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Dear Partner,

|   | December 2024 | 2024          | Alkeon Growth Strategy Since Inception (Cumulative) | Alkeon Growth Strategy Since Inception (Annualized) |
|---|---------------|---------------|---|---|
| <b>Alkeon Growth Partners<sup>1</sup></b> | <b>-0.28%</b> | <b>29.24%</b> | <b>2214.65<sup>2</sup></b>                          | <b>12.34%<sup>2</sup></b>                           |
| MSCI World                                | -2.68%        | 17.00%        | 295.89%   | 5.23%   |
| MSCI AC World                             | -2.45%        | 15.73%        | 269.20%   | 4.96%   |

Past performance is no guarantee of future results. Investing in securities involves substantial risks. Please see Important Notes at the end of this letter.

**Alkeon Growth Partners Portfolio Information (Approximate)<sup>3</sup>:**

- Net Exposure (delta adjusted) 68.3%
- Gross Exposure 161%
- Number of Long Positions 81
- Number of Short Positions 96

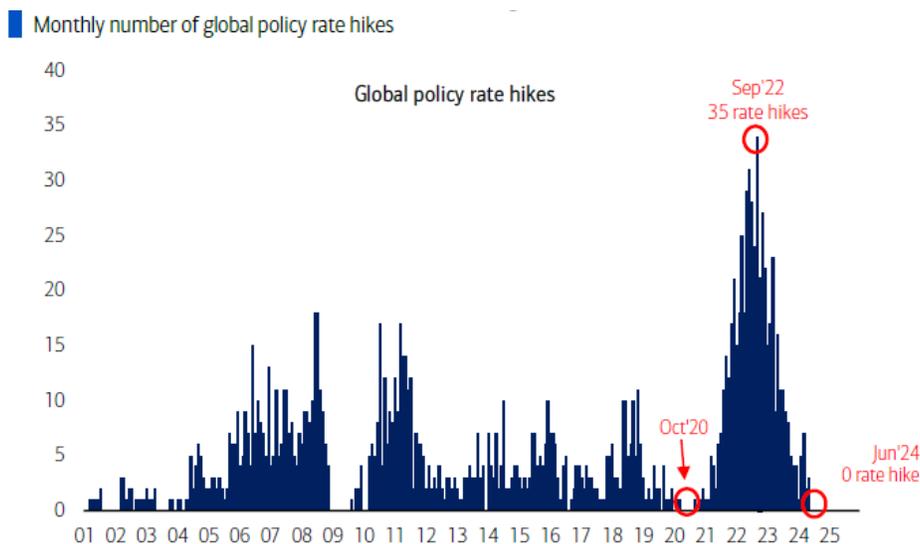
December offered negative results to global equities. Alkeon Growth Partners, LP returned -0.28%. Our long positions underperformed during the month, while our short positions and market hedges had positive performance. Portfolio performance was positive in Asia, and negative in the US, Europe and Latin America.

We continue to find significant opportunities to invest in high quality growth compounders at attractive relative multiples in the current market environment. Additionally, given more recently elevated valuations for the broader equity market, particularly in the US, we are also seeking to remain highly selective in our stock picking.

Furthermore, we see elevated tail risks currently, including around increased social polarization and potential for social unrest as well as unsustainable large fiscal deficits and global geopolitical uncertainty, and therefore we believe it is more imperative than ever to *balance our high conviction long investments* in quality secular growth companies with alpha-seeking short investments as well as structured market hedges, and also to stay globally diversified, seeking to reduce concentration in any single country, currency or regional economy.

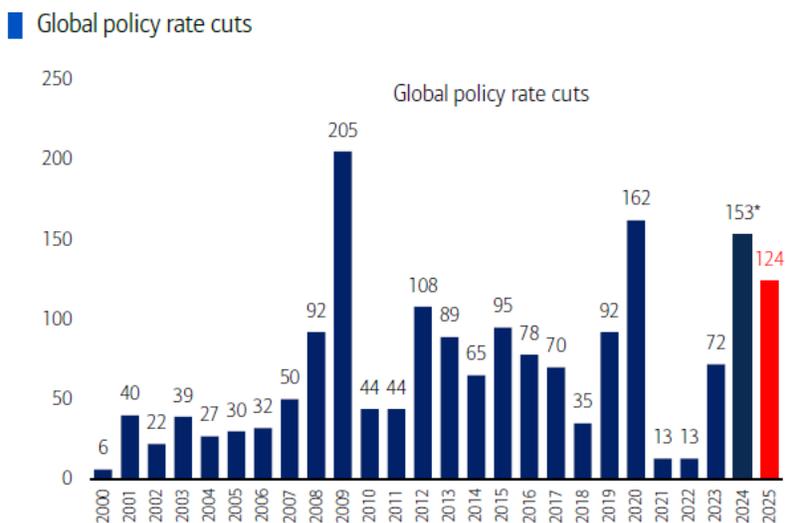
Stepping back for a moment and looking at the broader macroeconomic picture, last year marked the end of the most aggressive global tightening cycle in decades, which, as we show below, particularly hurt high growth stocks over this period. This dynamic is now changing, in our view. As we elaborate in this letter, we currently believe the monetary backdrop is likely to gradually shift and change in a way that is favorable to growth investing, especially as the economy slows down.

In fact, June 2024 was the first month since October 2020 in which no central bank globally raised rates.



**Exhibit 1.** Monthly Number of Global Policy Rate Hikes, July 2024, source BofA Global Research.

And 2024 saw the largest number of rate cuts since the Covid crisis.



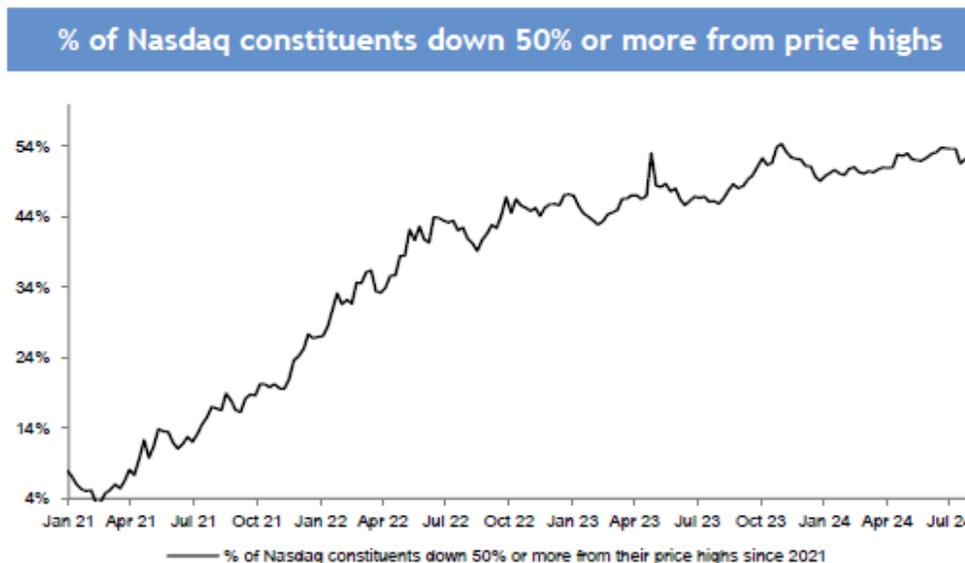
**Exhibit 2.** Global Central Bank Policy Rate Cuts, November 2024, source BofA Global Research.

To put things in perspective, the correction of high growth stocks in the last three and a half years (as shown below) has reflected not just a recession (i.e., a bear market defined as a larger than 20% decline) for this group, but rather a severe depression, in our view. Specifically, and according to Empirical Research, the 75 fastest growing US stocks corrected more than 69% vs. the market from their early 2021 peak through their trough in early 2023, erasing all 2019 and 2020 relative gains; in fact, erasing all relative gains since 2017! And then, even with the market's appreciation in 2023 and in 2024, the correction in high growth stocks still stood at more than 45% at the end of December.



**Exhibit 3.** *The Big Growers Relative Growth of a Dollar (Equally Weighted), December 2024, source Empirical Research.<sup>4</sup>*

As a result, this severe correction in high-growth stocks since their early 2021 peak has continued to present *potential significant opportunities to buy high quality, classic growth compounders at attractive relative multiples, in our view.* These opportunities continue to exist in a broad manner currently, in our view. Specifically, despite the market's recent positive performance, we believe many stocks remain oversold presently. For example, almost half of Nasdaq stocks were still down 50% or more from their 2021 highs recently.



**Exhibit 4.** *Percentage of Nasdaq Constituents Down More Than 50% Since 2021 Price Highs, September 2024, source JP Morgan.*

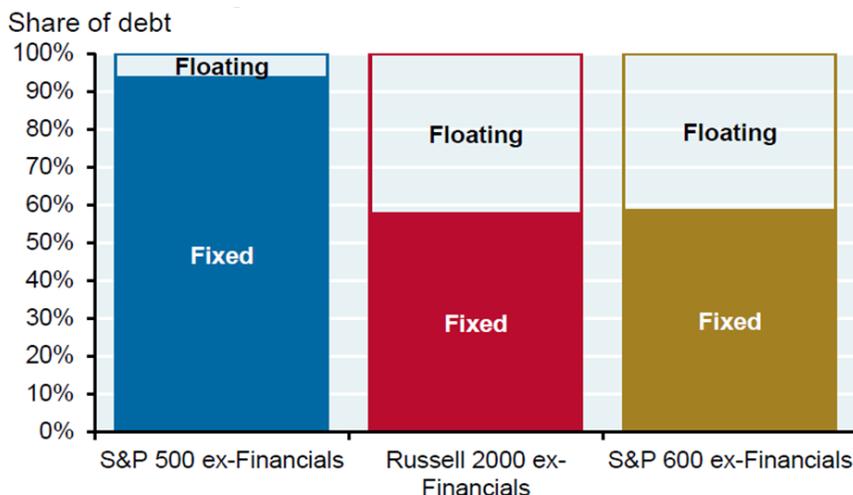
Moreover, many high growth segments of the market have actually continued to de-rate. For example, both Fintech and non-profitable Tech recently have been trading at Price/Sales relative multiples below their historical medians, with non-profitable Tech trading close to all-time lows.



**Exhibit 5.** Global Fintech & Non-Profitable Tech Price/Sales, September 2024, source JP Morgan.

This may start to change as rates go down, as long-duration groups, i.e., stocks expected to produce their highest cash flows in the future such as unprofitable tech, are very sensitive to changes in interest rates and they tend to outperform when rates go down.

Lower rates should also help the relative profitability of small cap stocks, which, excluding financials, have been carrying a larger amount of floating rate debt vs. large cap stocks.



**Exhibit 6.** Fixed vs Floating Rate Debt, July 2024, source JP Morgan.

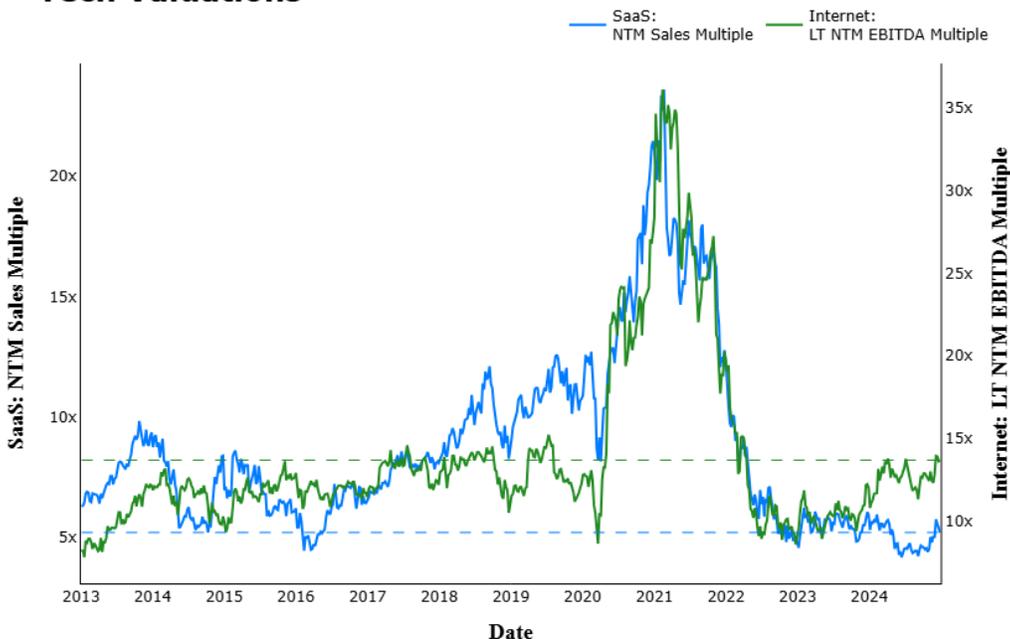
The challenge, however, small caps may face is the tug of war between falling rates and a slowing economy. Historically, small capitalization equities tend to perform better early in the economic cycle (for example coming out of a recession), not late in the cycle. Small caps also tend to include lower quality names, with much lower free cash flow margins, significantly higher debt to cash flow ratios and a much larger percentage of unprofitable companies in aggregate, relative to large caps.

|              | Operating Margin T12 | Net Debt/EBITDA | Earnings Growth Q4 | % Constituents that Reported a Loss |            |                    |
|--------------|----------------------|-----------------|--------------------|-------------------------------------|------------|--------------------|
|              |                      |                 |                    | Current                             | Decade ago | Start of Millenium |
| Russell 2000 | 3.7%                 | 4.6             | -19.6%             | 43.5%                               | 31%        | 22%                |
| S&P 500      | 13.9%                | 1.5             | 8.8%               | 4.8%                                | 4%         | 6%                 |

**Exhibit 7.** Russell 2000 Index vs S&P 500 Index, December 2024, source Alkeon, Bloomberg and FactSet.

To offer another example of how the correction in high growth stocks since 2021 has a long way to change course, both SaaS companies and fast-growth Internet companies are currently trading at multiples significantly below their 2021 peaks.

### Tech Valuations



**Exhibit 8.** SaaS and High Growth Internet Valuations, December 2024, source FactSet and Alkeon.<sup>5</sup>

In summary, and despite this year’s rally, we believe there currently do remain attractive opportunities to invest in high quality growth compounders at attractive relative multiples. Additionally, given elevated valuations for the broader equity market, particularly in the US, we also seek to stay highly selective in our stock picking.

Furthermore, we have continued to hedge our top portfolio investments via a combination of individual stock options and hedges embedded in index or ETF options attributable to such positions. At the end of December, approximately 16.93% of the aggregate exposure of our top five positions remained unhedged.<sup>6</sup> Our total value at risk (i.e., the risk of total loss of capital) for our top five positions at month end was approximately 33.39% in aggregate. Our historical aggregate “dollar at risk” exposure for our top ten positions is shown below:



**Exhibit 9.** Top Ten Positions, Dollars at Risk, % of NAV, source Alkeon.<sup>7</sup>

Additionally, and as noted above, in light of the more recently elevated valuations for the broader equity market, particularly in the US, we are also seeking to remain highly selective in our stock picking, and we believe that the presence of our short investments and market hedges can mitigate broader market risk in the event of a severe drawdown. This is imperative, in our view, *given the increased potential for tail risk events (such as default or currency debasement in light of unsustainably high fiscal deficits) and elevated geopolitical uncertainty, which we currently regard to be higher than ever.*

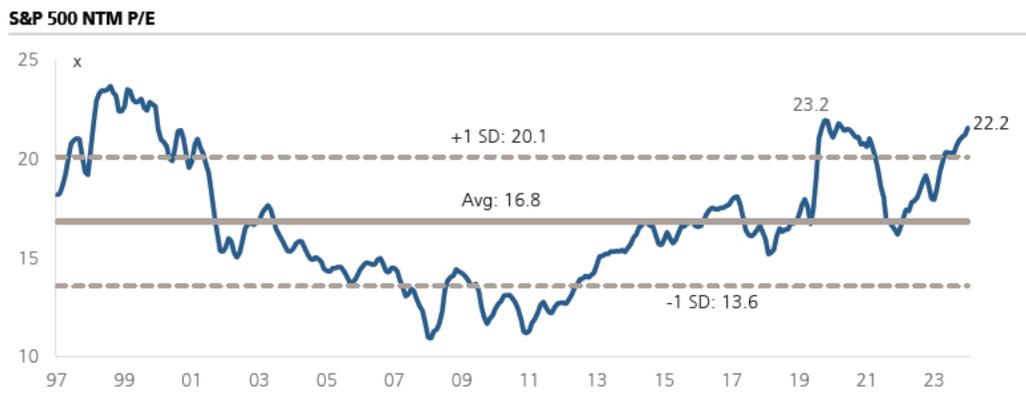
The US market is particularly expensive, offering a rather unattractive risk/reward proposition in aggregate, with a forward P/E ratio that stands 44% above its historical median.

| 12m Fwd. P/E across key geographies |         |            |                   |
|-------------------------------------|---------|------------|-------------------|
|                                     | Current | 20Y Median | Current vs Median |
| Italy                               | 10.0    | 11.9       | -16%              |
| Spain                               | 10.4    | 11.9       | -13%              |
| UK                                  | 11.6    | 12.4       | -6%               |
| Japan                               | 14.4    | 14.2       | 1%                |
| Eurozone                            | 12.9    | 12.8       | 1%                |
| France                              | 13.3    | 12.8       | 4%                |
| EM                                  | 11.8    | 11.3       | 5%                |
| Germany                             | 13.2    | 12.4       | 6%                |
| Switzerland                         | 17.0    | 15.1       | 12%               |
| World                               | 19.7    | 15.0       | 31%               |
| US                                  | 22.8    | 15.8       | 44%               |

Source: IBES

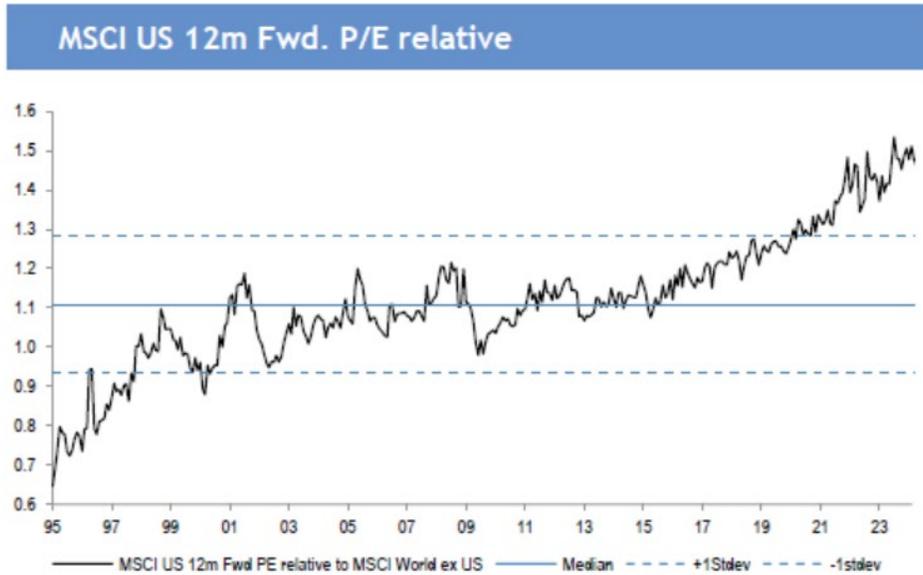
**Exhibit 10.** 12-Month Forward P/E, December 2024, source JP Morgan.

In fact, the only times the forward P/E on the S&P 500 was higher in recent decades was in early 2021 (post-Covid rally) and the Internet bubble in the late 90's.



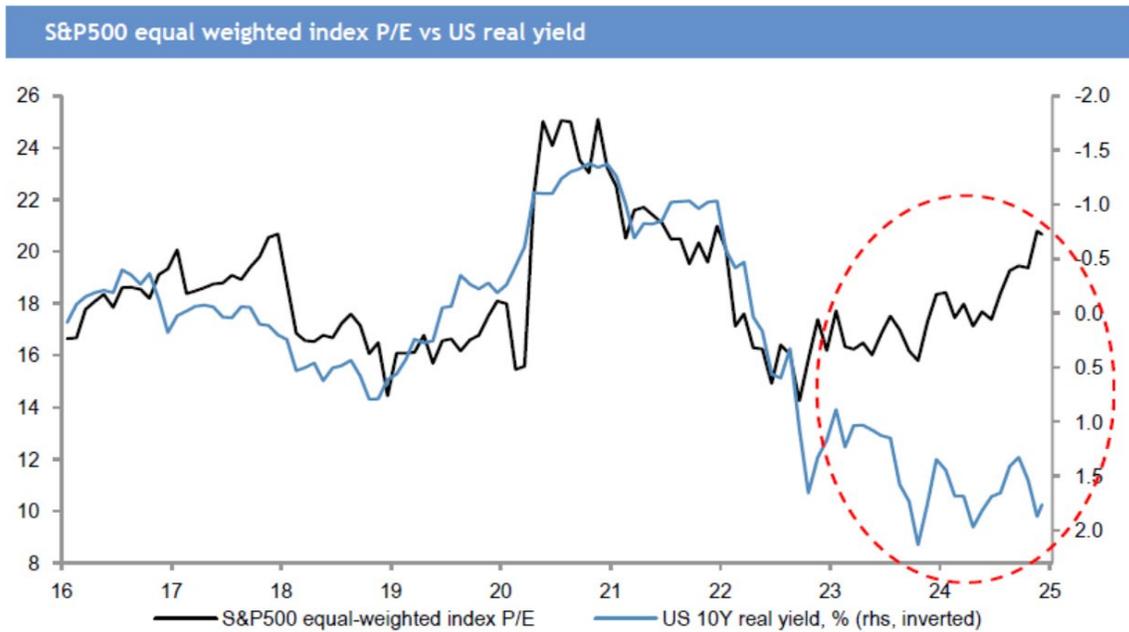
**Exhibit 11.** S&P 500 Index NTM P/E, December 2024, source UBS.

Moreover, on a relative basis against the rest of the world the US market trades at the biggest premium in decades.



**Exhibit 12.** MSCI US 12M Forward P/E Relative to World ex US, December 2024, source JP Morgan.

Even the S&P equally weighted P/E, which normalizes outliers, remains extended vs. real yields.



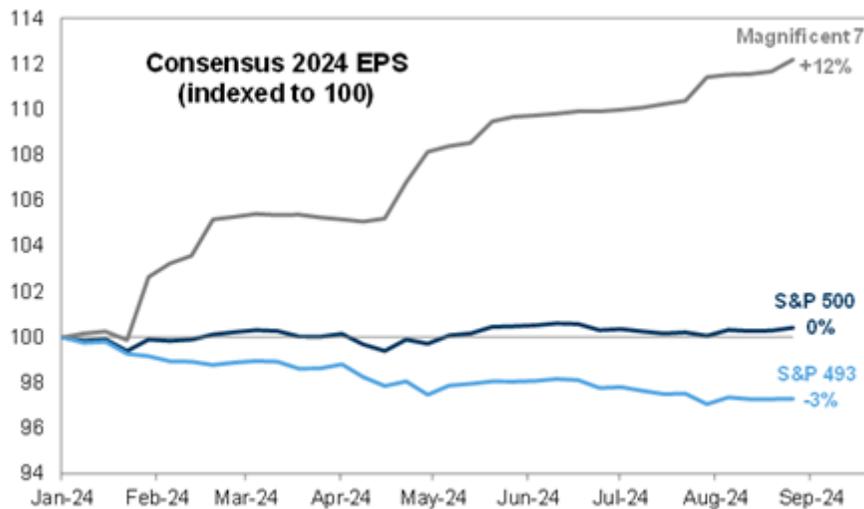
**Exhibit 13.** S&P 500 Equal Weighted Index P/E vs. 10-Year Treasury Yield, December 2024, source JP Morgan.

At the same time that broad equity market valuations are extended, earnings growth has been underwhelming, as well. Excluding the “Magnificent Seven”,<sup>8</sup> earnings growth for the S&P 500 (the “S&P 493”) was in fact negative last year.

| Magnificent 7, SPX and SPX ex Mag 7 2023 earnings growth |                        |
|--|------------------------|
|  | 2023 Net Income growth |
| AAPL UW Equity   | -3%                    |
| AMZN UW Equity   | 307%                   |
| MSFT UW Equity   | 13%                    |
| NVDA UW Equity   | 335%                   |
| GOOGL UW Equity  | 22%                    |
| TSLA UW Equity   | -29%                   |
| META UW Equity   | 66%                    |
| Magnificent 7  | 27%                    |
| SPX  | 1%                     |
| SPX ex Magnificent 7                                     | -4%                    |

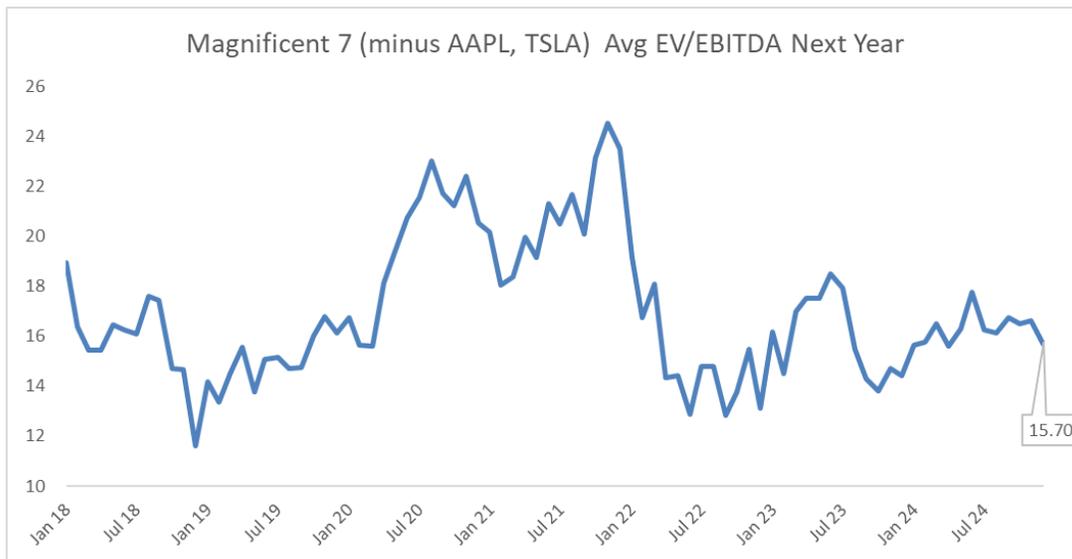
**Exhibit 14.** 2023 Net Income Growth for Magnificent Seven and S&P 500 Index, September 2024, source JP Morgan.

Moreover, YTD earnings revisions for the S&P 493 are negative.



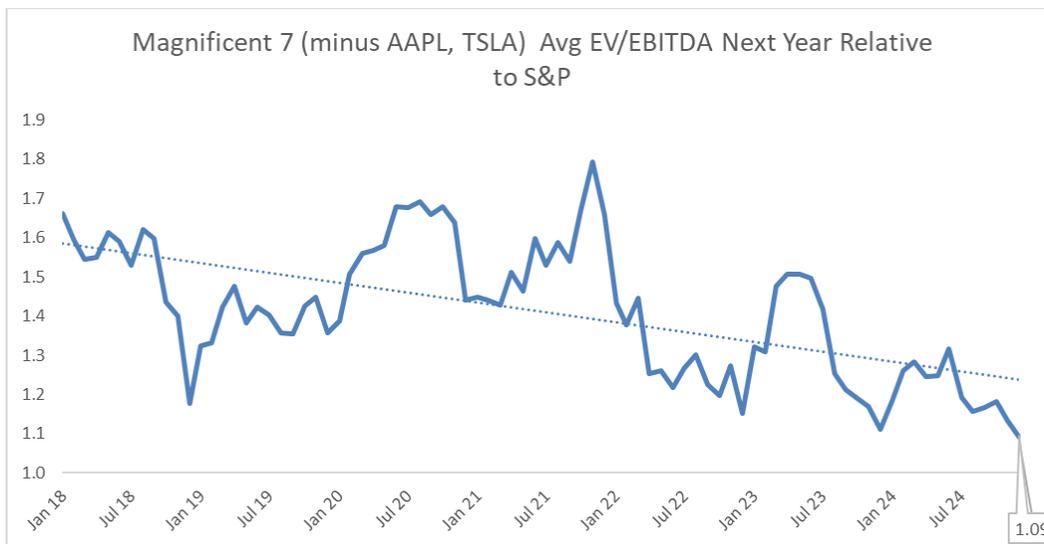
**Exhibit 15.** Negative Revisions for the S&P 493 and the Aggregate S&P 500 Index vs. the Magnificent Seven, August 2024, source Goldman Sachs.

This of course begs the question, are the Magnificent Seven overvalued? The numbers strongly suggest they are not. In particular, while we currently believe broad equity market valuations are indeed extended, for the five of the seven stocks in the Magnificent Seven that actually grew earnings last year, absolute cash flow valuations remain sensible, relative to recent historical levels, in our view.



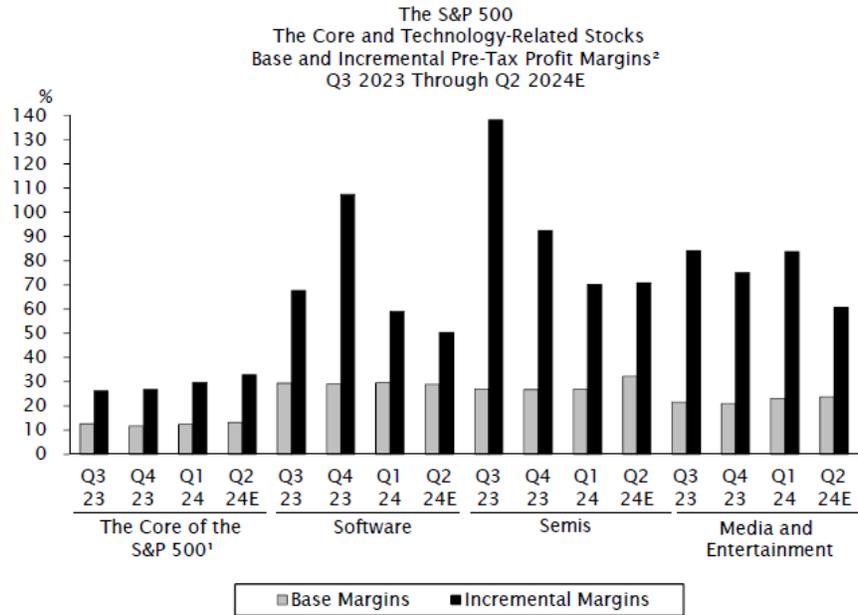
**Exhibit 16.** Magnificent Seven (ex AAPL, TSLA) Average Forward Year EV/EBITDA, December 2024, source Alkeon and Bloomberg.

Furthermore and impressively, relative to the S&P 500, relative cash flow valuations for the same group of five stocks have actually come down over the last six years!



**Exhibit 17.** Magnificent Seven (ex AAPL, TSLA) Average Forward Year EV/EBITDA Relative to S&P 500 Index, December 2024, source Alkeon and Bloomberg.

This is not surprising, given the significant cost-cutting and price optimization initiatives commenced by a number of these and other companies last year, some of which had never optimized for margins, e.g., companies like Meta and Spotify, which had never done so since IPO-ing. These recent profit optimization efforts created exceptional operating leverage, with industries such as software and semiconductors remarkably producing close to or greater than 100% incremental pre-tax profit margins on new sales in Q4 2023, and continuing to produce strong incremental margins this year.



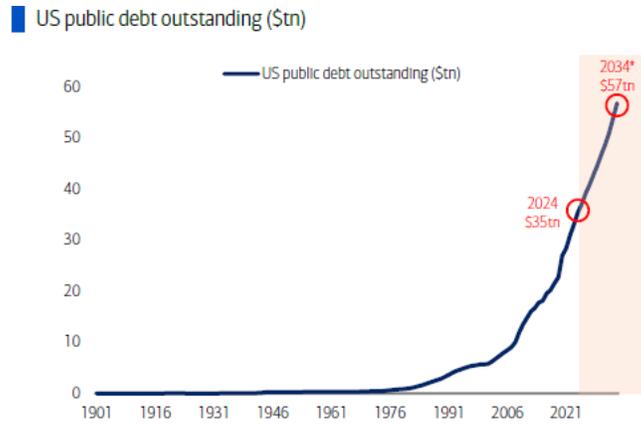
Source: Empirical Research Partners Analysis.  
<sup>1</sup> Excluding financials, REITs, utilities and energy.

**Exhibit 18.** *The Core and Technology-Related Stocks Base and Incremental Pre-Tax Margins, August 2024, source Empirical Research.*

In summary, we strongly reiterate the need to be highly selective in the current market, and thus the importance of stock picking. In fact, and given the elevated tail risks we currently see, such as increased social polarization and potential for unrest, unsustainably high fiscal deficits, and global geopolitical uncertainty, we believe it is more imperative than ever before to *balance our high conviction long investments* in quality secular growth companies with alpha-seeking short investments as well as structured market hedges, and to also stay globally diversified, as we seek to reduce concentration in any single country, currency or regional economy.

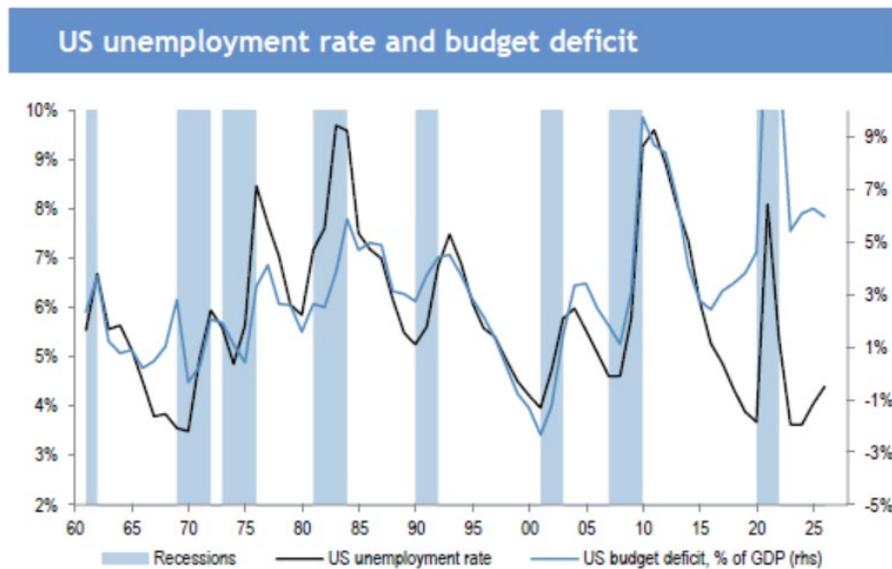
*A Changing Macroeconomic Backdrop*

Further highlighting the need to be selective in the current market, structurally the economy in the US remains especially vulnerable, as the three D's, Debt, Demographics and technological Disruption remain in full force and are highly disinflationary. Additionally, and of particular concern, the spike in US government debt over the last two decades is increasing bearish risk scenarios for asset prices and systemic instability, such as default, currency debasement and inflation. Against this backdrop, we believe a long/short strategy balanced with hedges that seek to mitigate tail risk can offer a suitable fit to equity investors in the current high-risk environment.



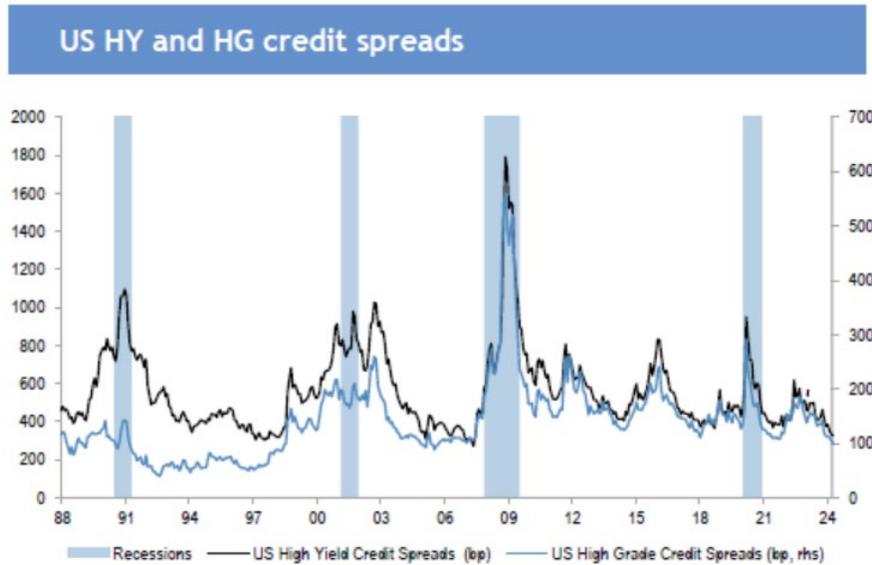
**Exhibit 19.** *US Public Debt Outstanding & CBO projections, November 2024, source BofA Global Research.*

The huge surge in government debt is particularly worrisome, as historically the correlation between US unemployment and the budget deficit has been quite high.



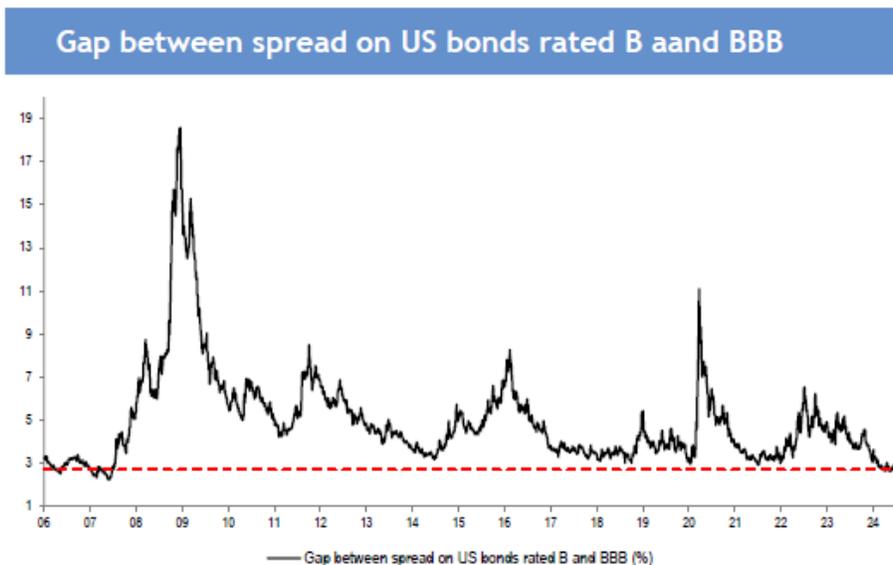
**Exhibit 20.** *US Unemployment Rate and Budget Deficit, December 2024, source JP Morgan.*

At the same time, complacency remains high with credit spreads standing at levels close to multi-year lows.



**Exhibit 21.** *US High Yield and High-Grade Credit Spreads, December 2024, source JP Morgan.*

Notably, credit spreads are currently the lowest since 2007.

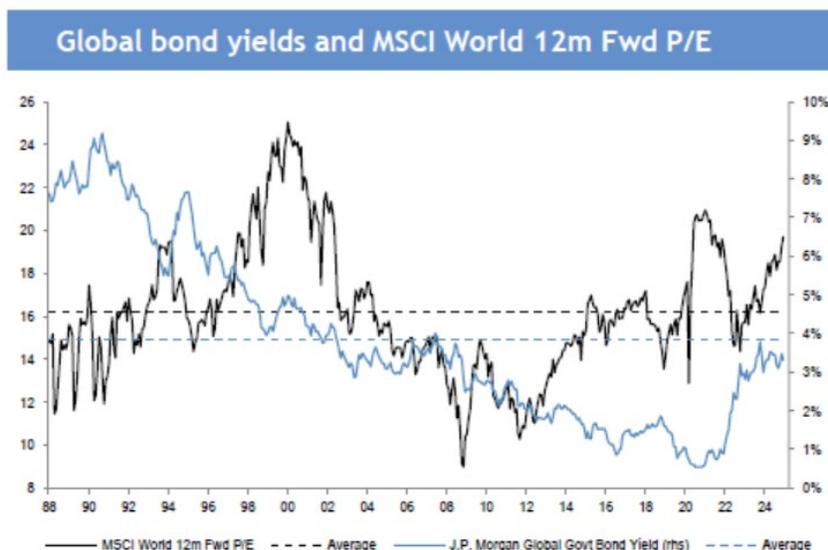


**Exhibit 22.** *Gap Between Spread on US Bonds Rated B and BBB, August 2024, source JP Morgan.*

In summary, we see, on one hand, significantly elevated tail risks and, on the other hand, very attractive opportunities for stock-picking. Therefore, we believe a long/short strategy balanced with hedges and designed to mitigate tail risks can offer a suitable fit in the current high-risk environment. Our short message in the current equity environment is simple: **Stay Hedged, Stay Balanced with Shorts, Stay Globally Diversified.**

## Broader Valuation Considerations

From a relative asset valuation perspective, we currently believe global equity valuations are elevated relative to bonds, although they appear more reasonable relative to their cost of capital, as on both a price-to-free-cash-flow basis and a price-to-return-of-capital (dividends plus buybacks) basis (see Exhibits 25 and 27 below, respectively), the market has been trading at reasonable levels relative to its long-term average.



**Exhibit 23.** MSCI World Index P/E and Global Sovereign Bond Yields, December 2024, source JP Morgan.

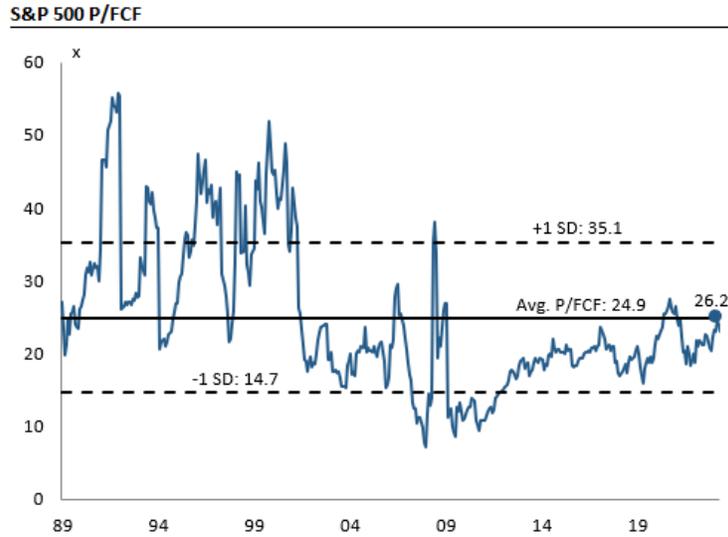
Moreover, the gap between dividend yield and bond yield is unattractive, in most regions globally.

| DM yield gap in the historical context |                |                |                                 |                   |                         |
|--|----------------|----------------|---------------------------------|-------------------|-------------------------|
|  | Dividend yield | 10Y Bond yield | Dividend yield minus bond yield | Average since '00 | Current vs Average (bp) |
| US                                     | 1.2%           | 4.2%           | -3.0%                           | -1.4%             | -154                    |
| Japan                                  | 2.3%           | 1.1%           | 1.2%                            | 0.9%              | 29                      |
| Eurozone                               | 3.2%           | 2.6%           | 0.6%                            | 0.4%              | 17                      |
| UK                                     | 3.7%           | 4.2%           | -0.6%                           | 0.5%              | -109                    |

\*Current as of 02<sup>nd</sup> Dec'24

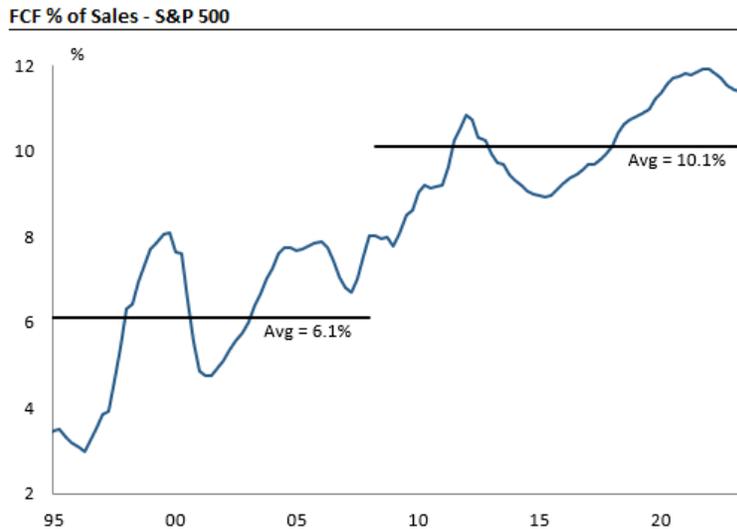
**Exhibit 24.** Average Developed Market Yield Gap, 2024 vs. 2000, December 2, 2024, source JP Morgan.

On the other hand, cash flow generation has been very strong, enabling cash flow valuations to remain reasonable relative to average historical levels.



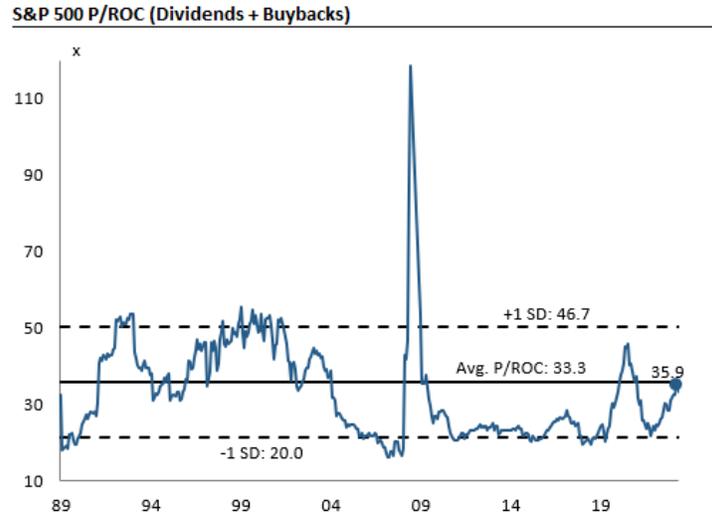
**Exhibit 25.** S&P 500 Index, Price/Free-Cash-Flow Ratio, June 2024, source UBS.

It is not surprising that although absolute P/Es remain elevated, P/FCF levels are more attractive. In particular, it is important to note that US companies have increasingly adopted asset-light models over the past decade. The result has been the almost doubling of free cash flow generation as a percentage of sales to above 10% in recent years.



**Exhibit 26.** US Equities Free Cash Flow as a Percentage of Sales Since 1984, Russell 1000 Index (pre-1990) and S&P 500 Index (after 1990), June 2024, source UBS.

Furthermore, from a price to return on capital (dividends plus buybacks) standpoint, US equities have been trading at reasonable levels relative to the historical average.

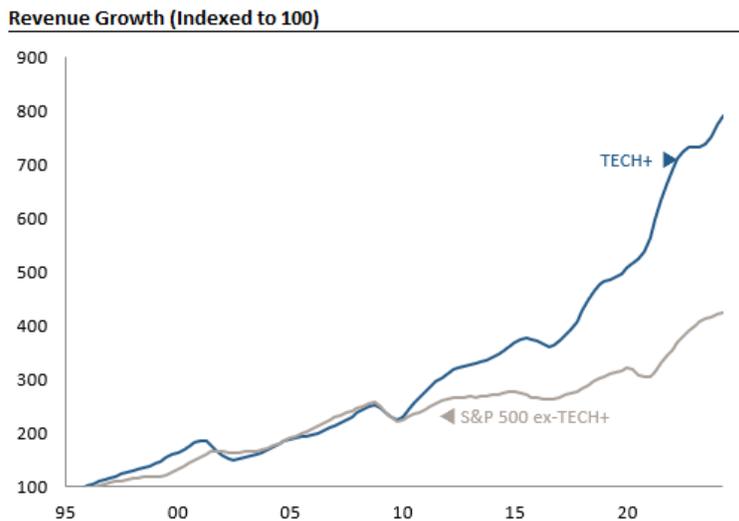


**Exhibit 27.** US Equities Price to Return of Capital Multiple Since 1984, Russell 1000 Index (pre-1990) and S&P 500 Index (after 1990), June 2024, source UBS.

Against a backdrop of potential rate-peaking and disinflation, we continue to favor high quality growth sectors such as technology and communication services. We believe these sectors are supported by, one, superior fundamentals, e.g., high barriers to entry, stronger balance sheets, and higher returns on invested capital; two, strong secular growth trends; three, a broader scarcity of growth assets; and, four, supporting cash flow valuations relative to the underlying growth rates.

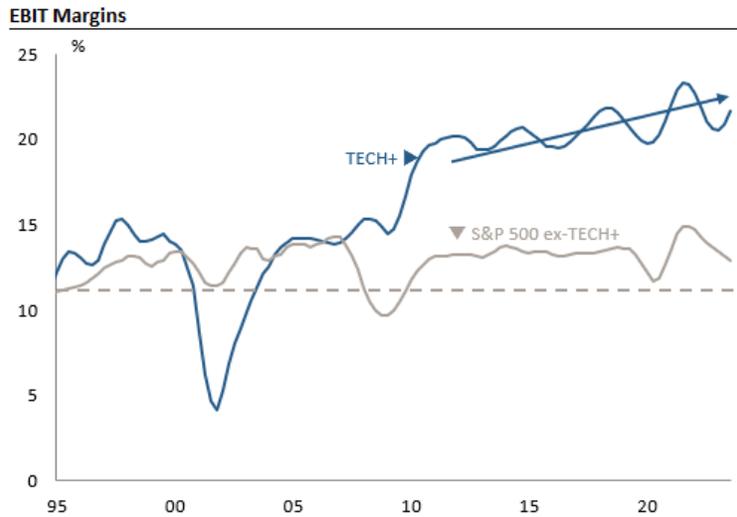
In particular, and as we have stated in previous investor communications, we consider technology to be not only a growth investment but also a defensive one, due to its cost-cutting (high ROI) and productivity enhancing proposition to the end customer, superior balance sheet, strong cash flow conversion, low labor cost to sales, ongoing industry consolidation, and, lastly, strong underlying secular innovation trends. To this last point, companies which innovate tend to be less correlated to the economic cycle. This is consistent with our own desire to identify secular growth stories with company-specific product cycles that are less dependent on the economic cycle.

It is noteworthy that revenue growth for technology stocks has substantially exceeded that of the broader market in the last decade. We would also add that, importantly, this was just not the case during the tech bubble, when technology revenues (and earnings) underperformed, lagging price appreciation.



**Exhibit 28.** S&P 500 Index Technology Revenue Growth, June 2024, source UBS.

Lastly, during the last decade margins for technology stocks more than doubled the market level.

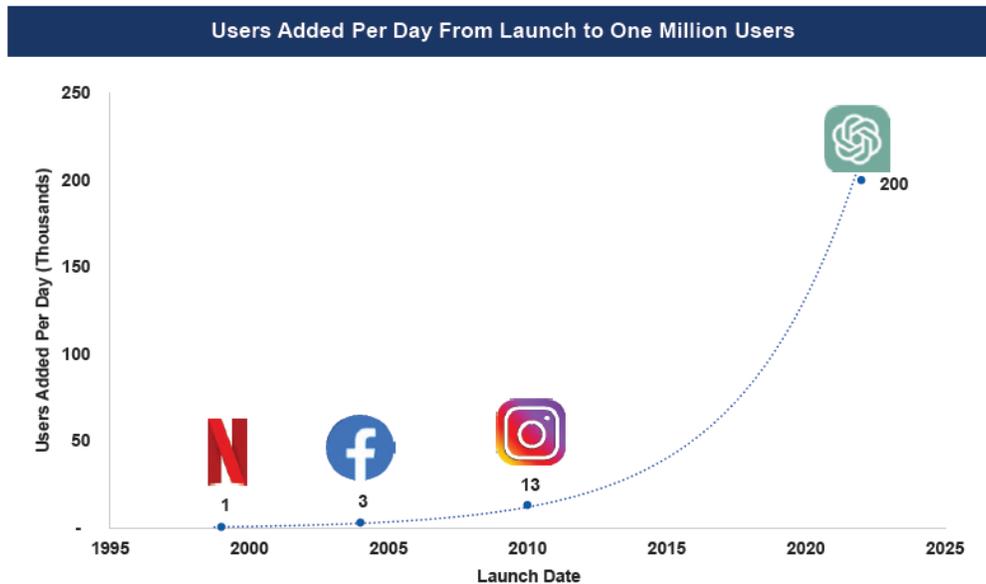


**Exhibit 29.** S&P 500 Index Technology EBIT Margins Growth, June 2024, source UBS.

In summary, we consider the current investment opportunity set to be attractive for high quality growth equities on a relative basis, particularly as the market is gradually entering a disinflationary and yield-peaking phase, in our view. We also reiterate the need to be highly selective in an environment of scarce secular growth opportunities, elevated market valuation, increased geopolitical uncertainty, and technological disruption that increases the gap between the “haves” and the “have-nots”, all of which we believe enhances the spectrum of opportunity for long-short investing currently.

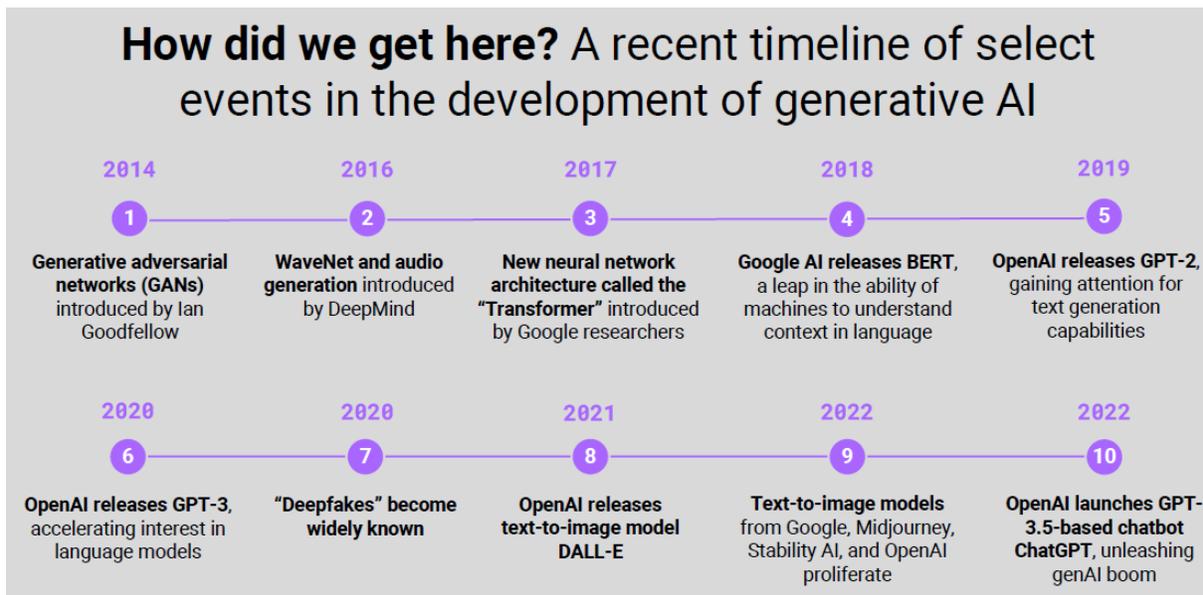
*Secular Opportunity for Technology*

In recent communications, we have extensively detailed our outlook on the emerging wave of technological innovation and AI, and more recently modern (Generative) AI, which we expect to be wide in scope, transformative and highly disruptive. As the digital foundation of the global economy expands rapidly, it is enabling disruption in a matter of months. Businesses can now reach millions of users in the shortest time ever.



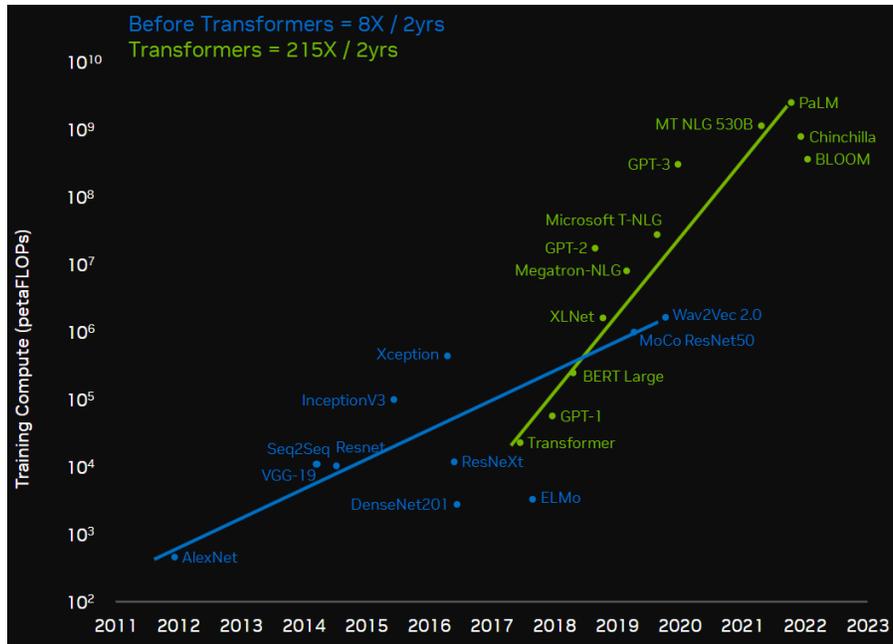
**Exhibit 30.** *Users Added per Day from Launch to One Million Users, source Morgan Stanley.*

The origins of this new technological revolution can be traced a few years back. In our quarterly communications, we first extensively discussed the AI revolution in 2017, the year in which Alphabet introduced their Transformer architecture, which was then split into BERT (short for Bidirectional Encoder Representations from Transformers, a machine-learning framework for natural language processing) and a series of GPT models.



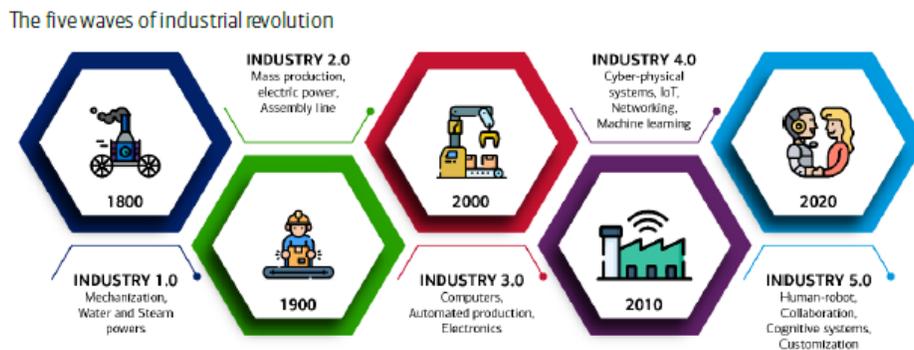
**Exhibit 31.** *The History of Generative AI, source CB Insights.*

And the next year, 2018, marked the first year in which the amount of data generated by machines surpassed the amount of data generated by humans (see Exhibit 56). This data explosion then began to feed new large and complex AI models, which in turn needed an advanced and powerful new compute platform for model training.



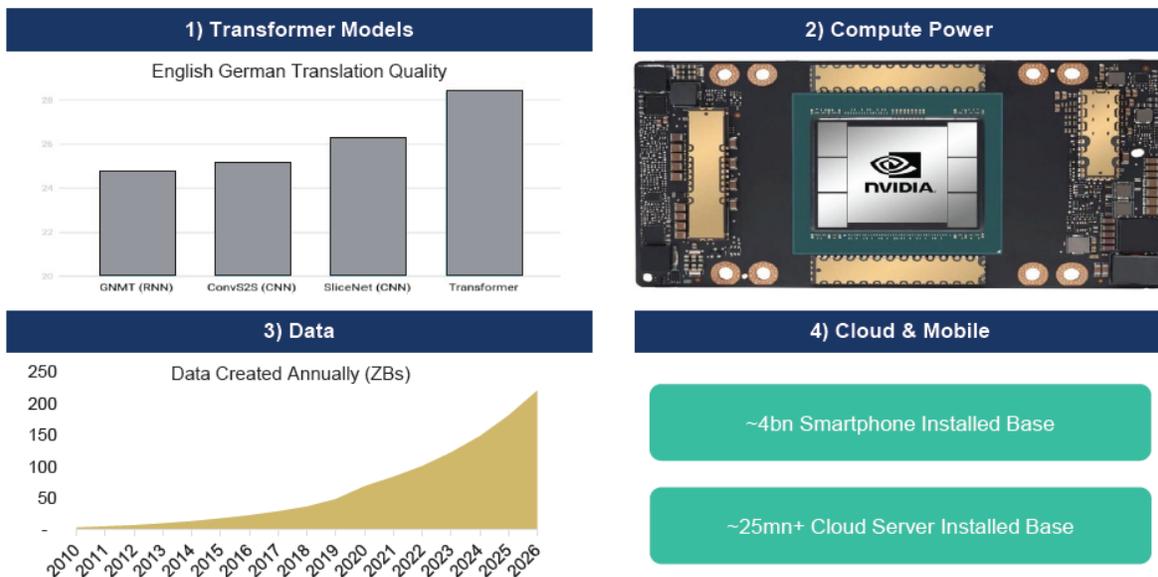
**Exhibit 32.** GPU Computing Powers AI Advances, source Nvidia.

The creation of a powerful compute platform that was able to accommodate and handle AI models with tremendous complexity occurred between 2020 and 2022, ultimately leading to the tipping point for generative AI at the very end of 2022 (AI going mainstream with the launch of ChatGPT). This amazing new platform is now propelling another wave of IT-enabled productivity growth (which some are calling the Fifth Industrial Revolution).



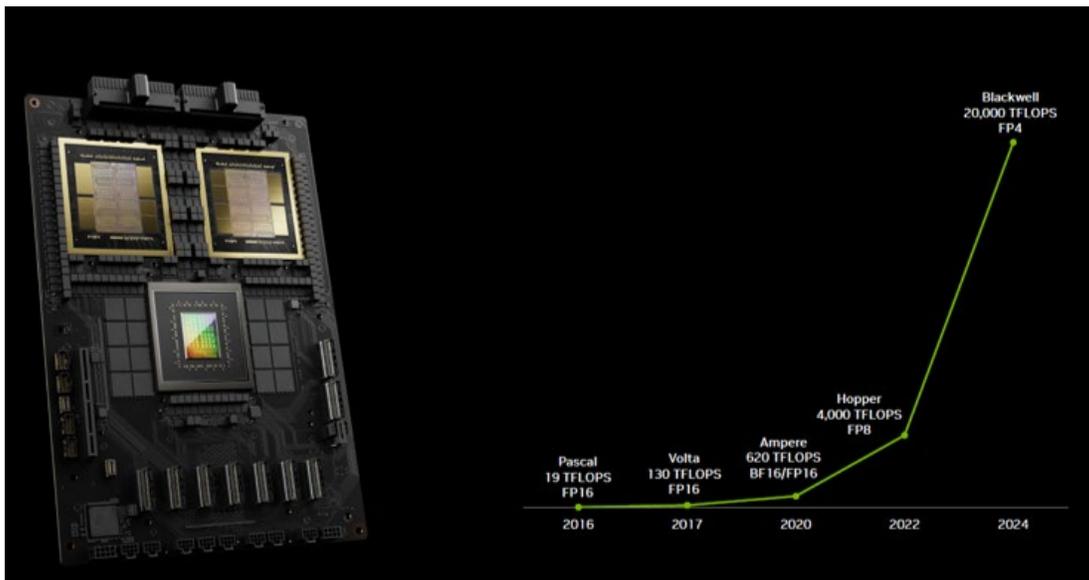
**Exhibit 33.** The Fifth Industrial Revolution Involves the Combination of Humans and Machines at Work, source BofA Global Research.

Beautifully, this marriage of powerful transformer models and advanced compute hardware platforms indeed led to the recent generative AI breakthroughs, bringing modern AI to the mainstream.



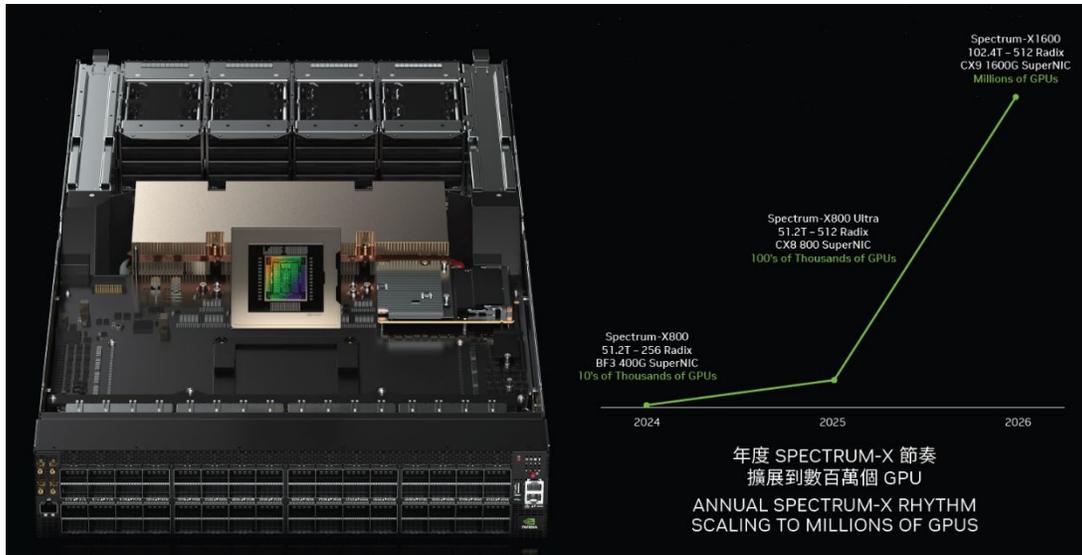
**Exhibit 34.** Four Key Factors That Led to The Current “AI Breakthroughs”, source Morgan Stanley.

As we will discuss later, recent advanced reasoning models require a tremendous amount of compute power, particularly as scaling now occurs on two dimensions, both training and inference. Newly introduced AI chips like Blackwell accelerate compute power exponentially.



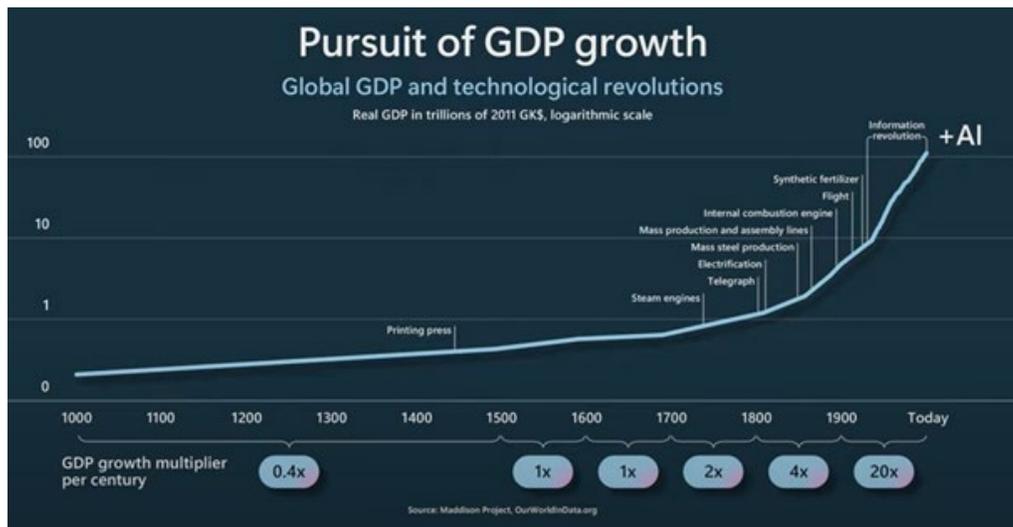
**Exhibit 35.** 1000x AI Compute in 8 Years, August 2024, source Nvidia.

This is needed as advanced AI models will require hundreds of thousands and eventually millions of GPUs for training and inference.



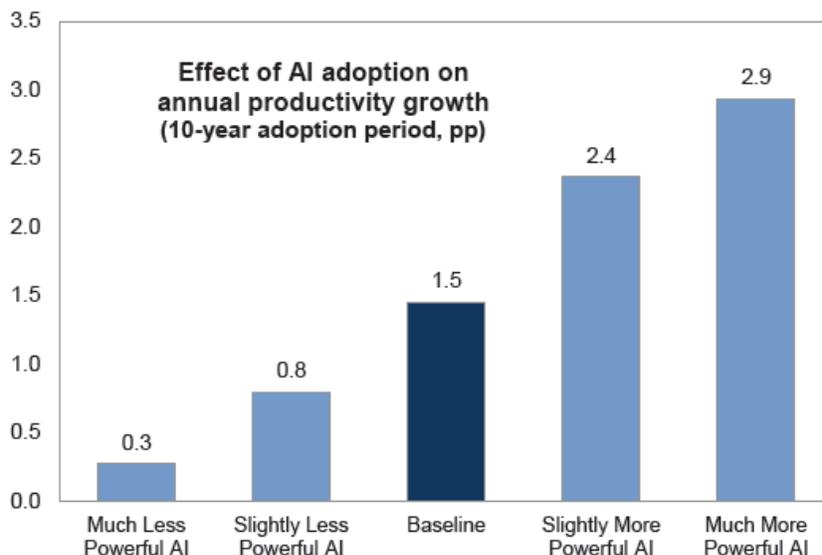
**Exhibit 36.** *Scaling to Millions of GPUs, June 2024, source Nvidia.*

Given these most recent advances in both model complexity and compute power, it is fair to say that the modern generative AI revolution is just beginning, and it will be transformational. We also believe this tectonic wave of technological innovation is likely to fuel GDP growth, as innovation and growth go hand in hand, and AI is likely to ultimately create more jobs than it destroys.



**Exhibit 37.** *Global GDP and Technological Revolutions, source Microsoft.*

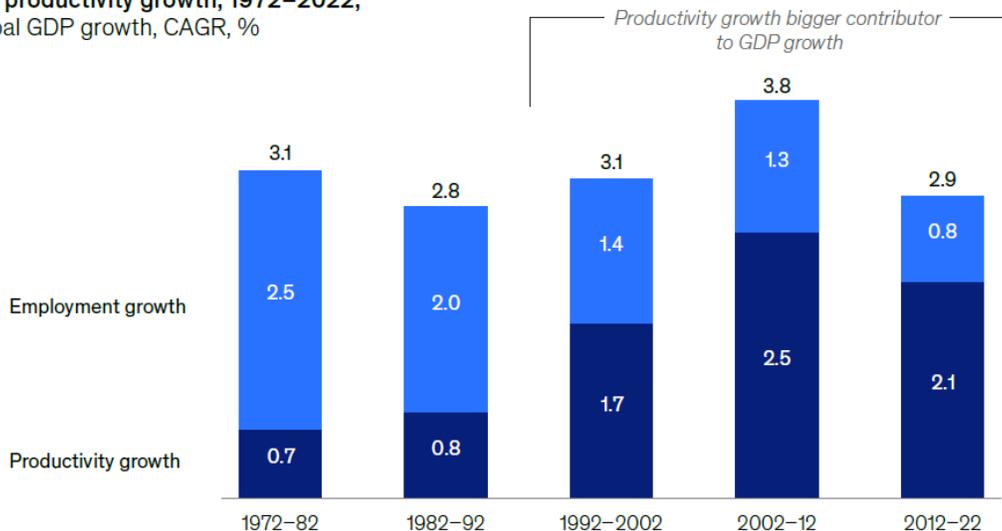
This is partly because, one, the effect of AI on annual productivity growth can be very significant. AI is likely to create a productivity boost we have only seen a few times in the past one hundred years, potentially adding a gain of 1.5% in output per year.



**Exhibit 38.** *Estimated Effect of AI Adoption on Productivity Growth, source Goldman Sachs.*

And of course, two, productivity growth has been the main engine of GDP growth over the past thirty years.

**Real GDP growth contribution of employment and productivity growth, 1972–2022, global GDP growth, CAGR, %**

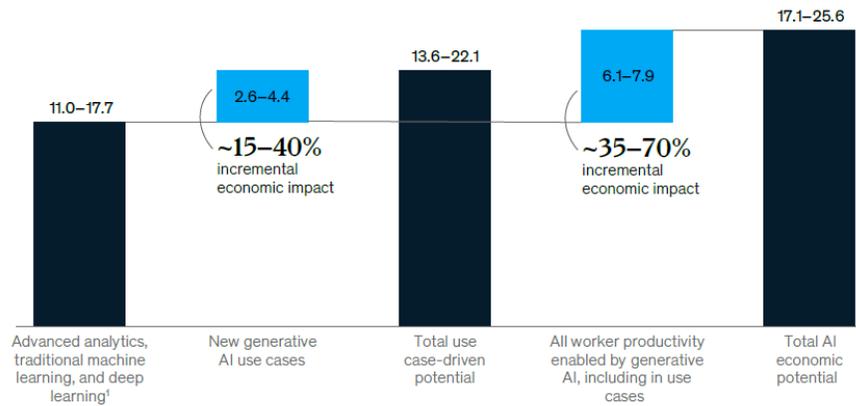


**Exhibit 39.** *Real GDP Growth Contribution of Employment, source McKinsey.*

Generative AI is also expected to disrupt the labor markets in a significant manner. McKinsey & Company has estimated that 60-70% of all workloads can be impacted or eventually be automated by AI. Looking at hundreds of occupations and detailed work activities, McKinsey estimated that a total economic benefit of \$17.1 to \$25.6 trillion annually, across all industries, with the incremental Generative AI impact in the \$6.1-\$7.9 trillion range.

Generative AI could create additional value potential above what could be unlocked by other AI and analytics.

AI's potential impact on the global economy, \$ trillion



<sup>1</sup>Updated use case estimates from "Notes from the AI frontier: Applications and value of deep learning," McKinsey Global Institute, April 17, 2018.

Exhibit 40. AI's Potential Impact on the Global Economy, \$ Trillion, source McKinsey.

There are more conservative estimates, but of the same incredible magnitude. For example, Morgan Stanley estimates that Generative AI can impact 25% of labor today and 44% in three years, affecting \$2.1 trillion of labor costs associated with these jobs today and \$4.1 trillion in three years, just in the US.<sup>9</sup> Globally, the incremental software opportunity alone is estimated to reach \$150 billion in three years.

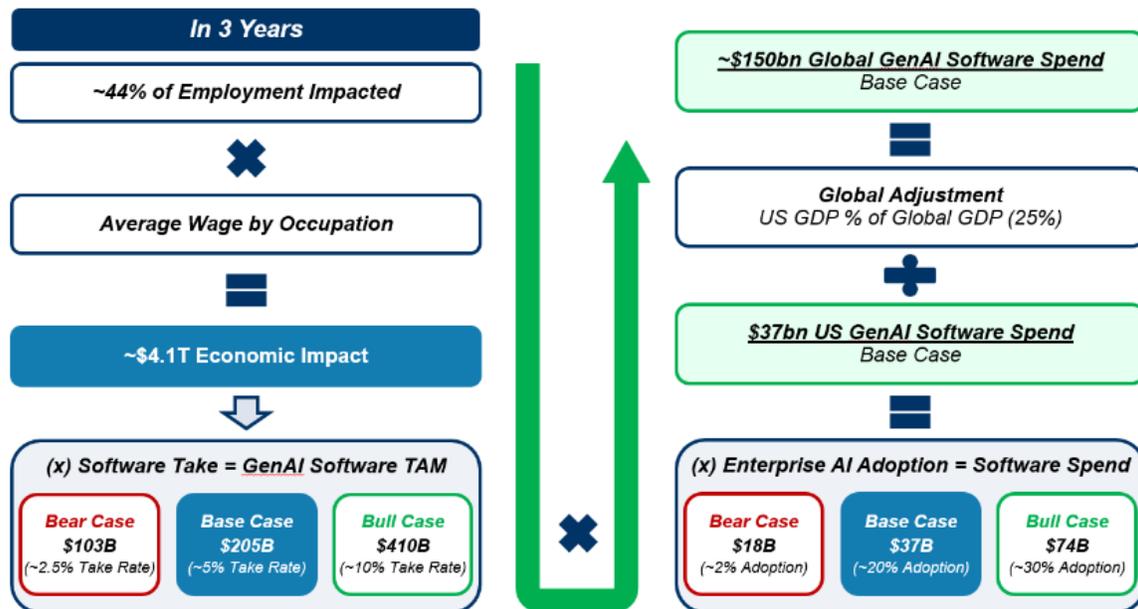


Exhibit 41. Global Generative AI Software Impact, January 2024, source Morgan Stanley.

Fundamentally, the reason behind this large-scale economic impact is simple, AI provides instant and large productivity gains.<sup>10</sup>



Michael Dell

"There aren't many gifts of 20% and 30% productivity that I can think of, certainly in my working lifetime, and as a result, this is a conversation in every boardroom."

(Goldman Sachs *Communacopia* + Technology Conference, September 2024)



"In just a year, Heathrow sped up forecast insights from two weeks to four hours while decreasing the margin of error from 30% to 10%, allowing the airport to become more efficient and accelerate productivity."

(Company Press Release, September 2024)

Recent earnings calls provided numerous examples of how Generative AI saves as many as thousands of years of work.

|  |  |
|--|--|
|  | <p>"We've used multiple large language models to accurately create or improve over 850 million pieces of data in the catalog. Without the use of generative AI, this work would have required nearly 100x the current headcount to complete in the same amount of time."</p>   |
|  | <p>"The average time to upgrade an application to Java 17 plummeted from what is typically 50 developer-days to just a few hours. We estimate this has saved us the equivalent of 4,500 developer-years of work (yes, that number is crazy, but real)."</p>  |
|  | <p>"We had approximately, give or take, 300 people who were involved in solving employee tickets for our employees. So about 2% of our 15,000 people. We have just launched last week, what we call the internal AI employee experience that has allowed us to reduce that headcount by 50%. And we think that can go down to 80%... Some of our best developers are 40% better in coding who have used our internal coding co-pilot."</p>               |
|  | <p>"When you look at our own deployment of Now Assist, the initial results are staggering. With better deflection, our IT help desk is saving 45 minutes per avoided case. In customer service, our colleagues are saving 30 minutes every time the computer generates the knowledge-based article for them. Our employees will save 21,000 hours with faster self-service, and our developers are completing non-complex scripts in half the time."</p> |

Exhibit 42. GenAI ROI Examples from Q2 2024 Earnings Calls, source Walmart, Amazon, Palo Alto Networks, ServiceNow.<sup>10</sup>

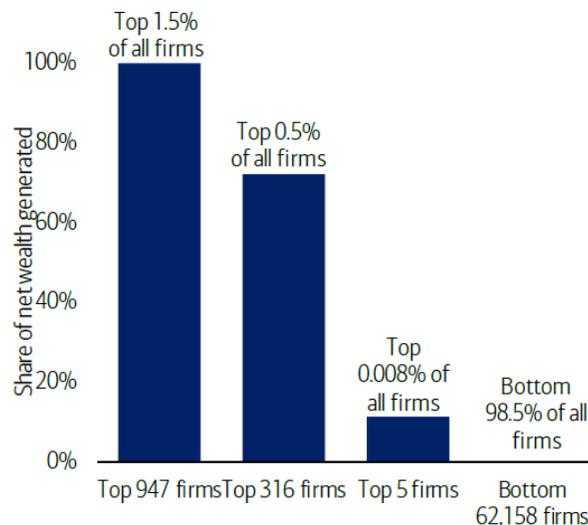
Recently, AI Agents that can process complex instructions, develop plans and complete tasks were introduced by companies like Salesforce, HubSpot, Workday and Microsoft, offering strong productivity gains and ROI to customers.<sup>11</sup>



**Exhibit 43.** Productivity Gains and ROI, September 2024, source Alkeon.

This cycle of AI disruption and associated value creation carries another important implication. There is going to be a small number of companies that generate the majority of added wealth. For example, according to BofA Global Research, between 1990 and mid-2020, the global market generated approximately \$56 trillion of wealth. Yet, only 1.5% of companies accounted for all of this wealth creation, with an acceleration of this concentrated wealth creation in recent years, in our view.

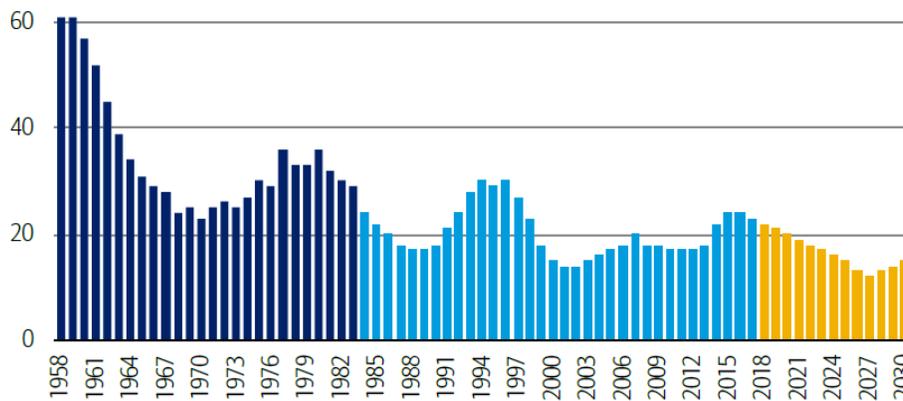
Share of net wealth\* generated by stocks between 1990 & mid-2020



**Exhibit 44.** Share of Wealth Generated by Global Stocks, 1990 to mid-2020, source BofA Global Research.

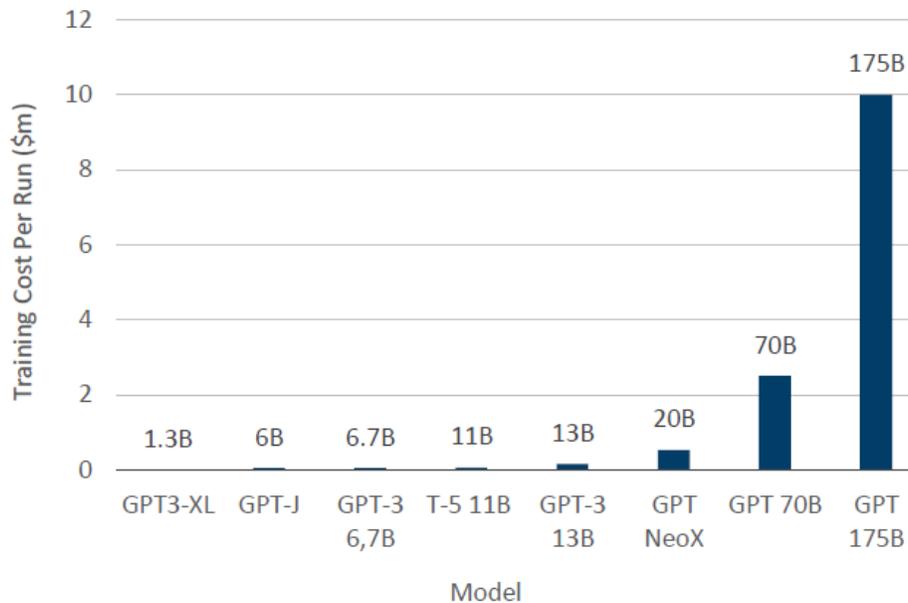
In this connection, BofA Global Research has predicted that 50% of S&P 500 companies could be replaced in ten years, as the average tenure of an S&P 500 company has been forecast to contract from its high of nearly sixty-one years in 1958, to thirty years in the 1980s, to twenty-four years in 1976 to approximately twelve years by 2027, supporting our view of a highly favorable environment for stock picking and highlighting the need for investors to remain exceedingly selective.

Average company lifespan on S&P 500 Index (year, rolling 7 year average)



**Exhibit 45.** Average Lifespan of S&P 500 Index Companies on the Decline, September 2021, source BofA Global Research.

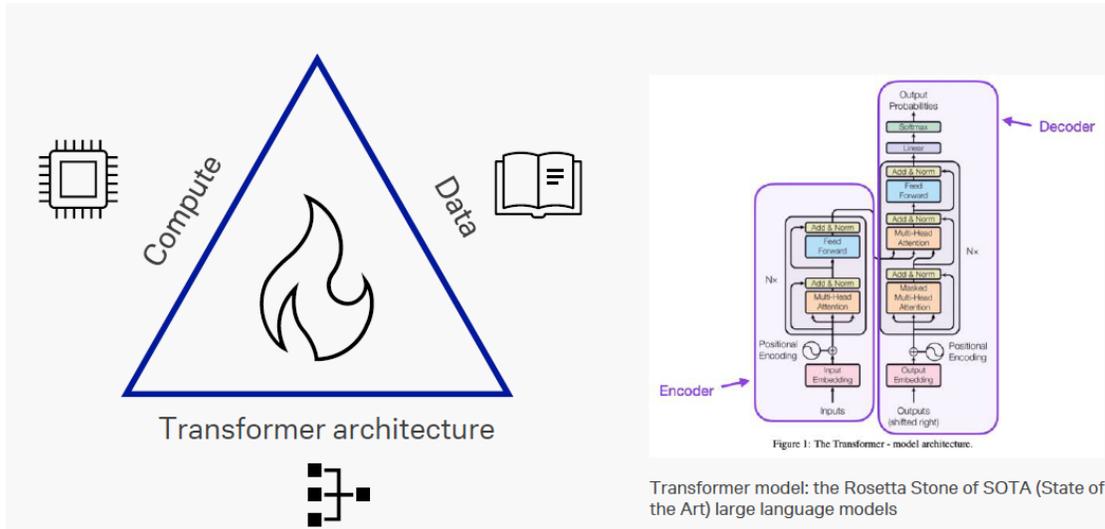
There is a fundamental reason behind this disruption, namely, the costs of innovating are high. AI is expensive, and has become increasingly so as the cost of AI training soared as models scaled up. For a model the size of GPT3, a single training run can cost more than \$10 million, and trillion parameter models can have training costs upwards of \$50 million for a single training run.



**Exhibit 46.** The Cost of AI Training is Soaring as Models Scale Up (Single-Run Costs), source Nvidia.

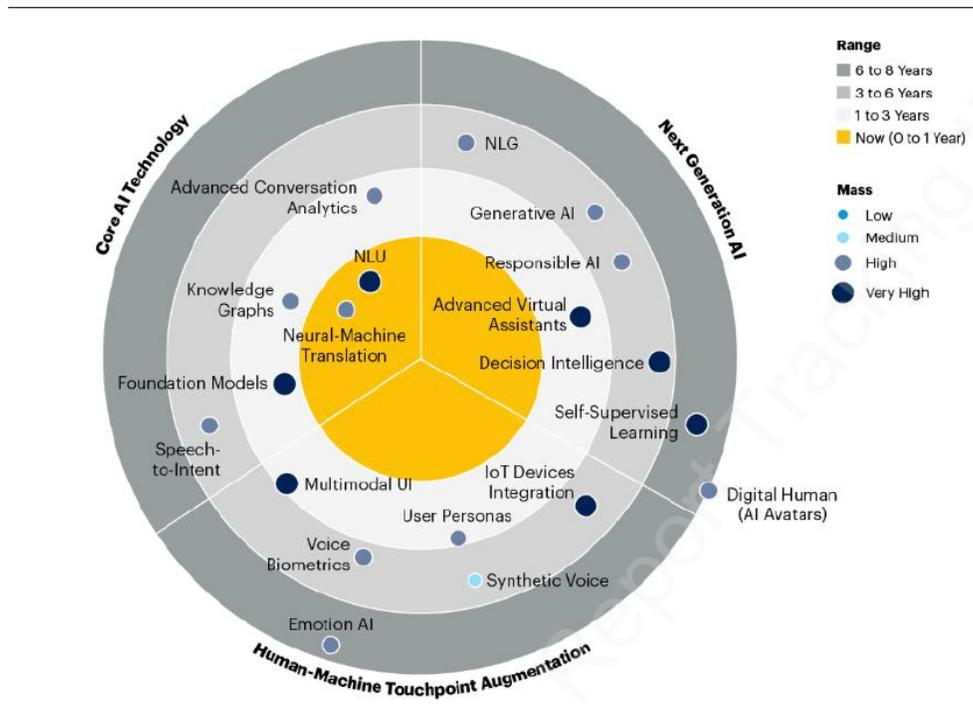
Consequently, we believe this pattern of disruption and concentration in wealth creation is likely to continue in the next decade, widening the gap between the “haves” and the “have nots”, and potentially creating an attractive backdrop for long-short equity investing.

Moreover, fundamentally we believe we are at the very beginning of a secular growth path that can favor a number of high-quality secular compounders with strong competitive positions. As we discuss later, **it is important to stress that the AI revolution is at its very early stages, as only in late 2022 did AI go mainstream with the introduction of ChatGPT.**



**Exhibit 47. The Tipping Point for Generative AI: Massive Computing Power, Data and the Invention of the Transformer Model, source Deutsche Bank.**

Unsurprisingly, there are a number of emerging technologies around conversational AI that can fuel tremendous growth in the next decade.



**Exhibit 48. Emerging Technologies Around Conversational AI, source Credit Suisse.**

In fact, Generative AI represents a huge leap, a step-function improvement over traditional AI models, with it being able to handle unstructured data and create new content. For the first time, the addition of a reasoning engine at the core of the algorithm allows AI to now be empathetic and imaginative, as it approaches human-mind complexity and relational reasoning.

### Generative AI Adds a Reasoning Engine to Software Tool Kit

By Representing the Relationships Between Words and Images in Numbers, Generative AI Enables Three Core Functions within Enterprise Software

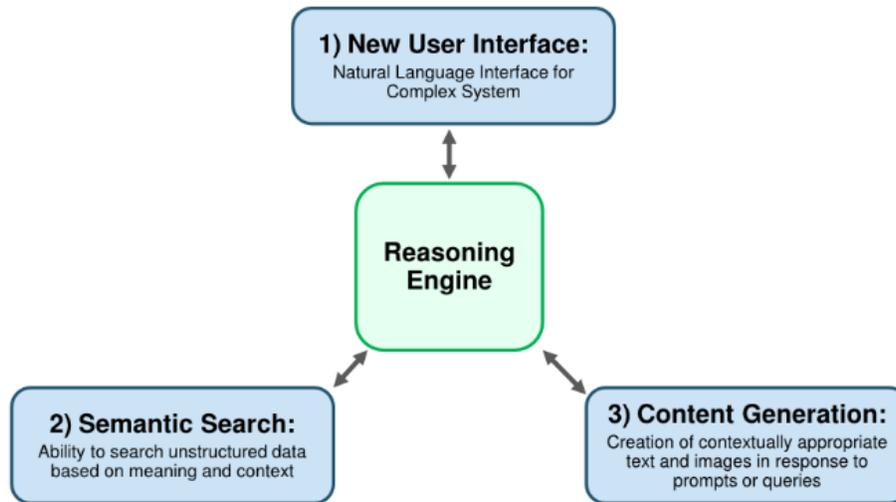


Exhibit 49. Generative AI Relational Reasoning Capabilities, source Morgan Stanley.

Key to this important breakthrough over the last two years is the ability to draw insights from large amounts of unstructured data.

### Generative AI Unlocks Insights from Unstructured Data...

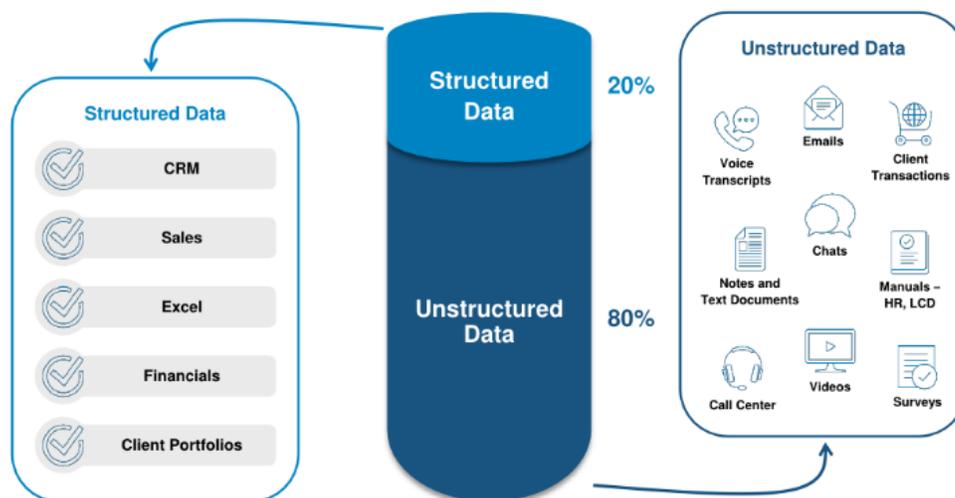
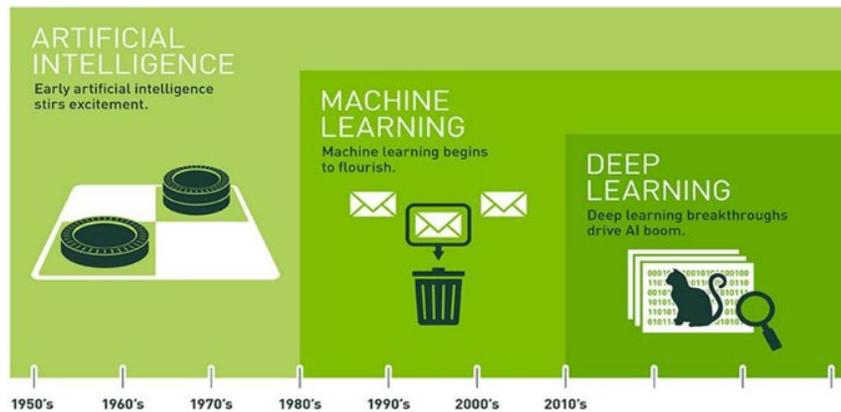


Exhibit 50. Generative AI Handling of Unstructured Data, source Morgan Stanley.

This new data paradigm is expected to significantly increase the amount of compute power needed to drive these very large datasets and complex Generative AI models, with hundreds of billions of parameters, and eventually trillions of parameters over the next ten years (see Exhibit 71).

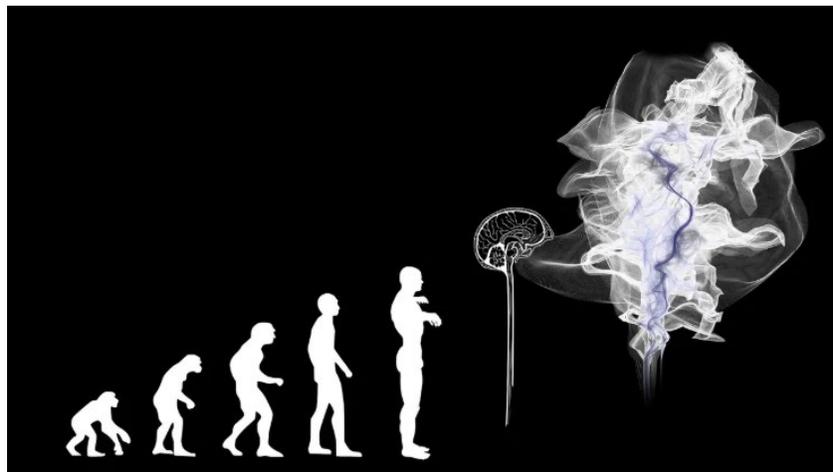
## Early Stages of the AI Revolution

As we detail below, the AI revolution has been decades in the making. But until most recently, the compute power needed to handle AI models with tremendous complexity was simply not there.



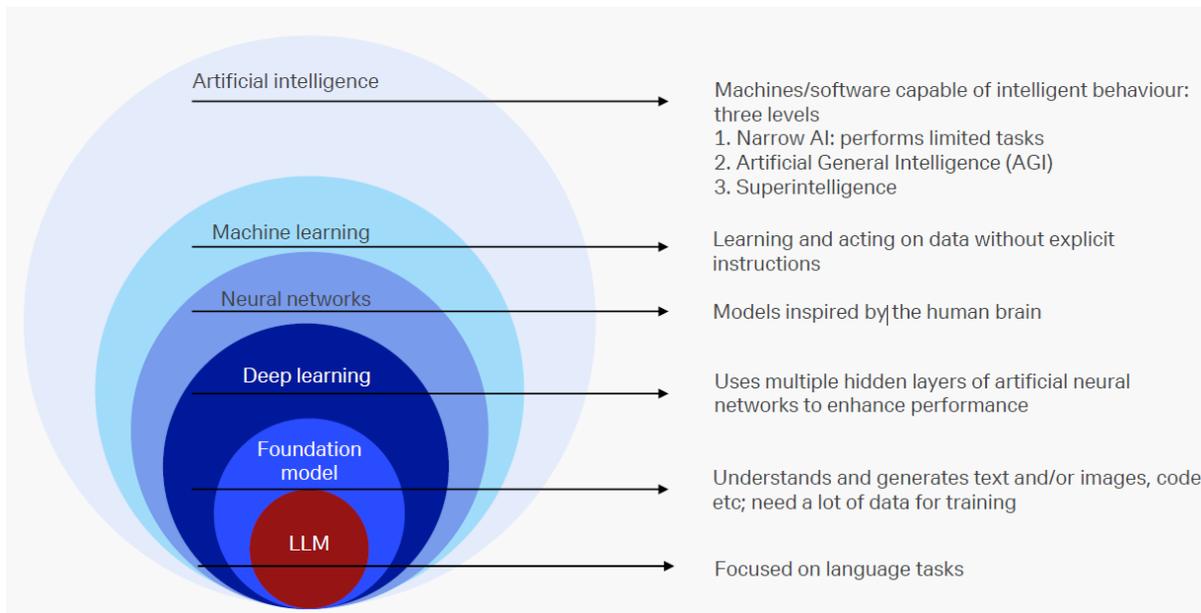
**Exhibit 51.** *The Era of Deep Learning, source Nvidia and JP Morgan.*

It was only recently in 2020 that AutoML Zero, developed by scientists at Alphabet, elevated the idea of automatic machine learning algorithms that are machine-created and can automatically improve themselves through Darwinian style evolution. This approach elevated machine learning innovation to a different level by unconstraining the hand-designed machine learning algorithm building and discovery process that can bias searches in favor of human-designed algorithms that are inherently limiting in the number of options they consider – as “you cannot search for what you cannot discover”.



**Exhibit 52.** *AutoML-Zero: Evolving Machine Learning Algorithms from Scratch, source Bigthink.*

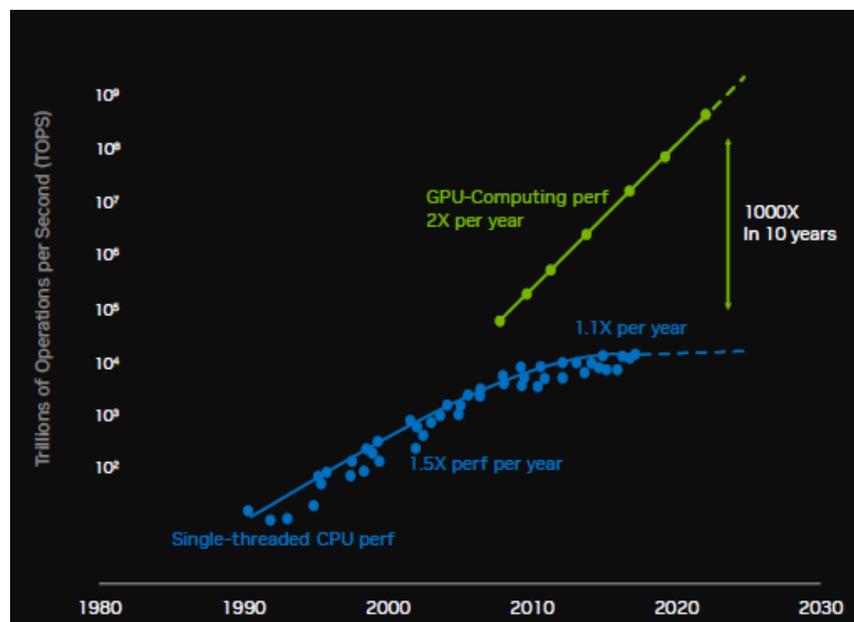
Such models, trained on vast amounts of data, necessitated the creation of powerful compute platforms between 2020 and 2022 that could attack AI problems of tremendous complexity. This ultimately led to the tipping point for generative AI at the very end of 2022, when large language models became capable of understanding and generating human-like text. These models were, for the first time, creative, empathetic, imaginative and generative.



**Exhibit 53.** *What is a Large Language Model and Where Does it Fit into AI?, source Deutsche Bank.*

Advancing and bringing AI to the mainstream at the end of 2022 was a hugely important milestone, as only in the last few years have advances in computing power (a more than 30,000-fold increase in seven years) enabled this new era of AI training. It took one GPU to train AlexNet (the convolutional neural network architecture designed by Alex Krizhevsky) a decade ago, while GPT-3 required 10,000 GPUs for training, all linked together.<sup>12</sup>

Incredibly, and as we were marking an inflection point of change in the last three years, advancing algorithmically closer to cognitive AI, the hardware needed to optimally process huge quantities of data and train these advanced AI models also advanced exponentially, reaching new milestones at the same time. Enter the era of Accelerated Computing, advanced computing in the post-Moore’s Law era, which can handle problems with tremendous complexity.



**Exhibit 54.** *Dramatic Acceleration in Inference Performance in the Last Three Years, source Nvidia.*

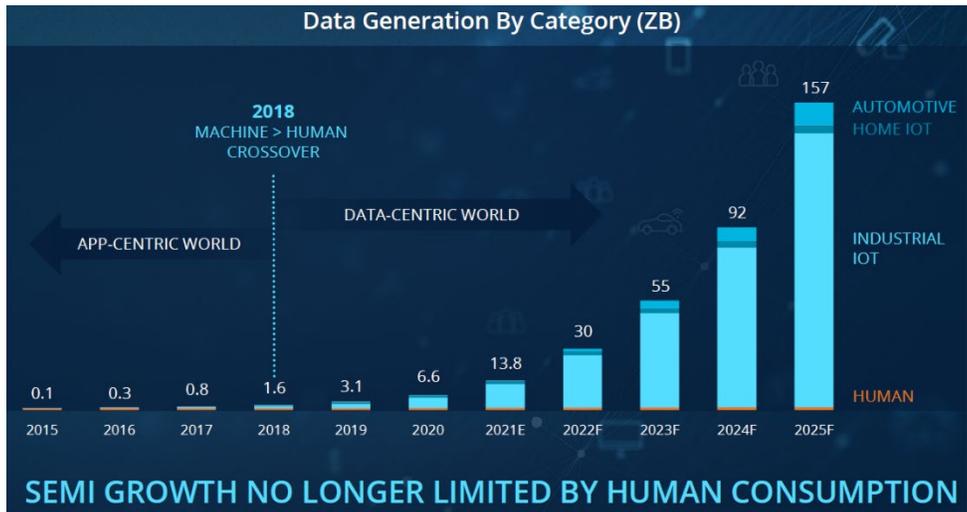
To enable AI models with billions and eventually trillions of parameters, AI chips are becoming larger and larger, with designers now embedding significant amounts of fast memory on the chip to handle the demands of AI training algorithms that require a huge amount of communication and a modest amount of relatively easy compute.

Private startup Cerebras recently showcased the largest chip ever built. This wafer-scale chip, which is purpose built to accelerate AI applications, has 2.6 trillion transistors and embeds 850,000 AI-optimized cores.



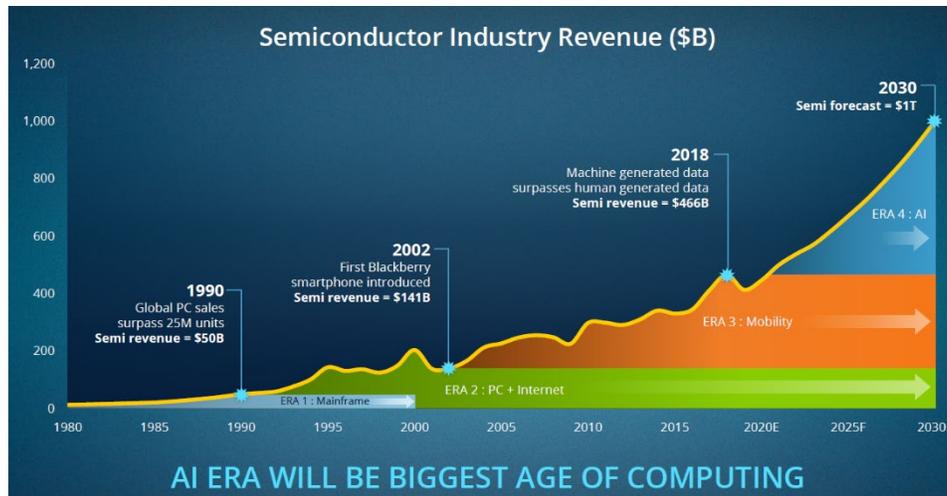
**Exhibit 55.** *The World's Largest Chip, source Cerebras.*

Such important hardware advances are coming at the right time, as only several years ago the amount of data generated by machines surpassed the amount of data generated by humans, and that gap is now widening exponentially.



**Exhibit 56.** *Data Generation by Category (in Zettabytes), source Applied Materials.*

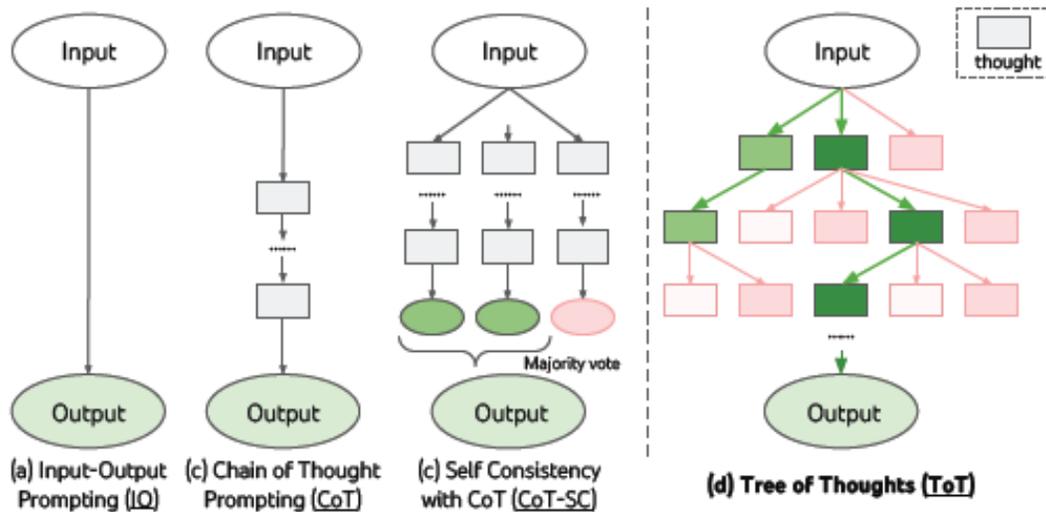
As a result, and having built an advanced computational foundation, the new modern AI era is expected to be the biggest and most transformational era of computing, with positive secular implications across software and hardware.



**Exhibit 57.** *Semiconductor Industry Revenue, Billions, source Applied Materials.*

We now find ourselves at the very early stages of the incredible modern generative AI revolution, which has the potential to be the most disruptive and transformative cycle of technological innovation humans have ever witnessed, in our view.

Early in the year, we talked about the recent emergence of advanced AI models that bring us closer to generalized reasoning. These models can advance on several layers of analysis and reasoning (“deep-path reasoning”), solving complex problems (such as advanced geometry problems) that even powerful LLMs were unable to solve. An example is DeepMind’s “Tree of Thoughts” that evaluates different reasoning paths, and can look ahead or back-track as needed before making optimal choices.



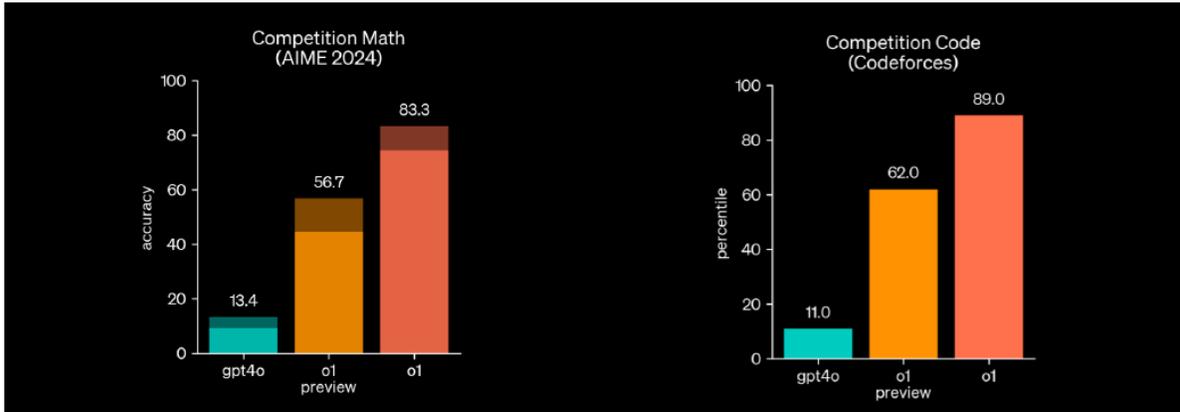
**Exhibit 58.** *Approaches to Problem Solving with LLMs – Each Rectangle Box Represents a Thought, source Google DeepMind and Princeton University.*

Then in September 2024, OpenAI released a powerful new model, named o1, a model that thinks and self-reflects before responding. In fact, the longer it thinks the better it does on complex reasoning tasks, such as math and code generation.



For a lot of the time that I have been here we have been trying to make the model better at solving math problems as an example. And we put a lot of work into this, and we've come with different methods.. One thing I kept, every time I would read one of these outputs from the model I would be so frustrated that the model would never seem to question it was wrong or it making mistakes, or things like that. (September 2024)

But one of these early o1 models we actually started talking to it and sort of asked these questions, and it was scoring higher on these math tests we were giving it, we could look at how it was reasoning, and you could see it started to question itself, and had interesting reflections, and that was the moment for me. (September 2024)



**Exhibit 59.** o1 Competition Math and Code Scores, September 2024, source OpenAI.<sup>13</sup>

o1 also opens up a new dimension of scaling, scaling inference in addition to training.



o1 is trained to “think” before responding. The longer it thinks, the better it does on reasoning tasks. It opens up a new dimension for scaling. We are no longer bottlenecked by pre-training. We can now scale inference compute too. (September 2024)

We haven't even talked about inference, and inference will be 90% of the AI workload by the end of the decade. (September 2024)



**Exhibit 60.** Pre-Training, Post-Training and Inference Proportions, September 2024, source OpenAI.<sup>14</sup>

For the first time we can see the model think, self-reflect and improve itself, and we can actually watch its chain of thoughts (see Appendix, Exhibits 85-86 at the end of this letter).<sup>15</sup>



**Noam Brown**  
@polynoamial

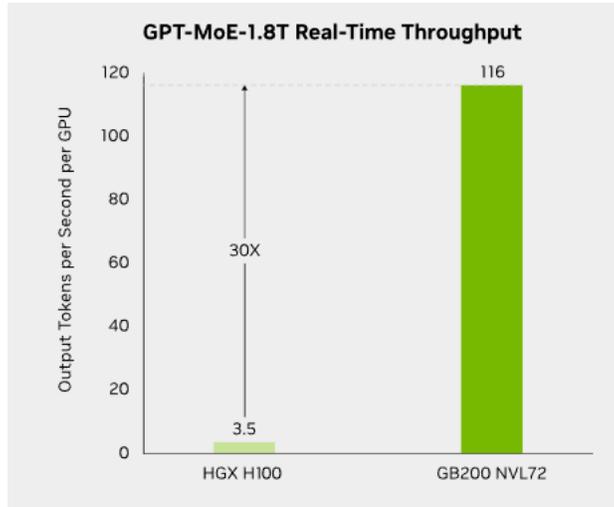
@OpenAI's o1 thinks for seconds, but we plan for future versions to think for hours, days, even weeks. Inference costs will be higher, but what cost? Would you pay for a new cancer drug? For breakthrough batteries? For a proof of the Riemann hypothesis? (September 2024)



**Will Depue**  
@willdepue

@Scaling inference time compute can compete with scaling-time compute! (September 2024)

As scaling dramatically occurs during inference, recent advances in inference performance are crucial to the success of models with generalized reasoning capabilities.



**Exhibit 61.** 30x Improvement in Inference Performance, source Nvidia.

AI progress is now taking place at unimaginable speed, with 2024 marking a year of significant new advances in multimodality and AI-powered humanoid robots.

Runway's Gen 2 Text-to-Video Jun'23

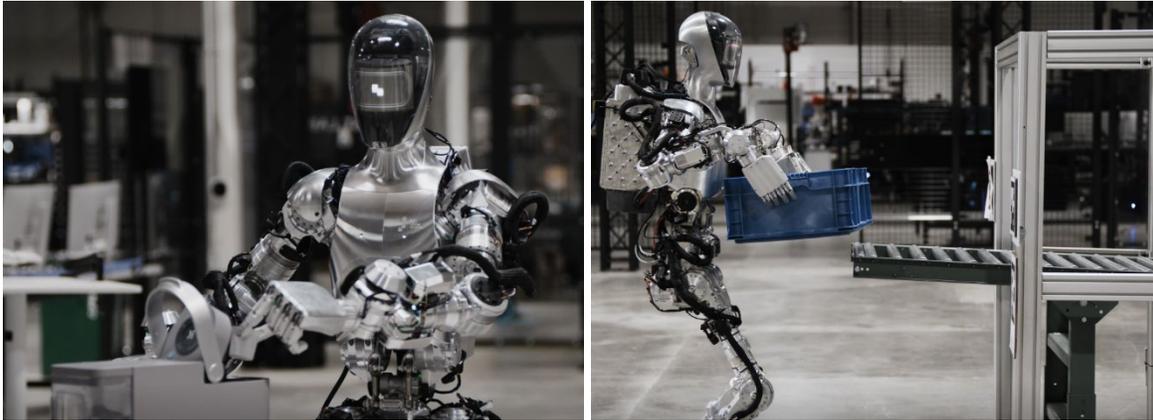


OpenAI Sora's Text-to-Video Feb'24



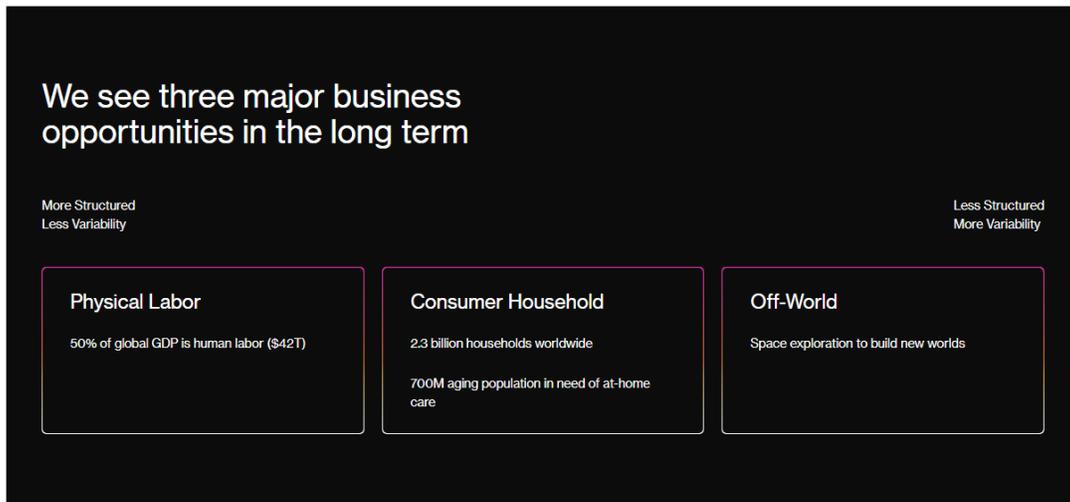
**Exhibit 62.** New Powerful Text to Video Models June 2023 and Feb 2024, source Runway and OpenAI.

Multimodality refers to AI models that can understand, transform and generate all data forms, including, texts, images and videos. These new models are now powering humanoid robots, such as the newly launched Figure robots, which are powered by a large multimodal OpenAI model.



**Exhibit 63.** *Humanoid Robots, source Figure.*

The founder of humanoid robotics firm Figure has famously said, “Every human will own a robot in the future, similar to owning a car/phone today”, which is a belief that other visionaries such as Elon Musk have shared.<sup>16</sup> In this connection, Figure believes that there will be significant labor shortages in certain occupations, with almost 10 million unsafe or undesirable jobs in the US alone, and that “humanoids will revolutionize a variety of industries, from corporate labor roles (3+ billion humans), to assisting individuals in the home (2+ billion), to caring for the elderly (~1 billion), and to building new worlds on other planets”.<sup>17</sup>



**Exhibit 64.** *AI & Robotics Possibility, source Figure.*

Traditionally, robotics and AI were different fields. But now, with the advent of multimodality for training robots, much more efficiently and faster than the past, the two fields are converging, giving rise to a number of startups that are producing next generation humanoid robots, that can observe, emulate and learn quickly.

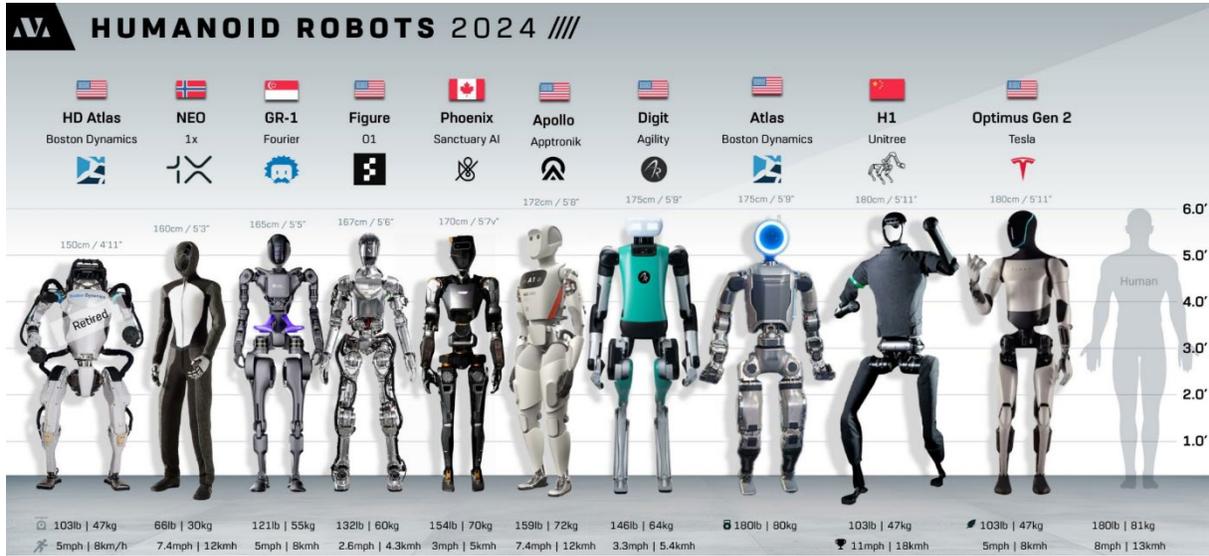


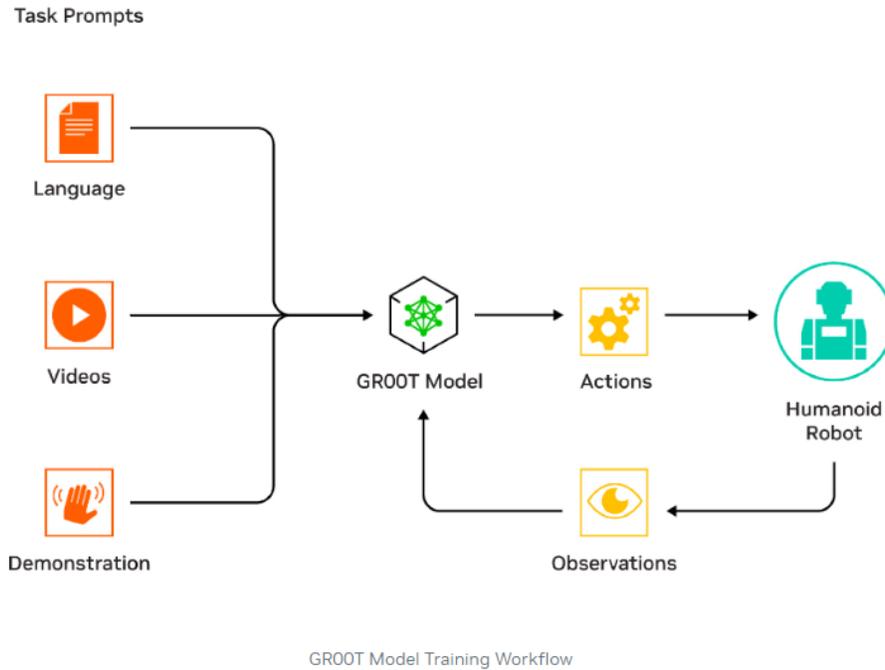
Exhibit 65. Humanoid Robots 2024, source LifeArchitect.ai.

A humanoid is a robot that resembles a human in bodily shape. This is a powerful idea, as the world is already setup for humans to operate in, providing a brownfield environment for humanoids, and expanding the Total Addressable Market (TAM) from manufacturing and warehousing to home assisting, caring for the elderly, education, entertainment and corporate labor.

| Type       | Industrial robot   |  |  | Service robot   | Humanoid robot   |
|------------|--|--|--|---|--|
|            | Traditional industrial robot   | Collaborative robot (Cobot)  |  |   |  |
| Definition | Industrial robots are heavy-duty machines designed to automate the manufacturing process   | Cobots are intended for direct human-robot interaction within a shared space, or where humans and robots are in close proximity  |  | Service robots are robots in personal use or professional use that performs useful tasks for humans or equipment.   | Humanoid robots are robots designed to resemble humans in appearance and behaviour   |
| Capability | <ul style="list-style-type: none"> <li>- Material handling</li> <li>- Assembly</li> <li>- Welding</li> <li>- Painting &amp; Coating</li> <li>- Quality inspection</li> <li>- Picking, sorting and packing</li> </ul>   | <ul style="list-style-type: none"> <li>- Assembly (part selection, dispensing of adhesive, fastening of screws, etc.)</li> <li>- Machine tending</li> <li>- Material handling</li> <li>- Quality inspection</li> <li>- Welding</li> </ul>          |  | Service robots include <b>consumer service robots</b> (domestic cleaning robots, automated wheelchairs, and social interaction robots), and <b>professional service robots</b> (cleaning robots for public places, delivery robots, fire-fighting robots, rehabilitation robots and surgery robots in hospitals, as well as autonomous mobile robots (AMR)) | <ul style="list-style-type: none"> <li>- Moving / walking</li> <li>- Interact with humans</li> </ul>   |
| Features   | <ul style="list-style-type: none"> <li>- Do work in place of human beings;</li> <li>- Can handle heavier and larger materials than cobots;</li> <li>- Moves at a faster speed than cobots;</li> <li>- Engineers need to re-write codes for any changes;</li> <li>- Often needs safety cages to keep humans out of the workspace</li> </ul> | <ul style="list-style-type: none"> <li>- Do work alongside human beings;</li> <li>- More easily programmable than industrial robots;</li> <li>- Not designed for heavy manufacturing;</li> <li>- Usually cheaper than industrial robots</li> </ul> |  |   | <ul style="list-style-type: none"> <li>- Could perform complex actions that require human-like dexterity, walking and climbing stairs;</li> <li>- Able to behave like humans and interact with humans</li> </ul> |
| User case  | <ul style="list-style-type: none"> <li>- Manufacturing factory</li> <li>- Warehouse</li> </ul>   | <ul style="list-style-type: none"> <li>- Manufacturing factory</li> <li>- Agriculture</li> <li>- Medical</li> <li>- Pharma</li> </ul>  |  | <ul style="list-style-type: none"> <li>- Transportation &amp; logistics</li> <li>- Hospitality</li> <li>- Medical robotics</li> <li>- Professional cleaning</li> <li>- Agriculture</li> </ul>   | <ul style="list-style-type: none"> <li>- Manufacturing factory</li> <li>- Warehouse</li> <li>- Entertainment</li> <li>- Education</li> <li>- Home assistance</li> <li>- Elderly care</li> </ul>                  |
| Example    |   |   |  |   |   |

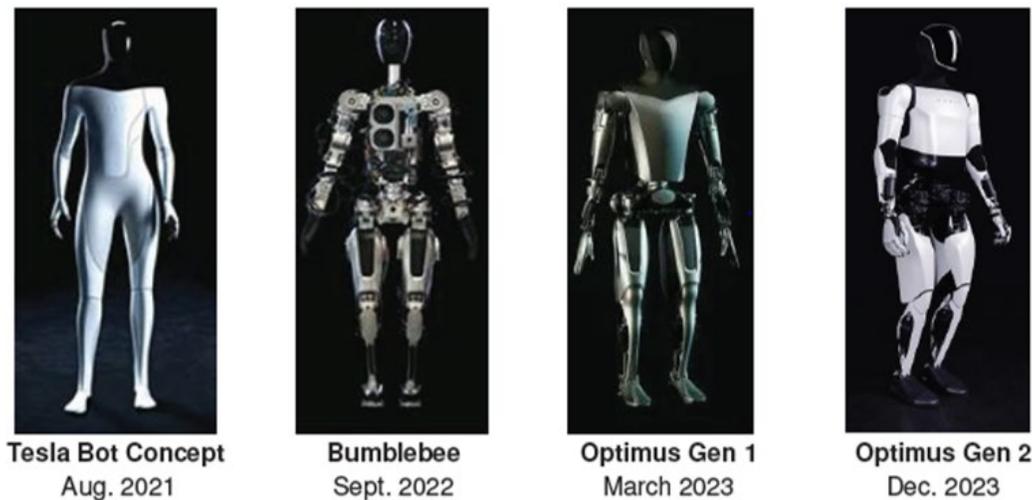
Exhibit 66. Types of Robots – Humanoid Robots Are a New Addition to the Robot Industry, July 2024, source Deutsche Bank.

For example, Nvidia’s project GR00T provides a multimodal foundation to train humanoid robots which can understand natural language and emulate human actions and movement, effectively learning by looking, observing and analyzing.



**Exhibit 67.** *Groot Model Training Workflow, source Nvidia.*

And Tesla’s Optimus, a general purpose humanoid, is designed to emulate a human, with hands and fingers capable to feel and sense textures and mass. As the robot simply mimics the human, training becomes very natural. Tesla is paying up to \$48 an hour for individuals to “play robot”, wearing a suit to capture movements and various motions as well as a VR headset, and perform tasks, which Optimus observes, analyses and mimics.



**Exhibit 68.** *Tesla Optimus Versions, September 2024, source Morgan Stanley.*

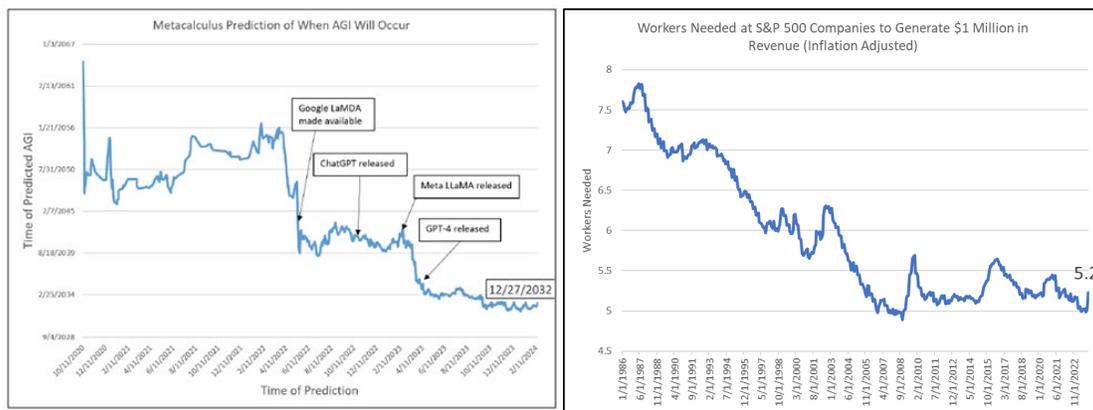
In our view, multimodal AI does represent a new paradigm shift, which is likely to accelerate our journey towards artificial general intelligence (“AGI”). Recently Google’s DeepMind introduced a framework that compares AI to human intelligence. Under this framework, we are currently at a Level 2 AGI out of 5 (as of February 2024) and rapidly moving towards Levels 3 and 4, in our current view.

### Levels of AGI

| Performance ▶                | Level 0:<br>No AI   | Level 1:<br>Emerging   | Level 2:<br>Competent   | Level 3:<br>Expert  | Level 4:<br>Virtuoso   | Level 5:<br>Superhuman  |
|------------------------------|---|--|---|---|--|---|
| Percentile of Skilled Adults | No AI   | similar to unskilled human   | >50%  | >90%  | >99%   | 100%  |
| Narrow                       | Narrow Non-AI   | Emerging Narrow AI   | Competent Narrow AI   | Expert Narrow AI  | Virtuoso Narrow AI   | Superhuman Narrow AI  |
| Autonomy Level               | <b>No AI</b><br>Human does everything   | <b>AI as a Tool</b><br>Human fully controls task and uses AI to automate mundane sub-tasks | <b>AI as a Consultant</b><br>AI takes on a substantive role, but only when invoked by a human | <b>AI as a Collaborator</b><br>co-equal human-AI collaboration; interactive coordination of goals & tasks | <b>AI as an Expert</b><br>AI drives interaction; human provides guidance & feedback or performs subtasks | <b>AI as an Agent</b><br>Fully autonomous AI<br><i>Not yet achieved</i> |
| General                      | <b>General Non-AI:</b><br>Human-in-the-loop computing, e.g., Amazon Mechanical Turk | <b>Emerging AGI:</b><br>ChatGPT<br>Gemini<br>Llama 2                                       | <b>Competent AGI:</b><br><i>Not yet achieved</i>  | <b>Expert AGI:</b><br><i>Not yet achieved</i>   | <b>Virtuoso AGI:</b><br><i>Not yet achieved</i>  | <b>Artificial Superintelligence (ASI):</b><br><i>Not yet achieved</i>   |

**Exhibit 69. Sparks of AGI: Happening Faster than We Anticipated, source Alkeon and Google DeepMind.**

And recent incredible advances in generalized reasoning and multimodality are bringing the AGI dream closer to reality, in a way that was unimaginable just a few years ago, making it potentially less than ten years away.

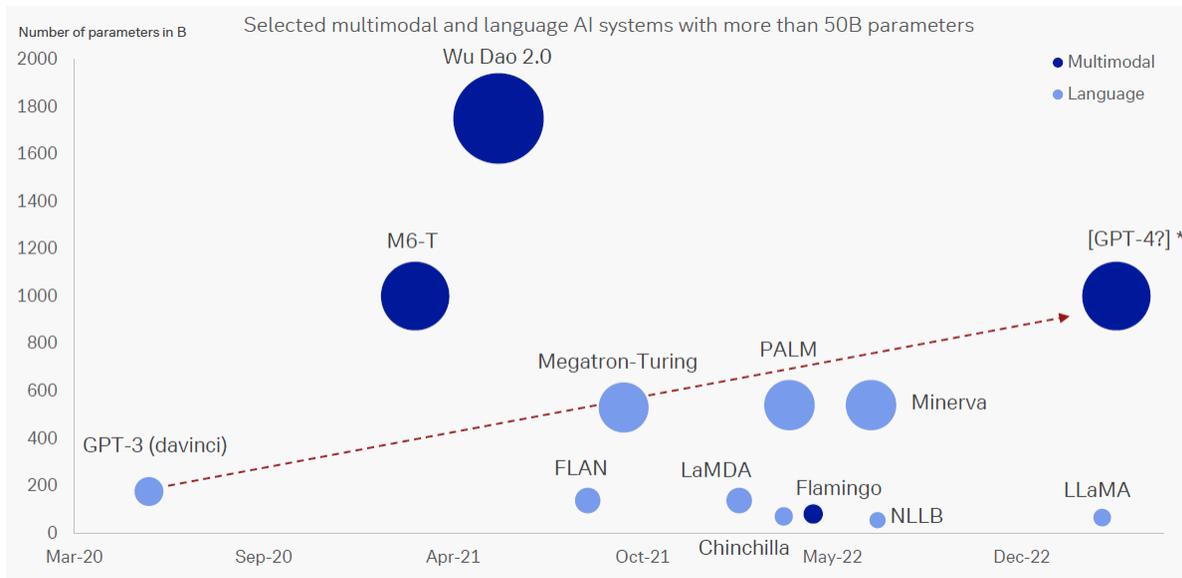


**Exhibit 70. AGI Potentially Less Than Ten Years Away, February 2024, source Alkeon (based on Metacalculus Survey and BofA Global Research Data).**

In short, we believe this journey towards AGI will eventually reflect the most fascinating technological discovery of our lifetime. This can be the most transformative and disruptive cycle of innovation we have ever witnessed, and by the end of this decade, we believe all of us will feel fortunate to have witnessed it.

Following the significant advances in software and hardware in the last few years, and as AI has begun to handle models with tremendous complexity, AI algorithms are becoming more “human-like”. Additionally, next-level use cases require gigantic models. Advanced AI models are becoming massive and highly complex, and this is the only way to approach models of human intelligence.

These days a large language model can be over 1 trillion parameters. The growth in model complexity has been exponential.

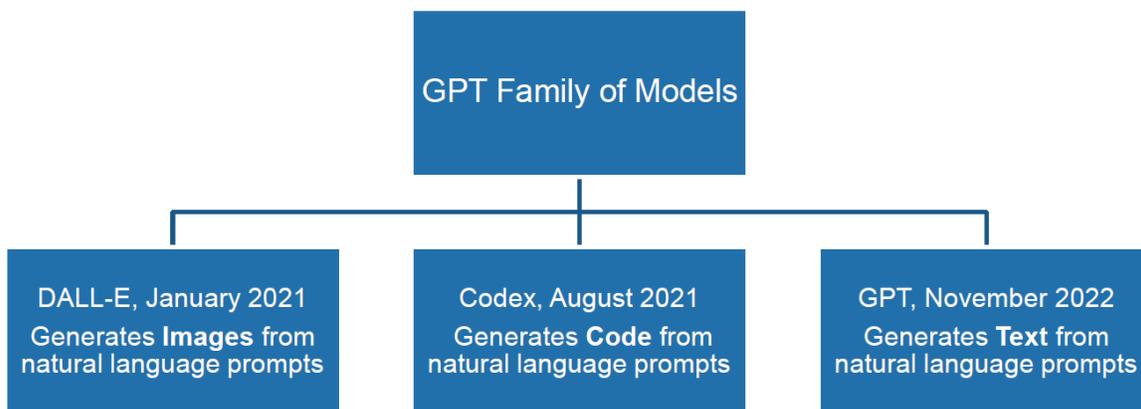


**Exhibit 71.** *The Number of Parameters in LLMs Has Surged, Surpassing 1 Trillion, source Deutsche Bank.*

One of the key moments that led to the current AI breakthrough was the 2021 introduction of OpenAI’s Generative Pre-Trained Transformer (“GPT-3”), one of the largest language models ever trained at 175 billion parameters, that received much attention and set the stage for the late 2022 inflection point of bringing AI to the mainstream. There was great hype around GPT-3 from the very beginning. As Jen-Hsun Huang described at GTC 2021:

*OpenAI’s GPT-3 is 175 billion parameters. That is 3,000 larger in just three years. The applications for GPT-3 are really incredible. Generate document summaries, email phase completion, GPT-3 can even generate Java script and HTML from plain English. Essentially telling AI to write code based on what you wanted to do.*<sup>18</sup>

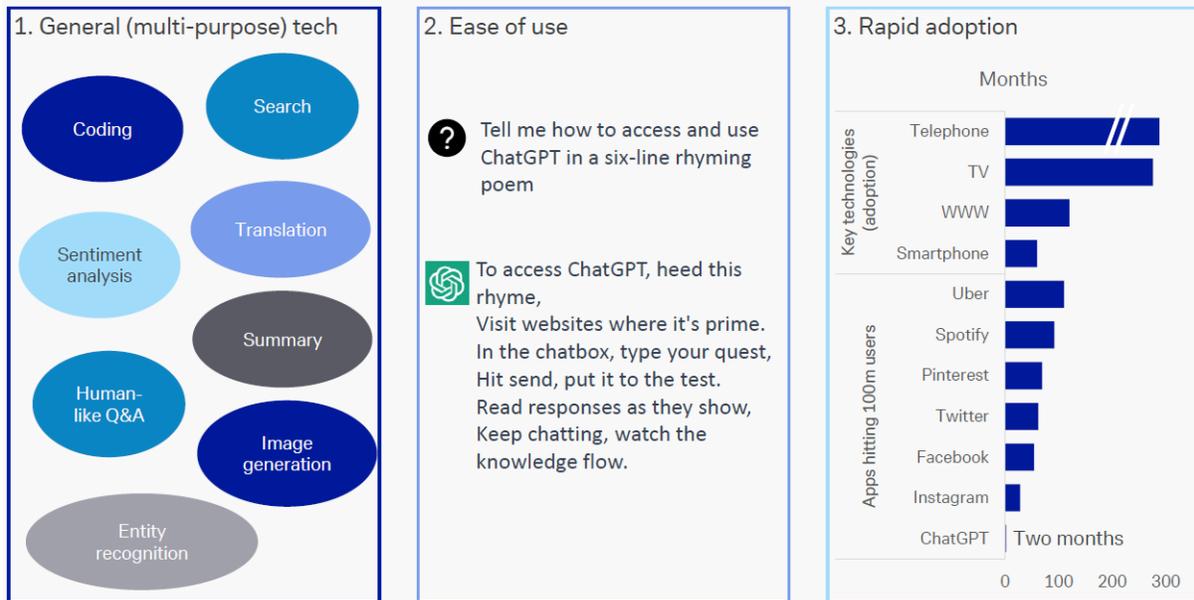
GPT-3 gave rise to the most important recent breakthrough in AI, namely generative AI, which builds models that allow computers to create new content.



**Exhibit 72.** *OpenAI’s Contribution in Focus, source Microsoft.*

ChatGPT, released at the end of November 2022, quickly became one of the most viral technologies of the year. ChatGPT was created by OpenAI as a conversational AI or chatbot. It is a generative AI based on the large language model (LLM) called GPT-3.5, a fine-tuned, more intuitive version of GPT-3 refined through reinforcement learning from human feedback (RLHF). As noted above, GPT-3 is one of the largest language models ever trained at 175 billion parameters. ChatGPT is a smaller, more condensed version of GPT-3.5 and includes an additional layer of safety guardrails for users. It was trained the last few years on large amounts of data, 300 billion words or 570GB from the internet through 2021, including Wikipedia, social media and news articles.

The game changer for ChatGPT was its free-to-use, open-source model, with a user-friendly UI, reminiscent of iMessage or WhatsApp. This makes it well suited for mass distribution and has enabled the widespread adoption and creative explosion on ChatGPT to date. In fact, ChatGPT reached its first one million users in five days, versus three months for Instagram and three and a half years for Netflix. Users write questions or prompts, and ChatGPT responds in an intelligent, uncannily human-like manner on any topic that the user wants and even writes poems, essays, songs, code, and witty jokes. In other words, it is a mass market, general purpose, sophisticated chatbot that can write like a human.



**Exhibit 73.** *What Is Special About Generative AI?*, source Deutsche Bank.

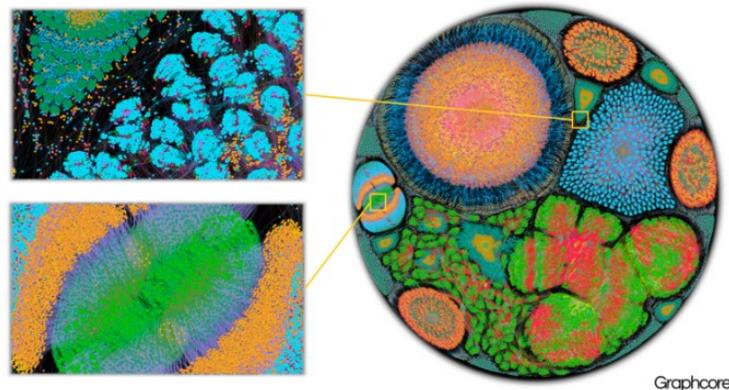
To highlight the dramatic advances of the last few years, in another breakthrough moment, researchers at Alphabet developed the world's first trillion parameter model, T5-XXL, a language model with 1.6 trillion parameters. Also, on June 1, 2021, China announced Wu Dao 2.0 ("Wu Dao" means enlightenment), a model similar to GPT-3 only 10 times larger: 1.75 trillion parameters! Wu Dao, like the recently introduced Alphabet MUM model, is based on multi-modality, the ability to learn from text, audio, images and video.

Claimed by its own creators to be 10 times more powerful than GPT-3, Wu Dao can not only understand what people say but also create images, sing and paint and will learn code in the future. Hua Zhibing, Wu Dao's virtual female child, is reportedly showing signs of relational reasoning and emotional interaction, providing hope that "the virtual girl will have a higher EQ and be able to communicate like a human".<sup>19</sup> Although much of this still needs to be proven, we currently believe there is now a path towards using mega-models to conquer human cognition.



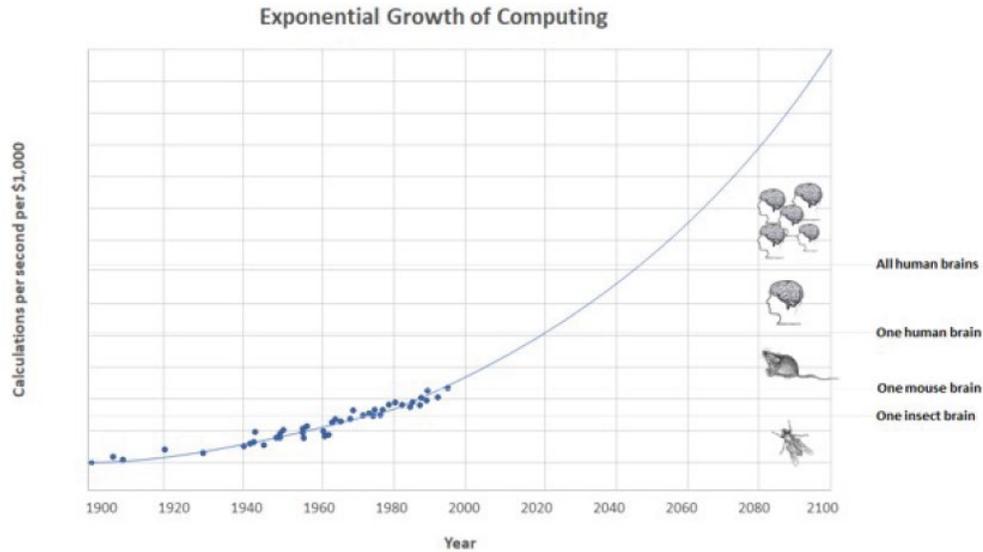
**Exhibit 74.** *Human Mind, source Getty.*

To visualize the incredible potential of next generation AI applications, it is instructive to look at the computational graph of a machine learning system – this is a representation of the model the system builds. AI startup Graphcore has published an amazing set of images of the computational graphs mapped to its machine learning system, which strikingly look much like a brain scan.<sup>20</sup>



**Exhibit 75.** *Example of a Machine Learning Model Used in Data Analysis, source Graphcore.*

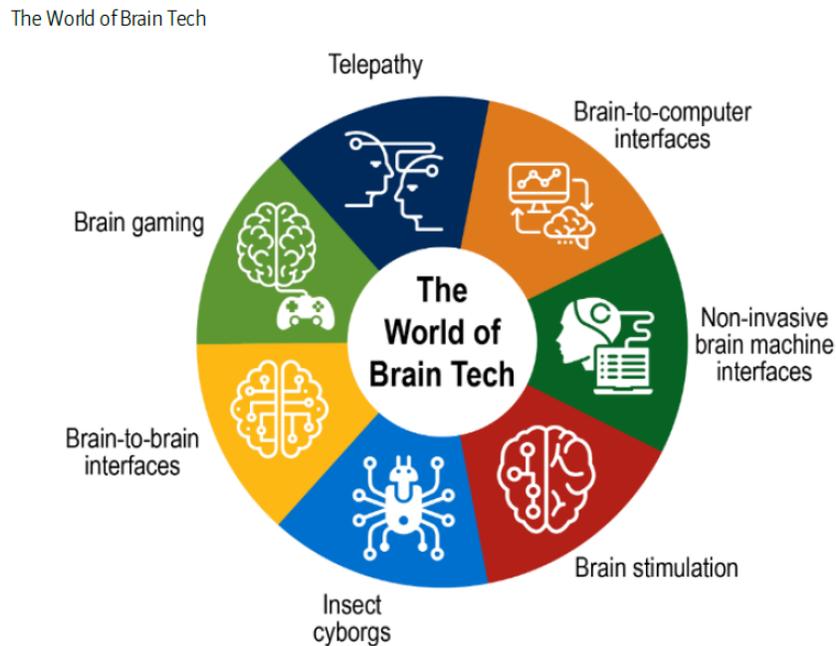
These breakthrough developments in image and speech recognition, conversational AI and AutoML –over just the last couple of years–, are now about to fundamentally change our relationship with machines and computers forever, as computers begin to learn our language and understand what we see and hear.



**Exhibit 76.** *Computing Power Roadmap, source Ray Kurzweil and Morgan Stanley.*

“As that happens the human-computer interface [will] no longer exist. We will become the interface. We will talk to computers and they will talk back. We [will] see information directly in our eyes. The new form factor is VR/AR.”<sup>21</sup>

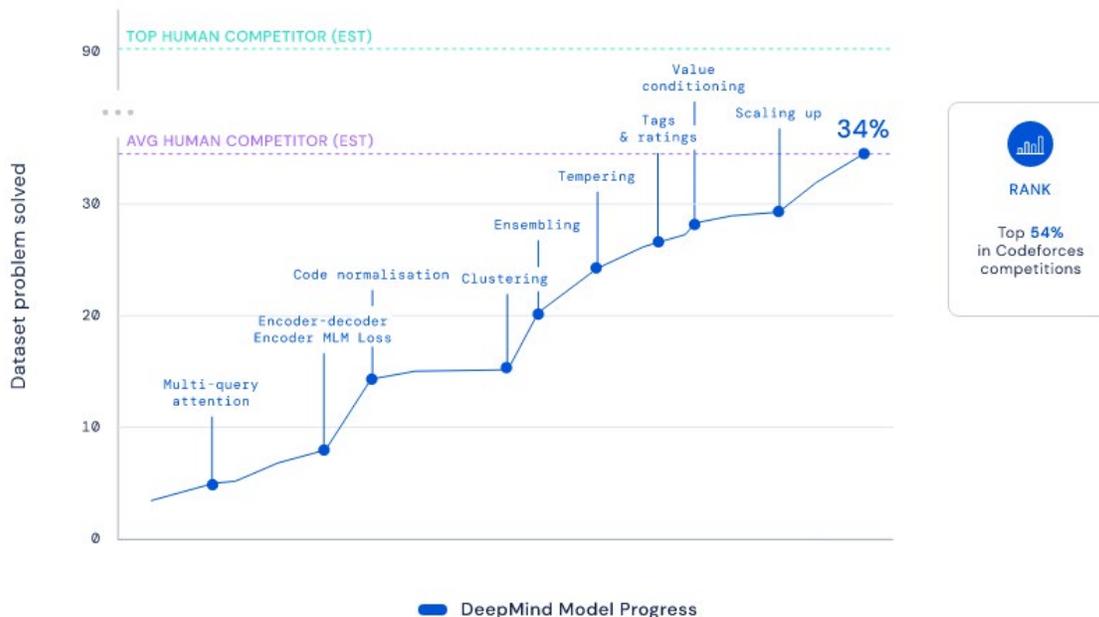
As AI slowly becomes more intelligent than the human mind, advances in brain technologies could make the communication between machines and humans seamless. Ultimately, the distinction between the physical mind and the digital mind may not even exist.



**Exhibit 77.** *Advances in Brain Technology, source BofA Global Research.*

We recently entered an era in which writing code becomes automated, moving rapidly to the stage where AI will write the majority of computer code. Essentially, you tell AI what to do, and it will write the code.

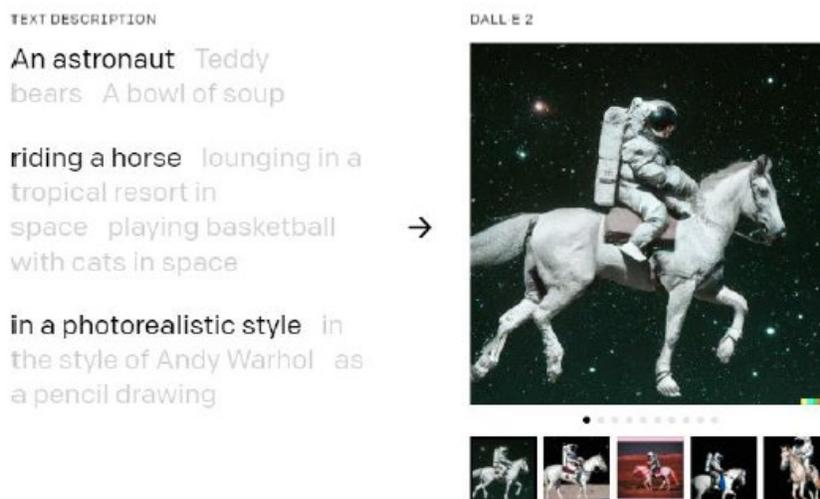
In 2022, AI surpassed the average programmer (top 54<sup>th</sup> percentile) in competitive coding. AlphaCode writes competitive computer programs, generating code using a transformer model, similar to language translation tasks. This requires critical analysis, creative problem solving, using NLP, code and so on.



**Exhibit 78.** DeepMind Model Progress, source Google.

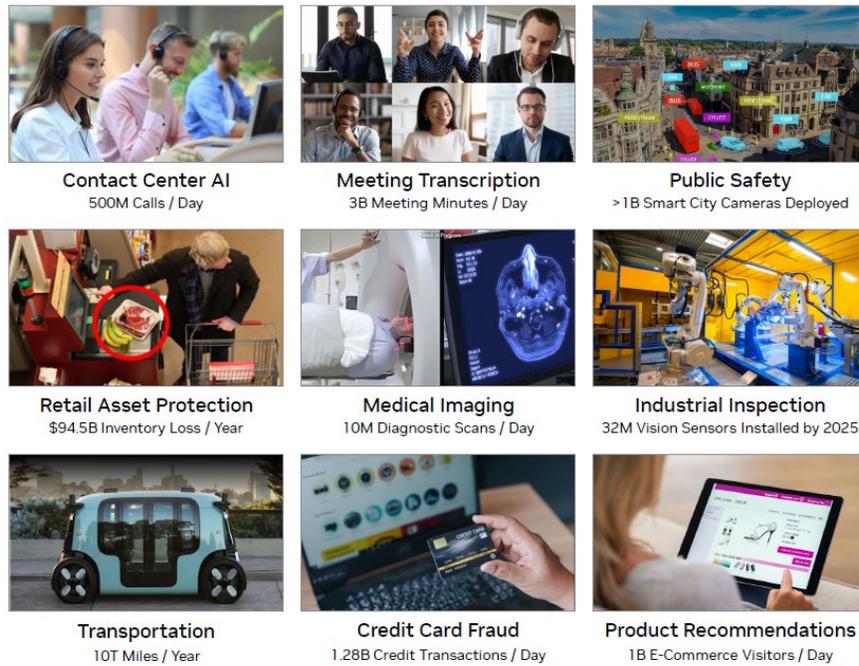
In summary, 2022 was a pivotal year in which AI went mainstream. In particular, generative AI hit a major inflection point in 2022, giving rise to Creative AI.

Creative AI uses AI to generate original content, including images, video, and speech. For example, AI imaging technology (through AI systems DALL-E 2 and Imagen) has been able to create original, realistic images from a text description. This will unlock faster, cheaper, more personalized content at scale.



**Exhibit 79.** OpenAI – DALL-E 2, source Credit Suisse.

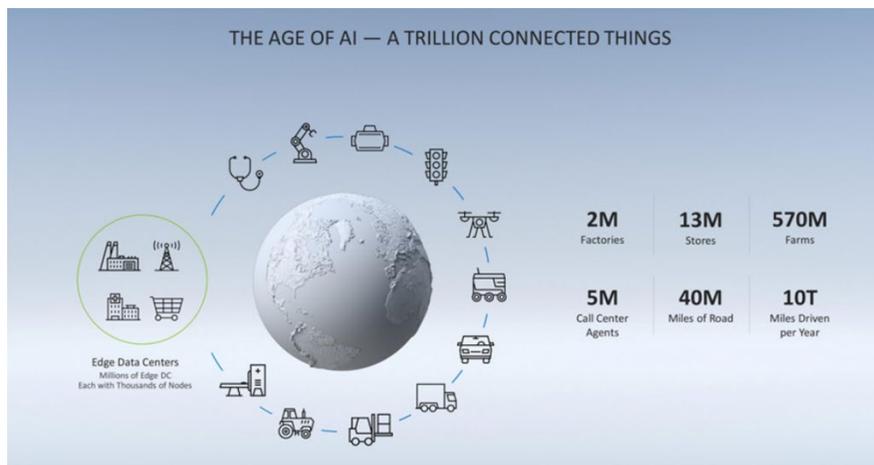
AI may be the greatest technological innovation of our time, and it is fundamentally redefining the boundaries of human intelligence, analysis, planning and creativity. For businesses, this means fundamentally changing how the world's largest industries operate.



**Exhibit 80.** *AI Is the Greatest Technology Force of Our Time, source Nvidia.*

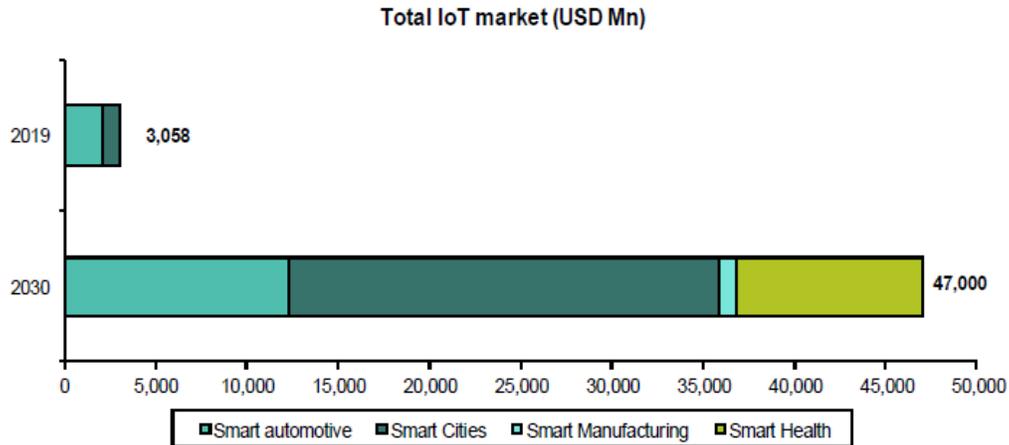
*"AI is quite possibly the most important – and best – thing our civilization has ever created, certainly on par with electricity and microchips, and probably beyond those." Marc Andreessen, General Partner of Andreessen Horowitz*

And although AI is attracting most of the media headline attention, the underlying foundational components of this upcoming Fourth Industrial Revolution, such as 5G and IoT applications, are fundamentally equally important.



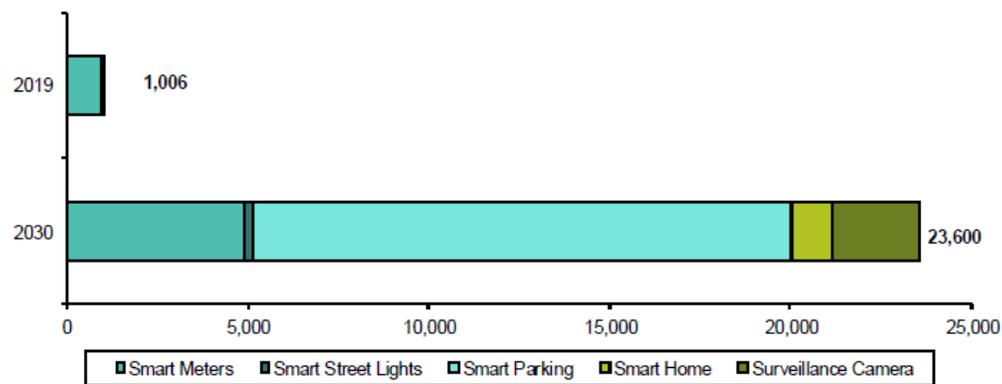
**Exhibit 81.** *The Age of AI, a Trillion Connected Objects, source Nvidia.*

As such, newly formed applications on top of this new powerful physical layer will be sizable – and are growing rapidly. For example, by 2030, the size of the US IoT market is expected to grow fifteen-fold relative to 2019.



**Exhibit 82.** *Estimated US IoT Market Growth, July 2020, source Bernstein.*

Importantly, carriers, which are now aggressively building 5G networks, have a strong economic incentive to support and promote advanced commercial applications. For example, smart city projects can allow carriers in the US to increase revenues almost twenty-four times over the coming years.



**Exhibit 83.** *Estimated Smart City Revenue Contribution, Millions, July 2020, source Bernstein.*

5G is expected to also transform another huge end market, namely logistics, from driverless long-haul transportation, to last-mile delivery robots, to smart delivery boxes, to IoT-5G-assisted sorting centers and fully automated warehouses. In China, companies like Alibaba and JD Logistics are already building intelligent 5G-enabled logistics parks.



**Exhibit 84.** *JD Logistics using 5G in Warehousing and Last-Mile Logistics, source Bernstein.*

Our most recently published quarterly letter provides an in-depth analysis of this broad-based wave of technological innovation, which is about to redefine the way we work, live and interact.

In closing, we remain the largest investors in the strategy and have our interests aligned with those of our limited partners.

Sincerely,

Alkeon Capital Management Investment Team

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<sup>1</sup> Alkeon Growth Partners, LP (AGP) is one of the original feeder funds into Alkeon Growth Master Fund, Ltd. You may be invested in a different feeder fund that also feeds into that master fund. Performance data presented above is on a fund level and reflects AGP performance, net of actual fees and expenses. AGP commenced operations in January 2003, and investors in AGP are generally subject to a 20% incentive allocation and management fees ranging from 1.25% to 2% depending on the series of interests they hold in AGP. Certain AGP investors (such as Alkeon affiliates) have been or are entitled to management fee and/or performance allocation waivers and have at times constituted, and may constitute in the future, a significant portion of AGP's assets. Therefore, AGP's fund-level returns generally are higher than the performance shown herein for the Alkeon Growth Strategy ("AGS"), whose investors have not received such waivers. In addition, the historical fund-level performance for AGP incorporates various fee classes, some of which are subject to lower fees than the highest fee classes currently offered. Therefore, investors in AGP likely would have experienced lower returns than those shown herein if they were subject to the current highest fee classes during all time periods.

<sup>2</sup> Performance data is from another investment vehicle which is managed substantially pari-passu to AGP and follows substantially the same investment strategy (the "Alkeon Growth Strategy" or "AGS") as AGP and other Alkeon-managed vehicles using the Alkeon Growth Strategy. The other investment vehicle's performance represents the longest track record available for the Alkeon Growth Strategy with an inception date of January 5, 1998 (MSCI data is as of January 1, 1998) and reflects the deduction of the vehicle's actual fees and expenses during the period shown, including the deduction of a 20% incentive fee and a 1% management fee charged to investors prior to March 1, 2004, a 1.5% management fee charged to new investors beginning March 1, 2004 and a 1.75% management fee charged to all investors beginning July 1, 2011. The performance shown above for AGS would have been lower had AGS been subject to the highest management fee share class available to AGP investors. Takis Sparaggis, Alkeon's Chief Investment Officer and the primary portfolio manager of the other investment vehicle, was employed by CIBC Oppenheimer Corp. from January 1998 through June 1999, and by CIBC World Markets Corp. from June 1999 through December 2001, and was the portfolio manager of the other investment vehicle at all times during that period. Effectively January 1, 2002, Mr. Sparaggis formed Alkeon, which has continued managing the other investment vehicle's portfolio since that time. While AGP is managed substantially pari-passu using the Alkeon Growth Strategy, performance may vary between AGP, the other investment vehicle and other Alkeon-managed funds using the Alkeon Growth Strategy. Performance results for AGS reflect the returns of the fund as a whole (rather than the returns of a particular investor), and reflect the fund's advisory fees, incentive fees and expenses and include the reinvestment of dividends and income. **Unless otherwise indicated, index returns are presented on a price return basis only – dividends, reinvestment and income are excluded.** The indices are unmanaged and investors cannot invest directly into them. Composite index results are shown for illustrative purposes and do not represent the performance of a specific investment. Please see Important Notes at the end of this letter, including "Comparisons to Indices". Past performance is no guarantee of future results.

<sup>3</sup> Alkeon Growth Partner, LP's exposure estimates are obtained from the Morgan Stanley Performance Measurement (MSPM) System. Unless otherwise indicated, market value exposure is shown. Please see Important Notes at the end of this letter, including "Gross and Net Exposure". Number of positions is calculated on an issuer basis.

<sup>4</sup> Performance against the market measured by the largest 750 stocks in the U.S. by market capitalization as well as any S&P 500 stocks not already included. "Big Growers" are the top 75 high growth profile stocks as ranked by Empirical Research.

<sup>5</sup> SaaS and High Growth Internet constituents defined by Morgan Stanley and JP Morgan, respectively.

<sup>6</sup> Exclusive of the premium paid for related options. References herein to top five portfolio investments are to the portfolio's top five long positions by issuer (measured by "dollars-at-risk") as of December 31, 2024.

<sup>7</sup> Data from Fund inception (January 2003) through the most recent month end. "Dollars-at-risk" exposure represents the market value exposure to an issuer, i.e., the cash equity market value plus the market value of the premium paid for any direct options exposure to the issuer (if any).

<sup>8</sup> "Magnificent Seven" stocks include Apple, Amazon, Alphabet, Meta, Microsoft, Nvidia and Tesla.

<sup>9</sup> Morgan Stanley, October 2023.

<sup>10</sup> References to specific companies are for illustrative purposes only. While some of these are Alkeon investments as of the date of this letter, Alkeon investments are subject to change, and their inclusion in the letter was not based on investment performance. An investment in any referenced company is speculative and may lose value, and no assumption should be made that an investment by Alkeon was or will be profitable.

<sup>11</sup> Based on Alkeon analysis and opinion as of the date of this letter. For illustrative purposes only. Logos listed above as examples only and do not necessarily represent Alkeon investments. *See also* Endnote 10.

<sup>12</sup> GTC 2021 Nvidia Keynote.

<sup>13</sup> Hunter Lightman, member of technical staff at OpenAI.

<sup>14</sup> Noam Brown, research scientist at OpenAI.

<sup>15</sup> Will Depue, OpenAI employee.

<sup>16</sup> <https://analyticsindiamag.com/soon-everyone-will-own-a-robot-like-a-car-or-phone-today/> and <https://interestingengineering.com/innovation/robots-musk-in-homes>.

<sup>17</sup> <https://www.figure.ai/master-plan#the-present>.

<sup>18</sup> GTC 2021 Nvidia Keynote.

<sup>19</sup> <http://en.people.cn/n3/2021/0607/c90000-9858374.html>.

<sup>20</sup> <https://www.graphcore.ai/blog/what-does-machine-learning-look-like>.

<sup>21</sup> Bernstein, April 2017.

# Appendix



User

Let  $n$  be an even positive integer. Let  $p$  be a monic, real polynomial of degree  $2n$ ; that is to say,

$$p(x) = x^{2n} + a_{2n-1}x^{2n-1} + \dots + a_1x + a_0$$

for some real coefficients  $a_0, \dots, a_{2n-1}$ .

Suppose that  $p\left(\frac{1}{k}\right) = k^2$  for all integers  $k$  such that  $1 \leq |k| \leq n$ .

Find all other real numbers  $x$  for which  $p\left(\frac{1}{x}\right) = x^2$ .

...(thinking)



OpenAI  
o1-preview

To solve this problem, we need to find all real numbers  $x$  such that

$$p\left(\frac{1}{x}\right) = x^2,$$

where  $p$  is a monic real polynomial of degree  $2n$ , and it is given that

$$p\left(\frac{1}{k}\right) = k^2$$

for all integers  $k$  with  $1 \leq |k| \leq n$ .

## Understanding the Given Information:

- Given Data Points:** We have  $2n$  data points from  $k = \pm 1, \pm 2, \dots, \pm n$ , which provide the values  $p\left(\frac{1}{k}\right) = k^2$ .
- Polynomial Function:**  $p(x)$  is monic of degree  $2n$ , which means its highest-degree coefficient is 1.

## Defining a New Polynomial:

Let's define a new function

$$q(x) = p\left(\frac{1}{x}\right) - x^2.$$

Our goal is to find all real solutions to  $q(x) = 0$ .

To solve this problem, we need to find all real numbers  $x$  such that

$$p\left(\frac{1}{x}\right) = x^2,$$

where  $p$  is a monic real polynomial of degree  $2n$ , and it is given that

$$p\left(\frac{1}{k}\right) = k^2$$

for all integers  $k$  with  $1 \leq |k| \leq n$ .

## Understanding the Given Information:

- Given Data Points:** We have  $2n$  data points from  $k = \pm 1, \pm 2, \dots, \pm n$ , which provide the values  $p\left(\frac{1}{k}\right) = k^2$ .
- Polynomial Function:**  $p(x)$  is monic of degree  $2n$ , which means its highest-degree coefficient is 1.

## Properties of $q(x)$ :

- Since  $p$  is a polynomial of degree  $2n$ ,  $p\left(\frac{1}{x}\right)$  can be expressed in powers of  $x$ .
- The function  $q(x)$  has zeros at  $x = \pm 1, \pm 2, \dots, \pm n$  because  $q(k) = p\left(\frac{1}{k}\right) - k^2 = 0$ .

## Constructing $s(x)$ :

Consider the polynomial

$$s(x) = x^{2n}q(x) = x^{2n}\left(p\left(\frac{1}{x}\right) - x^2\right).$$

Multiplying through by  $x^{2n}$  eliminates denominators, making  $s(x)$  a polynomial.

## Factoring $s(x)$ :

We know that  $s(x)$  has roots at  $x = \pm 1, \pm 2, \dots, \pm n$ . Therefore,  $s(x)$  can be expressed as:

$$s(x) = m(x)h(x),$$

where  $m(x) = \prod_{k=1}^n (x^2 - k^2)$  is a monic polynomial of degree  $2n$  whose roots are  $\pm 1, \pm 2, \dots, \pm n$ , and  $h(x)$  is a quadratic polynomial.

## Determining $h(x)$ :

We consider  $h(x)$  to be a quadratic polynomial:

$$h(x) = -x^2 + c,$$

where  $c$  is a constant to be determined.

## Matching Coefficients:

- The leading term of  $s(x)$  is  $-x^{2n+2}$ .
- The leading term of  $m(x)h(x)$  is  $(x^{2n})(-x^2) = -x^{2n+2}$ , ensuring the degrees match.
- Comparing the constant term of  $s(x)$  using  $x = 0$ :

$$s(0) = p^{(0)} \cdot 0 = 1, \text{ where } p^{(x)} = x^{(2n)} \\ p\left(\frac{1}{x}\right) = x^{(2n)}$$

- For  $n$  even (since  $n$  is even),  $(-1)^n = 1$ , so  $c > 0$ .

## Finding Additional Solutions:

Solving  $h(x) = 0$ :

$$-x^2 + c = 0 \implies x^2 = c \implies x = \pm \frac{1}{n},$$

since  $c = \frac{1}{n^2}$ .

## Conclusion:

The additional real numbers  $x$  satisfying  $p\left(\frac{1}{x}\right) = x^2$  are  $x = \pm \frac{1}{n}$ .

Exhibit 85. Chain of Thought – Math Example, September 2024, source OpenAI.



User

Write a bash script that takes a matrix represented as a string with format '[1,2],[3,4],[5,6]' and prints the transpose in the same format.



OpenAI  
o1-preview

So the user is requesting a bash script that can take a string representing a matrix, such as '[1,2],[3,4],[5,6]' and output its transpose, in the same format.

Let's first understand the input and output formats.

Input: '[1,2],[3,4],[5,6]'  
which corresponds to the matrix:  
1 2  
3 4  
5 6

So the input is a series of rows, each in brackets separated by commas.

The transpose of this matrix would be:

1 3 5  
2 4 6

So the requested output is '[1,3,5],[2,4,6]'

Overall Task:

Write a bash script that takes one argument (the string representing the matrix) and outputs its transpose in the same format.

Ok, let's think about how to parse the input string in bash, build the matrix (probably in arrays), transpose it, and then output the resulting transposed matrix in the expected format.

Constraints:

- Since it's bash, we have to be careful with parsing strings.
- The script should accept the input string as an argument.



OpenAI  
o1-preview

Approach:

- Parse the input string to extract the matrix elements.
- Build the matrix as an array of arrays.
- Transpose the matrix.
- Output the transposed matrix in the same format.

Implementation Steps:

1. Capture input string as argument.
2. Remove any spaces (if any).
3. Parse the input string to extract numbers into arrays.
  - Since the input is in the format '[1,2],[3,4],[5,6]', we can:
  - Remove outer brackets if necessary.
  - Split the string by ']' to get each row.
  - For each row, remove '[' and ',', then split by ',' to get elements.
4. Build a 2D array in bash (arrays containing arrays).
  - Since bash arrays are one-dimensional, we need to simulate 2D arrays.
5. Transpose the matrix.
  - For transposing, we'll need to switch rows and columns.
6. Output the transposed matrix in the required format.
  - Reconstruct the output string in the format '[1,3,5],[2,4,6]'



OpenAI  
o1-preview

Now, start coding step by step.

Under potential issues:

- Bash does not have multi-dimensional arrays natively, so we need to simulate.
- We need to handle numbers that can be more than one digit.

Let me try coding the bash script step by step...(code)

Exhibit 86. Chain of Thought – Coding Example, September 2024, source OpenAI.

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The performance results for all funds shown above are net of fees and expenses. Those results may not correspond to the results of the other funds that Alkeon manages using similar strategies or the results of a specific investor due to differences in, for example, the timing of investor cash flows, different levels of management fees or performance-based fees and each fund's other expenses.

References to strategy performance data (the "Alkeon Growth Strategy" or "AGS") is from another investment vehicle which is managed substantially pari-passu to Alkeon Growth Partners, LP ("AGP") and follows substantially the same investment strategy as AGP. The other investment vehicle's performance represents the longest track record available for the Alkeon Growth Strategy with an inception date of January 5, 1998 (MSCI data is as of January 1, 1998) and, unless otherwise indicated, reflects the deduction of the vehicle's actual fees and expenses during the period shown, including the deduction of a 20% incentive fee and a 1% management fee charged to new investors prior to March 1, 2004, a 1.5% management fee charged to investors beginning March 1, 2004 and a 1.75% management fee charged to all investors beginning July 1, 2011. Takis Sparaggis, Alkeon's Chief Investment Officer and the primary portfolio manager of the other investment vehicle, was employed by CIBC Oppenheimer Corp. from January 1998 through June 1999, and by CIBC World Markets Corp. from June 1999 through December 2011, and was the portfolio manager of the investment vehicle at all times during that period. Effective January 1, 2002, Mr. Sparaggis formed Alkeon, which has continued managing the investment vehicle's portfolio since that time. AGP commenced operations in January 2003, and it is subject to a 20% incentive fee and management fees ranging from 1.25% to 2% depending on the series of interests AGS performance referenced above may have been lower during certain periods had it been subject to similar fees as the Fund.

Calculation of Estimated Performance. The estimated performance results above for recent period ends were prepared by Alkeon and have not been compiled, reviewed or audited by an independent accountant. Alkeon based the performance results for prior years on audited financial statements for those years, but the information for recent, unaudited periods has not been audited and actual final results could vary materially. The performance results reflect each fund's returns as a whole (rather than the returns of a particular investor) and, for recent period ends, reflect estimates of that fund's advisory fees, incentive fees/allocations and expenses. Investors in AGP and AGS would have experienced lower returns than those shown herein if they were subject to the current highest fee classes during all time periods. Additionally, Certain AGP investors (such as Alkeon affiliates) have been or are entitled to management fee and/or performance allocation waivers and have at times constituted, and may constitute in the future, a significant portion of AGP's assets. Therefore, AGP's fund-level returns generally are higher than the performance shown herein for AGS, whose investors have not received such waivers. The results also reflect the reinvestment of dividends and income and a fund's profits or losses from new issues. All investors may not be eligible to be allocated such profits/losses. For more detailed historical performance information for a particular fund please contact Keith Davey at Alkeon at 212-716-6585 or [kdavey@alkeoncapital.com](mailto:kdavey@alkeoncapital.com). THE INFORMATION PROVIDED IS HISTORICAL AND SHOULD NOT BE TAKEN AS AN INDICATION OF FUTURE PERFORMANCE. The information contained herein has been obtained by sources believed to be accurate, but Alkeon makes no guarantee as to the accuracy or completeness thereof.

Portfolio Projections and Estimates. This communication includes references to certain portfolio and market projections and estimates. Such metrics have been prepared by Alkeon in a manner it deems to be reasonable and may exclude certain issuers where it believes there inclusion may be misleading or otherwise inappropriate for the specific calculation. **PAST PERFORMANCE IS NOT A RELIABLE INDICATOR OR GUARANTEE OF FUTURE RESULTS.**

Gross and Net Exposure. Gross exposure equals long exposure plus the absolute value of short exposure. For example, for 100 USD of capital, if a fund is 150 USD long and 50 USD short, it means that gross exposure is 150 + 50 = 200 USD or 200%. Gross exposure is calculated using each position's gross market value as a percentage of the fund's total gross market value. Net exposure is the exposure level of the fund to the market at the present time. It is calculated by subtracting the short percentage from the long percentage. For example, if a fund is 100% long and 25% short, then the net exposure is 75%. Net exposure is calculated using each position's delta-adjusted exposure with currency positions excluded. A position's delta-adjusted exposure represents its market value times delta (the measure of the sensitivity between an option or derivative price and the underlying stock price).

Comparison to Indices. Alkeon believes that, although the Alkeon Funds managed using the Alkeon Growth Strategy are not benchmarked to any index, comparisons to certain indices may be useful in evaluating the performance of the Alkeon Funds. The MSCI World Index captures large and mid cap representation across 23 developed markets countries. With 1,397 constituents, the index covers approximately 85% of the free float-adjusted market capitalization in each country. The MSCI AC World Index captures large and mid cap representation across 23 developed markets and 24 emerging markets countries. With 2,650 constituents, the index covers approximately 85% of the global investable equity opportunity set. The Alkeon Funds' portfolios contain equity securities and may consist of securities issued by companies in different countries with varying capitalizations and fixed income and non-equity investments, including short sales of securities and margin trading, and are not as diversified as the securities (when aggregated) that comprise the MSCI World Index or the MSCI AC World Index. Unlike the performance of the Alkeon Funds, the performance of the MSCI World Index and MSCI AC World Index do not reflect the impact of fees or expenses. **The index performance shown is on a price return basis only - it does not reflect dividends, their reinvestment or other income.** (A price return index is used in light of the Fund's investment strategy, i.e., the Fund has historically received negative dividend income, as the amount of dividends paid out by the Fund on short holdings has exceeded the dividend income received on long holdings historically.) Any such comparison between the performance results of the Alkeon Funds and the MSCI World Index and MSCI AC World Index should not be relied upon as an accurate prediction of future results. Investors cannot invest directly in an index.

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