	$39	$47	$55	$62
	200	$47	$62	$78	$94	$109	$125
	300	$70	$94	**$117**	**$140**	$164	$187
	400	$94	$125	**$156**	**$187**	$218	$250
	500	$117	$156	$195	$234	$273	$312
	600	$140	$187	$234	$281	$328	$374

Source: Gartner, World Bank, Goldman Sachs Global Investment Research

Raise PTs for MSFT, CRM, ADBE Given Revenue Tailwinds

We raise our outer-year revenue estimates and price targets for MSFT, CRM, ADBE as we believe Generative AI presents a strong tailwind that can define the next decade of growth for software. In light of the TAM framework we outlined in this report (Exhibit 16) and recent product announcements across a number of companies in our coverage, we set out to determine the possible lift Generative AI can have to our current growth expectations. While likely to have positive implications across our coverage, we honed in on those companies with tangible product offerings and a certain level of visibility into monetization. This resulted in us being able to attribute revenue growth to companies such as MSFT, CRM, and ADBE. As we are still very early in this cycle (with most products still not generally available), the changes to our top-line

estimates largely began in 2024 and extended to the outer years as we account for market release and adoption timelines that can take up to ~12-24 months for large deployments. For companies such as MSFT who already have in-market products with defined monetization strategies, (i.e., GitHub Copilot, Teams Premium), we see such these products increasingly becoming a growth driver as users already begin to adopt the offerings. We also assume a growing impact in later years as larger deployments in more core parts of the business (i.e., Microsoft 365, Azure, Dynamics) take place. In some cases, we expect the impact to surface later as next-gen products have been announced but are still in pilot/beta testing (i.e., CRM Einstein GPT, ADBE's Firefly). Though Adobe's Firefly services are still in beta, we took into consideration the ease of adoption based on end-market user and the average length of a sales cycle. Adobe's exposure to consumers/SMBS coupled with its strong direct-to-consumer selling channel for its Creative and Document Cloud offerings led us to assume possible revenue uplift from Generative AI services beginning in 2024. Given the growth estimates incorporated into our models prior to these changes assumed a level of growth from new product releases, we remind investors that the incremental growth we are factoring in does not represent the full underlying benefits of this adoption.

Microsoft: We raise our PT to $325 from $315 as we see the recent slew of product announcements translating to revenue over time. While the company has already begun monetizing add-on features to existing applications, such as Teams Premium ($10/user/month) and GitHub Copilot ($19/user/month on the business plan), we see the enhancements to its core offerings, such as Microsoft 365 Copilot, being the key driver of future revenue growth given its +345mn paid subscriber base and prior success in raising ARPU. We reference Microsoft's success in introducing and migrating users to premium E1/E3/E5 tiers after the addition of key product enhancements offers a playbook that can succeed in this product cycle. To account for the more near-term uplift from the release of Teams Premium and GitHub Copilot, we slightly raise our Productivity and Business Processes and Intelligent Cloud estimates, mainly via its Commercial Office segment and Azure, with a marginal lift to Dynamics 365. Anticipating pricing plans to be released for Microsoft 365 Copilot, Dynamics 365 Copilot and other Copilot offerings over the next 12 months and factoring in time to adoption, we revise our revenue expectations of these segments in a more pronounced manner in FY25 and outer years. At a high level, we raise our Microsoft Cloud (which encompasses Azure, Commercial Office 365, Dynamics 365, and LinkedIn Commercial) yoy growth estimates by ~1% and 2% in FY25 and FY26, expecting 20% and 18% yoy growth respectively. Exhibit 17 further outlines these estimate revisions.

Exhibit 17: Raise MSFT revenue estimates to account for a lift from the adoption of Gen. AI Copilot SKUs

All figures in $ mns	FY23 (E)				FY24 (E)				FY25 (E)			
	Prior Est.	GS Est.	Δ	Consensus	Prior Est.	GS Est.	Δ	Consensus	Prior Est.	GS Est.	Δ	Consensus
Azure Growth Rate (YoY)	29%	29%	0%	29%	22%	23%	1.1%	26%	23%	24%	1.3%	26%
Productivity and Business Process	$68,585	$68,585	$0	$68,389	$76,420	$76,638	$218	$74,844	$85,622	$86,509	$887	$81,913
YoY	8%	8%	0.0%	8%	11%	12%	0.3%	9%	12%	13%	1.0%	9%
Intelligent Cloud	$87,926	$88,020	$94	$87,594	$97,762	$98,511	$749	$101,651	$111,676	$113,475	$1,799	$119,472
YoY	17%	17%	0.1%	16%	11%	12%	0.8%	16%	14%	15%	1.6%	18%
More Personal Computing	$53,369	$53,369	$0	$52,966	$57,159	$57,159	$0	$54,632	$59,539	$59,539	$0	$58,186
YoY	-11%	-11%	0.0%	-11%	7%	7%	0.0%	3%	4%	4%	0.0%	7%
Total revenue (non-GAAP)	$209,880	$209,974	$94	$208,847	$231,342	$232,309	$967	$232,095	$256,837	$259,523	$2,686	$261,609
YoY	6%	6%	0.0%	5%	10.2%	10.6%	0.4%	11.1%	11.0%	11.7%	1.0%	12.7%
Cost of revenue	$65,906	$65,910	$4	$65,749	$71,074	$71,248	$174	$73,366	$76,849	$77,965	$1,116	$83,322
YoY	5%	5%		5%	8%	8%		12%	8%	9%		14%
Gross profit	$143,974	$144,063	$89	$143,099	$160,268	$161,061	$793	$158,729	$179,987	$181,558	$1,571	$178,287
YoY	6%	6%		6%	11%	12%		11%	12%	13%		12%
Gross margin	69%	68.6%	$0	69%	69%	69.3%	$4	68%	70%	70%	($13)	68%
Operating expenses	$57,816	$57,816	$0	$57,965	$60,678	$60,678	$0	$60,956	$64,499	$64,499	$0	$65,432
YoY	11%	11%		11%	5%	5%		5%	6%	6%		7%
Operating income	$86,158	$86,247	$89	$85,134	$99,590	$100,383	$793	$97,773	$115,489	$117,059	$1,570	$112,855
YoY	3%	3%		2%	16%	16%		15%	16%	17%		15%
Operating margin	41%	41.1%	+0 bps	41%	43%	43.2%	+14 bps	42%	45%	45%	+12 bps	43%
EPS (non-GAAP)	9.42	9.43	0.01	9.31	11.10	11.14	0.04	10.79	13.04	13.14	0.10	12.46
YoY	2%	2%		1%		18%		16%		18%		15%
Microsoft Cloud Revenue	$112,135	$112,135	$0		$133,201	$133,692	$490		$159,597	$160,831	$1,234	
YoY	23%	23%			19%	19%			20%	20%		
Gross margin	73%	73%			74%	74%			75%	74%		
OCF	$92,157	$92,210	$53	$88,997	$102,703	$102,975	$272	$104,429	$114,701	$115,476	$775	$120,718
YoY	3%	4%		0%	11%	12%		17%	12%	12%		16%
Cash capex	$26,474	$26,474	$0	$26,411	$27,995	$27,995	$0	$29,806	$29,955	$29,955	$0	$31,968
YoY	11%	11%		10%	6%	6%		13%	7%	7%		7%
FCF	$65,683	$65,737	$54	$61,432	$74,708	$74,980	$272	$74,615	$84,786	$85,522	$736	$90,317
YoY	1%	1%		-6%	14%	14%		21%	13%	14%		21%

Source: Company data, Goldman Sachs Global Investment Research

Salesforce: We raise our PT to $325 from $320 given the potential for Einstein GPT to drive greater adoption across the CRM ecosystem. As we expect the addition of Generative AI to simplify the Salesforce platform, this can drive improved onboarding, engagement and expansion rates. With multi-cloud customers spending anywhere from 3-300x a single cloud user and this group holding the highest retention rates, the successful deployment of Generative AI and analytics within their ecosystem could lead to numerous benefits, from **1)** stronger Data Cloud demand **2)** durable growth in other segments, such as Sales, Service and Marketing Clouds as data silos are broken down and **3)** improved unit economics as churn eases and sales efficiency improves. As Einstein revenue is typically recognized in the segment of the product it sits on (Sales, Service, etc), we see the various use cases across sales, service, marketing as providing tailwinds across the portfolio. Still, we call out potential acceleration in Data Cloud given it comprises Tableau and Mulesoft, which are likely to power the data analytics and integration needed for such offerings. We incorporate this into our estimates by marginally raising our FY25 (CY24) subscription revenue in the 2H of the year , with more upside in later years, once large deployments begin to be implemented.

Exhibit 18: Raise CRM revenue estimates to reflect potential lift from Einstein GPT

All figures in $ mns	FY24 (E)				FY25 (E)				FY26 (E)			
	Prior Est.	New Est.	Δ	Consensus	Prior Est.	New Est.	Δ	Consensus	Prior Est.	New Est.	Δ	Consensus
Subscription/ Support Revenue	$32,113	$32,113	$0	$31,852	$36,101	$36,149	$48	$35,367	$41,539	$41,715	$176	$39,977
YoY	10.7%	10.7%		9.8%	12.4%	12.6%		11.0%	15.1%	15.4%		13.0%
Professional Services Revenue	$2,553	$2,553	$0	$2,571	$2,859	$2,859	$0	$2,831	$3,145	$3,145	$0	$3,234
YoY	9.5%	9.5%		10.3%	12.0%	12.0%		10.1%	10.0%	10.0%		14.2%
GAAP Total Revenue	$34,666	$34,666	$0	$34,545	$38,960	$39,008	$48	$38,449	$44,684	$44,860	$176	$43,523
YoY	10.6%	10.6%		10.2%	12.4%	12.5%		11.3%	14.7%	15.0%		13.2%
Total Gross Profit	$27,230	$27,230	$0	$26,762	$30,696	$30,737	$41	$29,852	$35,302	$35,449	$148	$33,366
% margin	78.6%	78.6%		77.5%	78.8%	78.8%		77.6%	79.0%	79.0%		76.7%
Operating Income	$9,360	$9,360	$0	$9,191	$11,628	$11,669	$41	$11,327	$14,182	$14,330	$148	$13,043
% margin	27.0%	27.0%		26.6%	29.8%	29.9%		29.5%	31.7%	31.9%		30.0%
Expansion	450 bps	450 bps		405 bps	280 bps	290 bps		285 bps	190 bps	200 bps		50 bps
Non-GAAP EPS	$7.15	$7.15	$0.00	$7.10	$8.95	$8.98	$0.03	$8.89	$10.91	$10.96	$0.04	$10.45
Current RPO	$26,568	$26,568	$0		$30,288	$30,288	$0		$34,376	$34,376	$0	
YoY	8.0%	8.0%			14.0%	14.0%			13.5%	13.5%		
CFO	$8,249	$8,249	$0	$8,334	$10,311	$10,330	$19	$10,955	$12,991	$13,112	$121	$12,955
YoY	16.0%	16.0%		17.2%	25.0%	25.2%		31.5%	26.0%	26.9%		18.3%
Free Cash Flow	$7,412	$7,412	$0	$7,422	$9,435	$9,454	$19	$9,678	$12,075	$12,195	$121	$10,393
YoY	17.4%	17.4%		17.6%	27.3%	27.6%		30.4%	28.0%	29.0%		7.4%

Source: Company data, Goldman Sachs Global Investment Research

Adobe: We raise our PT to $480 from $475 after attending the company's Summit conference, where management announced various new features and products that can drive the next leg of growth across its creative, document and marketing offerings. Primarily, we see the company's Firefly suite, which will be available across many user touch points, as underpinning future innovation. Drawing a parallel to the release of its AI/ML technology, Sensei, which Adobe was able to build on to drive two price increases, we assume a similar strategy to be used going forward. We also consider the potential for some of these releases to be complimentary to existing offerings. In either scenario, we see this supporting durable growth in the future. Creative Cloud will likely drive the initial step-up in adoption with the benefits to Digital Experience being a later cycle benefit due to its longer-sales cycle motion. We expect to see a more pronounced boost to this segment over time as Adobe's DX platform is relatively new (with Adobe ramping investments in this are around 5 years ago), and has many components to adoption (AEM, CDP, etc).

Exhibit 19: Expect Creative Cloud revenue to show first signs of gen AI adoption with Digital Experience a longer-tailed benefit given deal nature

All figures in $ mns	FY23 (E)				FY24 (E)				FY25 (E)			
	Prior Est.	New Est.	Δ	Consensus	Prior Est.	New Est.	Δ	Consensus	Prior Est.	New Est.	Δ	Consensus
Net New DM ARR	$1,707	$1,707		$1,704	$2,156	$2,176	$20	$2,170	$2,067	$2,092	$25	$1,853
Digital Media	**$14,017**	**$14,017**	**$0**	**$13,985**	**$15,867**	**$15,886**	**$19**	**$15,647**	**$18,366**	**$18,398**	**31.94**	**$17,038**
YoY	9.1%	9.1%		8.9%	13.2%	13.3%		11.9%	15.7%	15.8%		8.9%
Creative Cloud Revenue	**$11,354**	**$11,354**	**$0**	**$11,292**	**$12,785**	**$12,803**	**$19**	**$12,590**	**$14,827**	**$14,856**	**28.65**	**$13,730**
YoY	8.5%	8.6%		8.0%	12.6%	12.8%		11.5%	16.0%	16.0%		9.1%
Document Cloud revenue	**$2,662**	**$2,662**	**$0**	**$2,700**	**$3,083**	**$3,083**	**$0**	**$3,079**	**$3,539**	**$3,542**	**3.29**	**$3,308**
YoY	11.7%	11.7%		13.3%	15.8%	15.8%		14.0%	14.8%	14.9%		7.4%
Digital Experience	**$5,005**	**$5,005**	**$0**	**$4,973**	**$5,688**	**$5,688**	**$0**	**$5,642**	**$6,269**	**$6,331**	**62.07**	**$6,439**
YoY	13.2%	13.2%		12.5%	13.7%	13.7%		13.5%	10.2%	11.3%		14.1%
Total revenue	**$19,358**	**$19,358**	**$0**	**$19,278**	**$21,875**	**$21,894**	**$19**	**$21,545**	**$24,929**	**$25,023**	**94.01**	**$24,041**
YoY	9.9%	9.9%		9.5%	13.0%	13.1%		11.8%	14.0%	14.3%		11.6%
Gross Profit	**$17,314**	**$17,314**	**$0**	**$17,144**	**$19,543**	**$19,561**	**$18**	**$19,176**	**$22,323**	**$22,398**	**74.60**	**$21,133**
% margin	89.4%	89.4%		88.9%	89.3%	89.3%		89.0%	89.5%	89.5%		87.9%
Operating Income	**$8,557**	**$8,557**	**$0**	**$8,642**	**$9,623**	**$9,641**	**$18**	**$9,686**	**$11,494**	**$11,568**	**74.60**	**$10,899**
% margin	44.2%	44.2%	+0 bps	44.8%	44.0%	44.0%	+5 bps	45.0%	46.1%	46.2%	12.49	45.3%
Diluted EPS (ex ESO exp)	**$15.50**	**$15.50**	**$0.00**	**$15.46**	**$18.13**	**$18.17**	**$0.03**	**$17.56**	**$23.09**	**$23.24**	**0.15**	**$20.02**
YoY	12%	10%		13%	13%	13%		14%	9%	14%		14%
CFO	**$8,121**	**$8,121**	**$0**	**--**	**$9,296**	**$9,312**	**$16**		**$11,005**	**$11,071**	**66.02**	
YoY	4%	4%		--	14%	14%			18%	19%		
FCF	**$7,674**	**$7,674**	**$0**	**$7,778**	**$8,845**	**$8,861**	**$16**	**$8,855**	**$10,527**	**$10,593**	**66.02**	**$9,870**
YoY	4%	4%		5%	15%	15%		14%	19%	20%		11%

Source: Company data, Goldman Sachs Global Investment Research

Impact of Generative AI Likely to Reach Multitude of Workforce Personas

Since the introduction of ChatGPT and the subsequent popularization of Generative AI, ample use cases spanning a wide range of applications have emerged, from business to technology to healthcare. Using recent product announcements as a launch pad, we hypothesize how Generative AI could evolve software categories (CRM, HR, Cybersecurity) as well as various verticals (i.e. healthcare).

- **Office Productivity Tools:** Some of the most apparent applications of Generative AI revolve around office productivity tools like Microsoft 365 and Google Workspace. When assessing the future use cases of Generative AI with respect to this use case, we expect these scenarios to be underpinned by broader real-time connectivity between data streams, data models, applications and the end-user. We anticipate deeper application integrations resulting in seamless cross product functionality. This should encourage increased efficiency as employees can expeditiously reference & leverage previously disparate data while working within one application. For example – an employee creating a presentation could leverage Generative AI to quickly pull notes from a Word file to populate a PowerPoint slide while never leaving PowerPoint. This type of technology is on the horizon based on demos of Microsoft 365 Copilot & Google Workspace. Future iterations could potentially prompt users to notify the right stakeholders of the documents with a draft of an email that can let them know it's ready. The real time data flow could reduce the time spent needed to synthesize and summarize data. Finally, Generative AI can unlock enhanced utilization within applications. Most users of Word, Excel, PowerPoint, etc. are likely only scratching the surface of these tools' potential. We

believe Generative AI is primed to simplify the complex capabilities of these applications, resulting in more in-depth and thoughtful insights, and better-quality end products.

- **CRM:** Digging into potential Generative AI use cases within sales and marketing, we believe most will center around 1) having real-time actionable data, 2) curating tailored sales motions, and 3) generating dynamic, scalable, and personalized content. CRM is one of the more fragmented sub-sectors of application software as it's comprised of sales, marketing, service, and commerce. The first integration of Generative AI in this segment will likely focus on producing suggestion/content/analytics based on models that were trained on disparate data sets. This content could be used to provide real time actionable data to generate tangible business returns.

    Given recent announcements in the space, including Salesforce's Einstein GPT for Sales and its anticipated capabilities are expected around automatically tackling more monotonous tasks (scheduling meetings, summarizing discussions). We think the next leg of evolution could curate tailored sales motions. By leveraging available client-related data and insights around what has worked with prior engagements, Generative AI could suggest proven strategies that may resonate more with clients, leading to more meaningful engagements and improved efficiency, while staying true to the company's brand and avoiding the need to reinvent the wheel. Finally, companies are likely to use this technology to create personalized, dynamic, scalable content by utilizing client data such as emails, mobile, etc.

    Generative AI could easily create personalized marketing campaigns - similar to what Einstein GPT for Marketing is slated to do. This technology is likely to evolve in such a way that a marketing team may only have to create the initial outline and Generative AI will dynamically create various iterations of content (images, graphics, videos, etc.) for the different cohorts/demographics of that campaign. Furthermore, similar to Dynamics 365, companies could utilize Generative AI to expand the parameters of data used to provide more comprehensive, dynamic and effective marketing materials.

- **Search:** Generative AI is likely to transform search in a way that will allow the engine to return concise, conversational answers in tandem with related links (versus the traditional list of websites that have been populated previously). Microsoft and Google's latest announcements in this area have demonstrated these capabilities as being top of mind. Still, we see a continued path of evolution that can allow a user to act directly from the search interface. As an example, if a user is looking to buy a product, book a hotel or request a service, they would be able to aggregate and present the relevant data and complete the transaction in one interface. While this could be implemented across search more broadly (e.g. Bing, Chrome, etc.), it may also be incorporated within company-specific websites.

    □ **Microsoft:** In Feb 2023, Microsoft released a new version of the Bing search tool and Edge browser, whose product updates are underpinned by Microsoft's partnership with OpenAI. The additional context users are expected to receive in their searches (given the context needed in a

Generative AI interaction) provides greater ROI to both users and advertisers. This, in turn, can increase the value of an advertisement versus the quantity of ad click-through rates. Taken along with the fact that generated responses can be displayed in tandem to relevant links, we also see the LLMs underpinning the AI models as providing a strong opportunity for international growth. We also expect the vast amount of data aggregated via mass search capabilities to refine the underlying models in a way that will be leveraged in the deployment of enterprise-grade applications where accuracy is paramount.

☐ **Alphabet:** Since the initial introduction of its first LLM during Google I/O in 2018, Google has been implementing AI into its core search product including better query understanding, language processing and response generation for more relevant search results. As a result, "zero-click" searches (i.e. search results that are directly generated by AI and do not lead to a user click) has been steadily increasing over the past ~5 years. Going forward, we will monitor how consumer's search habits continue to evolve and how Google is positioning itself as a result, both through its continued integration of AI/LLMs into Google Search and the introduction of new user interfaces outside of search (e.g. Bard, Google's chat-based AI model, which Google recently opened up early beta access to plans to formally launch to the broader public in the near future).

■ **Human Resources**: While not an area of focus today, we expect announcements around the applications of Generative AI within HR to evolve substantially. With companies such as Workday having fleshed out their platform capabilities (via organic R&D or small tuck-in acquisitions over the last 5 years), Generative AI can play a substantial role in allowing users to fully leverage these platforms, albeit them potentially not sitting on the same IT architecture. We postulate that the first wave may focus on assisting with more routine work, such as generating and updating job postings (where GAI can analyze prior descriptions to create an accurate post for the role today), suggesting employee engagement campaigns (based on prior successful employee initiatives), assisting in the sorting and identifying of promising candidates based on keyword analysis, and curating employee-specific onboarding content and processes. Longer-term this may take shape of learning best practices, accelerating analyses for faster decisions, and optimizing resources. Examples of such use cases are: 1) reducing the interview process as generative AI can screen candidates, review feedback of several interviewers and suggest next steps 2) being able to compile formal and informal feedback to reviews to determine an employees' eligibility for promotion or 3) faster time to market with critical analysis, such as how the firm is doing across D&I or ESG categories.

☐ **Workday**: As the leader in HR and core financials with an agile cloud platform, Workday is well positioned to adopt Gen AI in a meaningful way. We expect Workday to release product announcements around this technology in the coming months that will outline how the industry will unlock more value for its customers. Workday has the benefit of having both HR and ERP solutions that can allow it to provide more holistic recommendations that best fit the company as a whole rather than just departmentally. In addition to HR

solutions, where Gen AI can automate monotonous work, improve engagement (for employees and candidates alike) and guide decisions, Gen AI may be able to augment its workforce, talent, and spend management solutions to improve trend analysis and suggest strategies that can optimize resources. The company's planning solutions (powered by Adaptive – acquired in 2018) offer an additional avenue that can be innovated on to simplify user experiences as Gen AI models will be able to train on a vast amount of data and identify trends for best practices.

- **DevOps**: Companies are adopting Generative AI to augment current resources within DevOps at a rapid clip compared to other segments discussed in this note. For example, GitLab announced its AI suggested code suggestions tools, and Microsoft announced two iterations of its Copilot offerings for GitHub. GitHub Copilot has already been released, and assists developers with text-to-code functionality that allows users to simply type their desired output, and the associated code is written for them. This can lower the barrier for more casual code developers and increase the output of more experienced hires as they will be able to start on a project with a preliminary code base and expedite deployment times. While largely still being tested for accuracy (in-line with our assumptions that any large deployments of any Gen AI tool can take anywhere from 12-24 months), common use cases fall into: drafting an initial code framework on which developers can fine tune, recommend bug fixes, and identify security vulnerabilities. Expanded use cases we expect to be viable in the future extend across the software development lifecycle, from streamlined planning, improved configuration protocols and effective monitoring alerts. For example, GitLab is investing heavily toward how Gen AI tools can identify the right reviewer of code changes prior to deployment. Its strength in security and compliance will likely also make it a strong contender when it comes to the broader DevOps cycle. Voice-to-code commands or image-to-code are also areas where we expect innovation as the use of code may broaden within the organization as this can underpin greater use of low-code/no-code platforms. Given the knowledge base needed to successfully deliver such tools, we anticipate that there will be multiple players that can compete on different strengths (i.e. the Create stage of development vs the planning, configuring or monitoring of such assets). Considering that code can comprise the company's most sensitive operational data, the biggest hurdle to mass adoption will be rooted in the IP regulation and users' ability to opt-out of their data being leveraged in larger models.

  - ☐ **Microsoft**: Microsoft is capitalizing on its acquisition of GitHub in 2018 with market leading product releases that are likely to lead the path of innovation in the code-generation category. With GitHub Copilot and GitHub Copilot X, Microsoft is flexing the increased value it sees Gen AI can have in this category. The latest X version includes chat and voice capabilities, highlights the offerings' ability to provide AI generated answers for code documentation (by pulling from open-source code repositories) and is equipped with the latest data from GPT-4. Leveraging its own models such as Codex, (mostly utilized for speed), combined with its partnership with OpenAI, (which Microsoft utilizes for their larger models and accuracy), Microsoft is fleshing

out its developer ecosystem that can democratize code production, accelerate employee efficiency, and increase engagement within the Microsoft platform. The company is showing early success with the 1mn developers already utilizing Copilot averaging a 55% productivity boost.

☐ **GitLab**: GitLab has solidified its presence as a leading player in the DevOps market and is likely to adopt generative AI tools to stay competitive over time. As GitLab has offerings that span the software development lifecycle, we expect the company's focus to be around the platform and its ability to easily pull, reference and summarize the workflow to provide more powerful levers for productivity across the organization. GitLab's success in providing security and governance features (which drives customers to its highest paid Ultimate tier), will likely lead the company to focus on auto-detecting, suggesting, securing and configuring remedies, in addition to code assistant technology. GitLab has already laid out the plans to build an Intelligent Cloud Security offering that would automatically evaluate the code base to identify potential security vulnerabilities and offer potential solutions.

■ **Design:** Generative AI has the potential to be disruptive to the design ecosystem with capabilities such as text-to-image, image-to-3D, and scan-to-3D, helping accelerate the design/development of buildings, manufactured parts (autos, electronics), and digital content (video-games, VFX in movies), amongst other use cases. Further, we expect generative AI to play a foundational role in the oft-laborious process of idea-generation and iteration, assisting designers/engineers in generating initial drawings and models based on the parameters provided, which could significantly improve engineering productivity by focusing less on design development/iteration (as AI will present a number of design options) and more so on which design outcome most effectively meets the needs of the end-customer. In product manufacturing, we expect better alignment across the design to manufacturing lifecycle, with AI tools infusing critical manufacturing intelligence into the design process to ensure manufacturing feasibility from the start, which can reduce productivity bottlenecks, costs, and accelerate time-to-market. Similarly, the architecture/construction industry can benefit from significant efficiency gains using generative AI for design exploration and generation, while also helping to better predict cost and scheduling earlier in the lifecycle of a construction project.

☐ **Autodesk**: As a leader in the design category, we believe Autodesk has the potential to implement intelligent automation tools leveraging the connected data from its three industry clouds as more customers migrate to the platform. Autodesk is already implementing automation capabilities in the Fusion cloud, as discussed at its recent Analyst Day (link), with automated machining and modeling. These tools improve user productivity by quickly suggesting manufacturing designs and determining optimal machining strategies. Over time, we expect to see continued innovation in the field of generative design, which Autodesk already provides for offerings such as Fusion 360 and Revit. Generative design has the potential to significantly reduce the time it takes to design a product, spur innovative design ideas, and drive end-to-end connectivity between design and manufacturing that can

reduce costs and improve time-to-market.

■ **Cybersecurity**: Generative AI has very significant implications for the world of cybersecurity and can be leveraged to detect fraud, malicious actors, spam incidents etc. More advanced AI/ML in cybersecurity impacts both offensive and defensive applications: 1) attackers leverage Generative AI capabilities to increase the speed and variation of attacks, and 2) security vendors apply AI to reduce the time to detect and respond to zero-day attacks at scale. Unlike consumer AI where generative solutions can drive creative capabilities, enterprise-focused security AI requires far more exacting applications, and have historically been constrained by access to comprehensive data sets. This remains the biggest hurdle for AI in cybersecurity today, along with the challenges of preventing unintentional shutdowns of mission critical workloads. However, we are starting to see the benefits of AI/ML in threat detection and believe platforms with extensive internal data logs across both Endpoint and Network are best positioned to benefit long term.

  □ **CrowdStrike** is leveraging its extensive data and telemetry history to equip new modules on its Falcon Platform with AI capabilities. This has resulted in higher detection intelligence, scaled operations, and an overall better customer experience. In addition, CrowdStrike has a history of effective marketing to both decision makers and consumers, which positions them as a strong brand as consumer awareness of AI application grows.

  □ **Palo Alto Networks** is leveraging its extensive threat detection logs in building out major product releases including its AI-based security operations (SOC) platform XSIAM and updates in Prisma Cloud. Similar to CrowdStrike, Palo Alto's marketing is effective across both decision makers and end users in enterprise technology. The company has also has pointed to upcoming product releases focused on transforming the user experience on the platform.

■ **Healthcare/ Biotech**: Generative AI has multiple applications in the field of healthcare from patient care to drug development. AI tools can be leveraged for patient diagnosis, personalized treatment plans and novel drug design, among other use cases. On the drug development side, Generative AI could reduce the substantial cost and time associated with identifying potential candidates and predicting their properties (such as binding affinity, PK/PD, and potential safety/toxicity concerns) in silico (i.e., using computer simulations) before undertaking the more costly preclinical in vivo (in animals) and clinical (in humans) studies. Importantly, Generative AI can be used to create synthetic data to enhance and increase the diversity of datasets on which to train ML models, which could drive efficiencies in novel drug design and research in areas where authentic data may be expensive, scarce or difficult to collect (e.g., rare disease) – thereby speeding up trial timelines and lowering the cost of development, potentially translating to lower drug prices – as well as augment the accuracy and efficiency of ML models for diagnostic purposes (CT, MRI). Further, Generative AI could help improve imbalanced and unrepresentative datasets with the aim of mitigating bias in

ML uses for healthcare, as traditional AI/ML models may be constrained by existing training data that can skew towards favoring certain patient groups over others as a result of historic underrepresentation of minority groups in clinical trials. Lastly, Generative AI could theoretically create personalized treatment plans by taking a swath of variables into account (age, medical history, symptoms, etc), and aid in patient/study participant education with generated informational texts and simulations. We note the following case studies:

☐ **Absci (ABSI)** becomes the first to create and validate de novo antibodies with zero-shot Generative AI. Biotech ABSI published a paper on its achievement of de novo discovery in a zero-shot fashion, meaning the generation of antibodies that bind to specific targets without being trained on any prior examples of antibodies known to bind to those targets, to produce novel anti-HER2 (among three other targets) antibody designs that are unlike those found in existing databases. Because of ABSI's capabilities towards producing novel, customizable proteins with its E. coli-based system, the company was able to physically synthesize and test the novel antibodies in the wet-lab - representing the first time that a de novo antibody design using zero shot Generative AI was created and experimentally validated without first optimizing the design in the lab. Per ABSI, this development supports the potential to reduce the time and cost needed to develop drugs and may potentially lead to lower costing treatments for patients.

☐ **NVIDIA (NVDA)** works on generating synthetic MRIs to advance neurological research. Researchers from NVDA, the Mayo Clinic and the MGH & BWH Center for Clinical Data Science developed a model capable of producing accurate and reliable synthetic abnormal brain MRIs showing tumors, which can be used to train ML models to distinguish tumor tissue from healthy brain tissue. Importantly, the model offers a low-cost source of diverse data to supplement training sets without the patient privacy concerns associated with authentic images.

Risks Associated with Generative AI

■ **Content Moderation:** Content moderation has been a contentious topic for internet companies. Currently, social media platforms/ websites are not legally liable for the content published by their users, thus creating a legal shield for internet companies. Many believe that free and open access to Generative AI tools will only enable the creation of harmful content. AI models mimic human behavior; as such, these tools can be trained to generate misinformation, hate speech and other objectionable content. The question then becomes: will the onus fall on the creators of these Generative AI platforms or will the blame once again be shifted to the users publishing the content?

■ **Misinformation:** Generative AI tools have been under intense scrutiny around the accuracy of information being disseminated. This can be particularly dangerous with users that are unable to determine the accuracy of answers or biases implicit in the

generated response. Poorly trained models are often responsible for the inaccurate or biased data. Ultimately over time as the underlying data models are re-trained with improved information, accuracy increases. However, eliminating information bias is more challenging since AI models are trained by human beings.

- **Copyright Infringement:** The lines are rather blurry around the originality of content created from Generative AI tools. Several questions have been raised around copyright infringement by Generative AI tools, especially in the text-to-image category. Artists, writers, musicians and other creative professionals worry about the threat to their original work from AI technology. With no precedent in place it is still early days for legal recourse, thus limiting large scale enterprise adoption. Businesses remain cautious in their implementation of Generative AI tools fearing backlash from copyright violation and other lawsuits.

- **Privacy:** AI platforms are built on large language learning models which leverage large volumes of data to train their algorithms. AI platforms need to ensure the data collected is accurate, in consent with local laws, stored and managed securely, regularly updated, etc. It could become imperative for AI platforms to maintain strict compliance with data privacy regulations such as the General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA).

- **Ethical Issues:** Aside from the legal concerns around patent and copyright infringement associated with Generative AI tools, skeptics point to issues around plagiarism, job losses and the rightful compensation for original content creators. Since Generative AI tools are indeed trained on existing available data, the likelihood of content being plagiarized is high and the onus falls on the human users to sensibly use the content generated. While the fear is ripe that AI will make certain jobs redundant via automation and productivity enhancements, it will simultaneously create the opportunity for new roles in data science, AI research, machine learning engineers, etc. As for the rightful attribution and compensation for creative professionals whose work is leveraged to train AI models, the legal and ethical debate remains unresolved.

Burst of Product Innovation Lays the Foundation for the Growth of Generative AI

Since the release of ChatGPT on 11/30/2022, there's been notable activity around generative AI, its productivity implications, and potential applications ranging from sales to code development, and more. As of recent, GPT-4 was released (03/14/2023), Google's offering, Bard, entered into beta testing (03/21/2023), and a partnership between Amazon & Hugging Face was announced (02/21/2023), with all aiming to accelerate the training, fine-tuning, and deployment of LLMs used to create generative AI applications. As we continue to see new use cases emerge (i.e., Adobe Firefly, GitHub Copilot, etc.), we note that we're starting to see competing product releases. For instance - Microsoft 365 Copilot vs. Google Workspace and Bing Chat vs. Google Bard are two of the most high-profile instances of this emergence, and we expect these trends to continue given our belief that we're on the cusp of a new era of innovation.

Below we highlight important product announcements/enhancements from companies such as Adobe (Sensei GenAI & Firefly), Microsoft (Bing, Microsoft 365 Copilot, GitHub Copilot, etc.), Google (Bard), and more - advancements which we think will help underpin the next wave of innovation within both software & broader tech.

Adobe (Buy, PT $480)

Since the announcement of Sensei (Adobe's AI/ML tool) at MAX 2016, Adobe has seamlessly integrated this offering across all three cloud platforms (Creative, Document, and Experience). Given Adobe's top-line CAGR of 19% (FY17 – FY22) since Sensei's implementation, we think Adobe has positioned itself attractively to continue driving strong customer renewal and new market share gains, especially given the introduction of Firefly & Sensei GenAI last week. With Firefly's ability to quickly convert text-to-images, and likely text-to-video (a future iteration), Adobe should further cement itself as the industry standard amongst content creators and marketing professionals. Furthermore, with Sensei GenAI's initial implementation within Experience Cloud helping drive deeper insights and more personalized marketing content (amongst other features) we think Adobe provides a holistic and attractive value proposition. With Firefly & Sensei GenAI spearheading Adobe's entrance into Generative AI, we think Adobe should retain its position as a stalwart in its industry for years to come.

Exhibit 20: Summary of Adobe's AI Products & Innovations

Product	Description	Key Usage
Sensei	- Launched at Adobe MAX 2016, leverages AI/ML & deep learning to help automate mundane tasks and boost productivity - Spans the companies 3 cloud offerings (Creative, Document, Experience) - Adobe announced plans at Adobe MAX 2017 to turn Sensei into a creative assistant (similar to Siri) - Within Creative Cloud: handles organizing, editing, and producing, as well as aiding search within Adobe stock & Photoshop Lightroom, while underpinning Adobe Dimension & Character Animation leading to high quality effects - Within Document Cloud: underpins Scan, Sign, and Acrobat DC, with features allowing for boundary detection, easy conversion of document images to PDFs, scanning of business cards and addition of contact information to your contacts, improved appearance & text quality and removal of shadows, and form field recognition - Within Experience Cloud: helps deliver actionable data insight by better understanding customers' interest & needs, enables personalized commerce experiences, and sports robust marketing automation	Automation and Insights in Creative Apps of DX Workflows
Revealed at Summit 2023:		
Sensei GenAI	-Integrated into Adobe Experience Manager, Adobe Journey Optimizer, Adobe Real-Time Customer Data Platform, Customer Journey Analytics, and Marketo Engage -Tailored for marketing & customer experience teams, Sensei GenAI is designed to assist on tasks ranging from planning & asset creation to personalization & customer journey management - Leverages various LLMs including ChatGPT (via Microsoft Azure OpenAI) and FLAN-T5 (Hugging Face)	Marketing & Customer Experience Teams
Firefly	-Integrated directly into Creative, Document, and Experience Cloud, Firefly can produce images and text effects, based off of user-entered text-prompts	Across Digital Asset Workflow
Partnerships:		
NVIDIA	- Working to co-develop advanced generative AI models, largely focused on deep integration of said models into creative workflows - Models to be brought to market via Adobe's Creative Cloud products (Photoshop, Premier Pro, etc.) and NVIDIA's Picasso cloud service	Creator Productivity
Microsoft	- Utilizing Azure OpenAI LLM within Adobe Experience Platform for Firefly - Enables integration of Adobe's Digital Experience Platform solutions to better align data and eliminate data silos	CRM

Source: Company reports, Data compiled by Goldman Sachs Global Investment Research

Microsoft (Buy, PT $325)

Microsoft's initial $1bn investment in OpenAI (2019) and subsequent investments highlight the company's early move toward Generative AI. The company has already announced multiple product updates leveraging this technology, which is augmenting human usage and product functionality across numerous verticals, including office productivity (Microsoft 365 Office -in beta) sales and marketing (Dynamics 365, Viva Sales) and DevOps (GitHub Copilot X). Microsoft's already expansive product offerings, its suite of applications (Excel, Outlook, PowerPoint, Teams, Word, etc.), and vast amount of data (organized on Microsoft Graph) should deepen Microsoft's moat while driving increased customer value and market share gains, especially as Microsoft capitalizes from first-mover advantage. Furthermore, as Microsoft has an exclusive partnership with OpenAI (OpenAI solely utilizes Azure to train its models), Microsoft can leverage its access to the latest GPT release (e.g. easily leveraging the latest GPT release, GPT-4, for GitHub Copilot X) to complement in-house models that are trained on specific Microsoft customers. The company's re-investment in search with chatGPT features should accelerate the training and accuracy of these models to ensure their readiness for enterprise-grade uses.

Exhibit 21: Summary of Microsoft's AI Products & Innovations

Product	Description	Key Usage
Bing/Edge	- Enable generated responses in either a chat feature or in tandem to relevant search links	Search
Microsoft 365 Copilot	- Leverages LLM with existing M365 apps (Word, Excel, PowerPoint, Outlook, Teams) as well as new features such as Business Chat, which utlizes the data from your calendar, emails, chats, documents, meetings, and contacts to generate content, presentations, analysis, appointments, and more	Office Productivity
Dynamics 365	- Introducing AI tools built for sales, service, marketing, operations, and supply chains, the introduction of Dynamics 365 Copilot is positioned to help eliminate repetitive tasks (especially those that are centered around CRM/ERP tasks), driving increased efficiencies across the employee base	CRM
Viva Sales	- Focused on sales representatives, Viva Sales auto creates content (such as the aggregation and summarization of sales calls, question extraction, KPI assessment) within Microsoft 365 apps	CRM
Teams Premium	- Teams add-on that can increase how intelligent, personalized and protected Teams meetings can be. Teams can generate a summary of the meeting, generate action items, and safeguard confidential information	CRM
GitHub Copilot	- Working similar to an advanced autocomplete function, this provides options for coders to create lines of code. This can enable coders to focus more on value-enhancing sections to more basic or repetitive areas, find errors or security vulnerability in a faster manner, and speed up the software development life cycle	DevOps
GitHub Copilot X	- Adopts the recently release GPT-4 - Integrating chat & voice, bringing Copilot to pull requests, the command line, and docs to better answer questions around projects - Has the potenital to vastly increase developer productivity by writing ~80% of code (vs. 46% in Copilot)	DevOps
Azure OpenAI Service	- Combines Open AI models such as GPT-3.5, Codex, and DALL•E 2 with Microsoft's enterprise-grade and AI-optimized Azure infrastructure to create applications	DevOps
Power BI	- Leveraging Microsoft's Power Apps, this offers translation of language to Power Fx code (a low-code programming language) to simplify the building and deployment of custom AI apps	DevOps
Microsoft Designer	- For creative professionals or hobbyists, this product offers automated design creation via natural- language prompts with a platform for editing	Design Creativity

Source: Company reports, Data compiled by Goldman Sachs Global Investment Research

Salesforce (Buy, PT $325)

CRM announced the introduction of Einstein GPT across all of its clouds – an offering that's positioned to drive increased employee productivity and deliver enhanced customer experience via automating previously time-consuming tasks (e.g., sending personalized emails, generating targeted content, auto-generating code, etc.). The Einstein GPT integration is open and extensible, supporting both public & private AI models while also providing out-of-the-box Generative AI capabilities

Exhibit 22: Summary of Salesforce's AI Products & Innovations

Product	Description	Key Usage
Einstein GPT:		
Sales	- Automatically create tasks for salesforce (e.g. composing emails, scheduling meetings, etc.), that allow reps to focus on go-to-market	CRM
Service	- Helps compile field/service how-to into unified documents that help with knowledge transfer and faster customer resolutions. Offerings also auto-generate personalized chat agent replies to improve personalization and expedited service interactions	Improved Customer Service Experience
Marketing	- Generate personalized content across various channels (email, mobile, web, and advertising) to engage customers throughout the sales cycle	Specialized Marketing Content
Slack Customer 360 Apps	- Produce summaries of sales opportunities and draw attention to action items, such as updating internal logs, reports, etc.	Sales Efficiency
Developers	- Utilize Salesforce Research's proprietary large language model by using an AI chat assistant to generate and interact with code	DevOps

Source: Company reports, Data compiled by Goldman Sachs Global Investment Research

Meta (Buy, PT $215)

We see Meta as an emerging AI leader as investments toward AI development & compute capacity continue to scale (according to our estimates, META will spend a cumulative ~$110bn in capex from 2019-2023, the majority of which going toward its AI efforts). With regard to Generative AI specifically, Meta has launched a number of products including Make-a-Scene and Make-a-Video (link), a text-to-image and text-to-video model, and, most recently, LLaMA (link), a series of LLMs available to researchers via direct API access and optimized for smaller computing power. Looking at artificial intelligence more broadly, Meta has infused AI into its core products since its inception, including user-facing (e.g., recommendation engine & discover/interest graph, content moderation, etc.) and advertiser-facing (automated creatives & campaign management including Advantage+, ad targeting, modeled measurement/attribution esp. in light of data privacy, etc.) capabilities.

Amazon (Buy, PT $145)

While much of the focus around the theme of Generative AI have been dominated by market share dynamics in Search & gross margin implications from higher compute costs against a potential increase in mix of non-commercial search, we believe as enterprises push deeper into integrating AI/ML tools into their tech stacks to drive core businesses, hyperscalers stand to benefit and are underappreciated beneficiaries of this theme (including Amazon's cloud computing business, AWS). When thinking more directly about the impact to cloud businesses from large language models and Generative AI tools becoming more prevalent, we would expect the significant volume of compute required to train and ultimately generate an output to benefit both growth and margins. AWS is exposed to this theme in a number of ways, both directly through AI/ML service offerings (Amazon Lex, Amazon Polly, Amazon Transcribe, Amazon Comprehend, Amazon Kendra, Amazon Translate, Amazon SageMaker, among others) and partnerships with Generative AI companies (including Hugging Face, Stability AI, AI21 Labs, C3 AI, etc.).

Exhibit 23: Summary of Amazon's AI Products & Innovations

Product	Description	Key usage
Amazon Lex	- Build chatbots with conversational AI - Fully managed artificial intelligence service with advanced natural language models to design, build, test, and deploy conversational interfaces in applications	Conversational AI
Amazon Poly	- Deploy high-quality, natural-sounding human voices in dozens of languages - Polly uses deep learning technologies to synthesize natural-sounding human speech, so customers can convert articles to speech. With dozens of lifelike voices across a broad set of languages, Amazon Polly can be used to build speech-activated applications	Text to speech
Amazon Transcribe	- Automatically convert speech to text - Content producers and media distributors can use Amazon Transcribe to automatically convert audio and video assets into fully searchable archives for content discovery, highlight generation, content moderation, and monetization	Speech to text
Amazon Comprehend	- Derive and understand valuable insights from text within documents - Natural-language processing (NLP) service that uses machine learning to uncover valuable insights and connections in text	Natural language processing
Amazon Kendra	- Find answers faster with intelligent enterprise search powered by machine learning - An intelligent enterprise search service that helps customers search across different content repositories with built-in connectors	Intelligent search
Amazon Translate	- Fluent and accurate machine translation - Neural machine translation service that delivers fast, high-quality, affordable, and customizable language translation	Machine translation
Amazon SageMaker	- Build, train, and deploy machine learning (ML) models for any use case with fully managed infrastructure, tools, and workflows	Managed ML Offering
AWS Trainium	- Second-generation machine learning chip that AWS purpose built for deep learning training - Trainium based EC2 Trn1 instances deliver faster time to train while offering up to 50% cost-to-train savings over comparable GPU-based instances - Trainium has been optimized for training natural language processing, computer vision, and recommender models used in a broad set of applications, such as speech recognition, recommendation, fraud detection, image recognition, and forecasting	ML chip
Partnerships		
Stability AI	- Stability AI is a leading open source generative AI company, including the Stable Diffusion text-to-image model - AWS is preferred cloud provider to power Stability AI's AI models for image, language, audio, video and 3D content generation	Generative AI
Hugging Face	- AWS will make Hugging Face's products (including a LLM tool that competes with the technology behind ChatGPT) available to cloud customers for their own applications - Hugging Face will build next version of BLOOM (their LLM model) on AWS	LLM Model
C3 AI	- Recently announced expansion of Strategic Collaboration Agreement with AWS - Partnership focuses on pairing AWS's scalability, innovation, and agility with C3 AI's industry-leading software - C3 AI will integrate C3 AI applications, such as C3 AI Law Enforcement, with AWS services including Amazon Comprehend, and co-sell the C3 AI Platform and applications with AWS - All six of C3 AI's application suites, as well as the C3 AI Platform, are available in the AWS Marketplace	AWS Marketplace Partnership

Source: Company reports, Data compiled by Goldman Sachs Global Investment Research

Alphabet (Buy, PT $128)

Going back 5+ years ago, Google began a series of introductions outlining how AI would be the driving force behind many of the company's products alongside a broader computing shift (including Google Assistant, Duplex, Lens, Translate, LLMs integrated within Search, etc.). We see the recent announcement of Bard as an extension of these efforts to match broad product iteration (the continuing evolution of search) with recent consumer excitement about the conversational AI nature of ChatGPT. At each subsequent Google I/O event (the company's annual developer conference), we have seen Google introduce and build upon the Google Assistant to widen the input mechanism for search (e.g., text-to-audio, predictive analytics in the Discover tab, etc.) and to infuse all of its products with elements of AI (e.g., Maps turn by turn directions, YouTube's recommendation engine, auto-complete in Gmail and Google Docs, etc.). In addition, we see Google at the forefront of AI-driven automation within digital advertising with Performance Max, its automated end-to-end campaign management service that optimizes spend across inventory from Google's O&O properties and third-party sites via the Google Display Network, which we expect will see increasing advertiser adoption & spend going forward. In our recently published note (link), we detailed recent AI product announcements and provided a framework of the current landscape of current AI/ML initiatives inside Alphabet (across Google and DeepMind).

We'd also note that Alphabet recently made another wave of product announcement related to Generative AI including introducing: 1) new features within Google Workpsace to improve productivity across the suite of apps (e.g., draft, reply, summarize, and prioritize your Gmail; auto-generated images, audio, and video in Slides; go from raw data to insights and analysis via auto completion, formula generation, and contextual categorization in Sheets, among others); 2) the PaLM API as a way for developers to build on top of Alphabets LLMs; 3) MakerSuite, a tool that simplifies AI development workflows and lets developers prototype ideas quickly; & 4) new Generative AI capabilities to Google Cloud.

Exhibit 24: Summary of Google's AI Products & Innovations

Product	Description	Key usage
Language Models		
LaMDA	- "Language Model for Dialogue Applications" - Group of neural language models built on Transformer that is capabile of more open-ended conversation given it's trained on dialogue-based text - First unveiled at Google I/O 2021, with LaMDA 2 unveiled a year later (at Google I/O 2022).	Open-ended conversation-based text generation
PaLM	- "Pathways Language Model" - LLM trained with **Pathways** system, a model architecture that enables a single model to generalize across multiple domains & tasks - Capabilities include language understanding & generation, reasoning, pattern recognition, code generation, etc.	Enables single model to generalize across multiple domains & tasks
MUM	- "Multitask Unified Model" - Ability to answer more complex search queries by processing multimodal data (e.g. different media formats including text, images, audio & video) - Successor to BERT (~1,000x more powerful, according to GOOGL) - First introduced in 2021 and integrated into Google Search	Improved natural language processing to answer more complex search queries
BERT	- "Bidirectional Encoder Representations from Transformers" - Neural network-based technique for natural language processing built on Transformer architecture - First introduced in 2019 and integrated into Google Search	Improved natural language processing to answer more complex search queries
Generative Models		
Bard	- Conversational AI tool that can generate variety of text-based outputs - Utilizes LaMDA LLM and has ability to source information from the open web for response generation	Conversational text generation
Imagen and Parti	- "Pathways Autoregressive Text-to-Image" - Text-to-image autoregressive (Parti) and diffusion (Imagen) models - Can generate high-fidelity images based on text inputs	Text-to-image generation
Imagen Video and Phenaki	- Generative AI model that combines encoder-decoder and transformer models - Can generate videos based on text inputs	Text-to-video generation
AudioLM and MusicLM	- Framework for audio generation - Creates continuations of speech and audio using input promts of similar speech/audio	Audio generation
Computer Vision		
ViT and MaxViT	- "Vision Transformer" and "Multi-Axis Vision Transformer" - Vision models for image recognition (based closely on Transformer architecture for text-based tasks) - Enables a variety of image-based tasks including deblurring, dehazing, low-light enhancement, etc.	Image recognition & enhancement
Pix2Seq	- Language interface framework for detecting and serializing objects within an image - Generates a sequences of tokens that correspond to discrete objects within an image	Object recognition and serialization
GPNR & LFNR	- "Generalizable Patch-Based Neural Rendering" and "Light Field Neural Rendering" - Method for creating 3-D scenes/rendering of objects based on inputs of static images	3-D scene / object rendering
Multimodal Models		
PaLI	- "Pathways Language and Image model" - Language-image model (combination of language & vision models) enabling a variety of tasks including visual question answering, image captioning, object detection, image classification, optical character recognition (OCR) and text reasoning - Multilingual in over 100 languages	Multimodel interactions (across vision & language applications)
FindIt	- Visual grounding model that can detect objects based on image and text-based query inputs	Object detection & visual grounding
VDTTS	- "Visually-Driven Text-To-Speech" - Automated speech generation using text and video as inputs	Speech generation (from text & video)

Source: Company reports, Data compiled by Goldman Sachs Global Investment Research

Generative AI has varied applications across different industry verticals and in many cases is still in the stages of translating to viable products with monetization opportunities. Below we highlight a list (not exhaustive) of Generative AI tools available across different categories.

Exhibit 25: Generative AI Tools

	Tools	Features
Image Generative AI Tools - Marketing, Design & Manufacturing	Artbreeder	Creates collages & generates images with option of manipulating subject's age, gender, etc.
	Craiyon	Converts text-to-image (not suitable for larger images)
	DALL-E	Creates, edits, or variates images & offers the commercial rights to the created content
	NightCafe	Art generation with different styles & resolution options
	starryai	Enables creation of artwork with different options of style, aspect ratio, etc. & gives full ownership of produced content
	Colormind	Allows creating color palettes, based on a movie scene, artwork, or other images, if needed
	Designsai	Allows generating logos & banners, provides design templates, and enables the export of the produced items to different formats
	Fronty AI	Allows creating websites compatible with mobile devices & SEO necessities
	Khroma	Allows training of a personalized algorithm to create genuine color palettes
	Uizard	Creates design for mobile applications, websites, or landing pages based on sketches
Video Generators - Marketing	Elai	Allows for conversion of a blog post or article to a video; offers >25 avatars, produces personalized avatars for customers
	Flexclip	Supports video creation, offers video editing tools, such as adding transitions, filters, or removing backgrounds
	Lumen5	Offers templates to create original videos based on presentations, or online meeting recordings
	Synthesia	Enables text-to-video conversion; provides >70 avatars; offers service in >65 languages
	Veed.io	Video generation & editing, adding subtitles, removing background noise, and resizing videos
Voice Generators - Customer Support Solutions	Lovo.ai	Enables text-to-speech conversion, generates realistic and emotive AI-generated voiceover
	Murf	Creates voice overs for different contexts, enables adding punctuation, and provides the commercial rights of the content
	Play.ht	Provides AI-generated voices useful for various commercial purpose, offers services in >140 languages, and enables text-to-speech conversion
	Replica	Enables text-to-speech conversion, and offers AI-generated voices
	Speechify	Allows text-to-speech conversion while enabling the adjustment of reading speed & offering realistic AI-generated voices
Text Generators - Office Support Solutions	Copy.ai	Enables generation of blog posts, social media posts, and e-mails, provides multi-user choice, & offers content creation service for >25 languages
	Frase IO	Produces slogans, summaries, introductions, articles, titles, and product descriptions
	Jasper	Provides the users with content templates, enables collaboration, and offers solutions for >20 languages
	Peppertype	Offers ready-made templates for creating meta descriptions, articles, and e-mails; enables commerical use of the produced content
	Rytr	Creates appropriate titels for SEO optimization, produces blog posts, articles, e-mails, and social media advertisements
	Notion.AI	Is a writing assistant that helps individuals write draft notes, edit grammar and spelling, write memos, summarize meetings.
Code Generators - DevOps Solutions	K-Explorer	Makes code completion & custom model suggestions
	Kite	Provides users with multi-line code completions, supports >16 languages
	OpenAI Codex	Converts natural language to code, usable in >12 programming languages
	PyCharm	Provides users with code completion, highlights errors & enables automated refactoring
	Tabnine	Provides users with whole-line code completion & learns coding patterns

Source: AI Multiple, Data compiled by Goldman Sachs Global Investment Research

Valuation & Key Risks

Salesforce (Buy, on CL): We raise our 12-month price target to $325 from $320 as we raise our revenue estimates to account for the potential lift from new product enhancements. Our price target is derived from an equal weighting of a DCF (~2% perpetuity growth rate, unchanged), 24x Q5-Q8 EV/FCF (unchanged), and 7x Q5-Q8 EV/Sales (unchanged).

Key downside risks include: 1) Sales execution, 2) Macroeconomic slowdown, 3) Unsustainable pace of acquisitions, 4) Slower than expected operating margin expansion or higher than expected expense growth, and 5) Adverse changes in the IT spending environment.

Microsoft (Buy, on CL): We raise our 12-month price target to $325 from $315 as we raise our revenue estimates to account for the potential lift from new product enhancements. Our price target is derived from an equal weighting of a DCF (~2% perpetuity growth rate, unchanged), 30x Q5-Q8 EV/FCF (unchanged) based on multiple contraction across the peer group, and 30x Q5-Q8 P/E (unchanged).

Key downside risks include: 1) Slower than anticipated public cloud adoption, 2) Overall slowdown in IT spending, 3) Slower pace of margin expansion, and 4) Adverse competitive landscape.

Intuit (Buy): We maintain our 12-month price target of $575. Our PT is derived from a three-pronged, equal-weighted blend of an EV/FCF multiple, P/E multiple and DCF. Our EV/FCF target multiple is 25x our Q5-Q8 FCF estimates and our P/E target multiple is 30x Q5-Q8 EPS. Our 10-year DCF assumes a perpetual growth rate of ~3% (unchanged).

Key downside risks include: 1) Increased SMB failures and churn related to extended COVID headwinds, 2) Higher than expected competition in both SMB and consumer businesses limiting Intuit share gains, 3) Decelerating customer growth and higher than expected attrition, 4) Slower than expected adoption of QuickBooks Online, QuickBooks Advanced, and TurboTax Live, 5) Slower adoption of Intuit's higher priced assisted offerings, thereby limiting ARPC growth, 6) Online ecosystem growth slowing and not reaching long-term targets for 30% growth, 7) Synergies between core Intuit, Credit Karma, and Mailchimp taking longer than expected to materialize, 8) Incremental competition from Microsoft, Salesforce, Hubspot in the SMB segment, 9) Slower than expected margin expansion.

GitLab (Buy): We maintain our 12-month price target at $65. Our price target is derived from an equal weighting of a DCF and EV/Sales. Our DCF implies a ~3% perpetuity growth rate (unchanged) and we apply an 8x Q5-Q8 EV/Sales (unchanged).

Key downside risks include: 1) Incremental competition as GitLab faces competition from a number of large software platform companies such as Microsoft and Atlassian, and a number of pure-play DevOps vendors such as JFrog, Jenkins, CircleCI, and Grafana, 2) Slower-than-expected adoption of expanded platform stages such as Plan,

Secure, Package, Verify, and Configure, 3) Slower-than-expected traction with the upmarket motion and enterprise customer growth, 4) Higher-than-expected customer attrition, and 5) Longer-than-expected FCF burn.

Autodesk (Sell): We maintain our 12-month price target of $180. Our price target is derived from an equal weighting of a DCF (~2% perpetuity growth rate, unchanged), 20x Q5-Q8 EV/FCF (unchanged) and 21x Q5-Q8 P/E (unchanged).

Key upside risks include: 1) Faster than expected adoption of construction software, 2) More resilient demand in cyclical end-markets such as manufacturing and commercial construction, 3) Greater pace of monetization of non-compliant users, and 4) Faster margin expansion.

Alphabet (Buy): Our $128 12-month price target is based on an equal blend of (1) EV/GAAP EBITDA applied to our 2024 estimates and (2) a modified DCF using EV/FCF-SBC multiple applied to our 2027 estimates discounted back 3 years. Specifically:

- 14.0x EV/GAAP EBITDA or 1.99x EV/GAAP EBITDA-to-growth applied to our 2024 estimates.

- 22.0x EV/FCF-SBC applied to our 2027 estimates discounted back 3 years at 12%. The discount rate represents CAPM using the blended average of companies within our coverage universe consisting of: (1) 3% risk free rate (based on the normalized 10-year rate); (2) average beta of ~1.3; (3) equity risk premium of 7%.

Risks to our Buy rating include: a) competition of product utility levels and advertising dollars; b) headwinds to monetizable (product) search from industry disruption; c) shifting media consumption habits; d) heavy investments depress operating margins for longer than our forecasts; e) no/low levels of incremental shareholder returns going forward; and f) regulatory scrutiny and industry practices altering the business model's prospects. In addition, Alphabet is exposed to the volatility caused by the global macroeconomic environment and investor risk appetite for growth stocks.

Meta (Buy): Our $215 12-month price target is based on an equal blend of (1) EV/GAAP EBITDA applied to our 2024 estimates and (2) a modified DCF using EV/FCF-SBC multiple applied to our 2027 estimates discounted back 3 years. Specifically:

- 12.0x EV/GAAP EBITDA applied to our 2024 estimates. We apply a 12x multiple to reflect META's 5-year average historical multiple.

- 18.0x EV/FCF-SBC applied to our 2027 estimates discounted back 3 years at 12%. We apply an 18x multiple to reflect the low end of GOOGL/META's historical +/- 1 standard deviation range of ~18-29x. The discount rate represents CAPM using the blended average of companies within our coverage universe consisting of: (1) 3% risk free rate (based on the normalized 10-year rate); (2) average beta of ~1.3; (3) equity risk premium of 7%.

Risks to our Buy rating include: a) competition for user growth, user engagement & advertising dollars across an array of incumbent and emerging Internet, media and commerce companies; b) large investments in long-tailed initiatives depress operating

margins for longer than our forecasts; c) no/low levels of incremental shareholder returns going forward; d) regulatory scrutiny and industry practices altering the business model's prospects; e) potential antitrust scrutiny could prove to be a headwind to M&A aspiration (to add talent and product innovation inorganically) and/or result in a break-up or dis-synergies of prior period M&A activity; & f) inability to monetize upside optionality opportunities (messaging layer, social commerce/shopping, Oculus/Metaverse). In addition, Meta is exposed to the volatility caused by the global macroeconomic environment and investor risk appetite for growth stocks.

Amazon (Buy): Our 12-month PT of $145 is based on: (1) An equal blend of EV/GAAP EBITDA applied to our 2024 estimates and a modified DCF using an EV/(FCF-SBC) multiple applied to our 2027 estimates discounted back 3 years; (2) SOTP of EV/Sales applied to our 2024 estimates for 1P, 3P, Retail Subscription, AWS and Other segments; (3) SOTP of EV/EBIT applied to North America and AWS segments, and EV/Sales applied to the International segment, all based on 2024 estimates.

Key risks include: (-) Any impact to eCommerce or Cloud growth from competition; lack of success in scaling high margin businesses including Advertising, Cloud, third-party selling and the subscription business; investments across any array of initiatives creating a headwind to gross or operating margin; any product or platform changes necessary to comply with changes to the global regulatory environment; exposure to the volatility caused by the global macroeconomic environment and investor risk appetite for growth stocks.

Nvidia (Buy): Our 12-month price target for NVDA of $275 is based on 55x our normalized EPS estimate of $5.00. Key downside risks to our estimates and price target include: 1) worse-than-expected demand for Gaming GPUs; 2) a moderation or decline in data center capex by cloud hyperscalers and/or enterprises resulting from macro weakness; 3) further tightening of China export restrictions, 4) delays in new product introductions and their impact on revenue and profitability, and 5) supply chain issues.

Adobe (Buy): Our 12-month price target of $480 (vs $475 previously) is based on a three-pronged valuation framework based on equal weights to a DCF, EV/Sales multiple, and a P/E multiple. Our DCF assumes a 4% perpetual growth rate. We use a 9x Q5-Q8 EV/Sales and a 20x Q5-Q8 P/E multiple. We raise our revenue estimates to account for the potential lift from new product enhancements.

Key risks include: 1) prolonged and worse-than-expected COVID-19 impact causing slower net new business, deal delays, and longer sales cycles, 2) slower and more volatile Digital Experience growth, 3) slower net new subscriber additions, 4) higher expense growth limiting margin expansion, and 5) increased competition.

Autodesk (Sell): We maintain our 12-month price target of $180. Our price target is derived from an equal weighting of a DCF (~2% perpetuity growth rate, unchanged), 20x Q5-Q8 EV/FCF (unchanged) and 21x Q5-Q8 P/E (unchanged).

Key upside risks include: 1) Faster than expected adoption of construction software, 2) More resilient demand in cyclical end-markets such as manufacturing and commercial construction, 3) Greater pace of monetization of non-compliant users, and 4) Faster

margin expansion.

Snowflake (Buy): We maintain our 12-month price target of $185. Our price target is derived from an equal weighting of a DCF analysis and EV/Sales multiple. Our DCF analysis is based on a terminal growth rate of ~4% and our relative valuation is based on a 14.5x Q5-Q8 EV/Sales multiple.

Key downside risks include: 1) Adverse changes in the IT spending environment, 2) Competition - particularly from cloud service providers (CSPs) and Databricks, and 3) Outages from reliance on CSPs.

MongoDB (Buy): We maintain our 12-month price target of $280. Our price target is derived from an equal weighting of a DCF using a ~3.5% perpetuity growth rate and 11x Q5-Q8 EV/Sales.

Key downside risks include: 1) Adverse changes in the IT spending environment and spending priorities, 2) Competition in the non-relational database market, particularly from proprietary offerings from cloud service providers (CSPs), 3) The ramp to profitability as the company continues to invest ahead of a large and growing market opportunity, 4) Slowing pace in public cloud adoption, and 5) Potential for rising interest rates.

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GS DataWorks analysis provided by Dan Duggan, Ph.D.

Disclosure Appendix

Reg AC

We, Kash Rangan, Eric Sheridan, Toshiya Hari, Gabriela Borges, CFA, Salveen Richter, CFA, Anisha Narayan, CFA, Gili Naftalovich, Ben Miller, Alexandra Steiger, Matthew Martino, Alex Vegliante, CFA, Max Gamperl and Jacob Staffel, hereby certify that all of the views expressed in this report accurately reflect our personal views about the subject company or companies and its or their securities. We also certify that no part of our compensation was, is or will be, directly or indirectly, related to the specific recommendations or views expressed in this report.

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