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The Investment Engineers

Tracking AI in 10 charts

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April 2025

Foreword

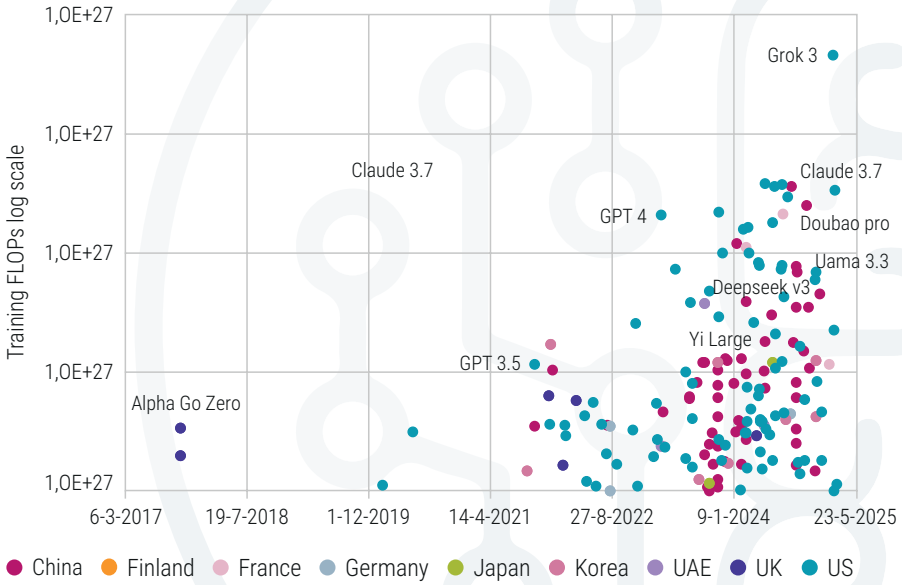
Artificial Intelligence (AI) is revolutionizing industries and reshaping the future of technology. Even as stocks have faltered so far in 2025, global competition has spurred continued investments into new AI models, digital infrastructure, new applications. Notably, speaking at the World Economic Forum in January, Demis Hassabis, CEO of Google DeepMind said the company was on track to submit AI-designed drug candidates into clinical trials this year. More mundanely, but no less impactfully, AI agents are poised to shift from merely answering questions to taking action, as the technology seeks to fulfill its productivity-enhancing promise.

As we delve into the intricacies of AI through ten insightful charts, we aim to provide a comprehensive overview of its current state and future potential. The data presented in these charts not only underscores the transformative power of AI but also serves as a guide for strategic investment decisions. As AI continues to advance, it is crucial for professional investors to stay informed about its trajectory and implications. This collection of charts provides valuable insights into the dynamic world of AI, offering a clear understanding of its current landscape and future potential.

Chart collection by portfolio managers **Daniel Ernst** and **Sam Brasser**

Global AI

Figure 1: Notable AI models by country



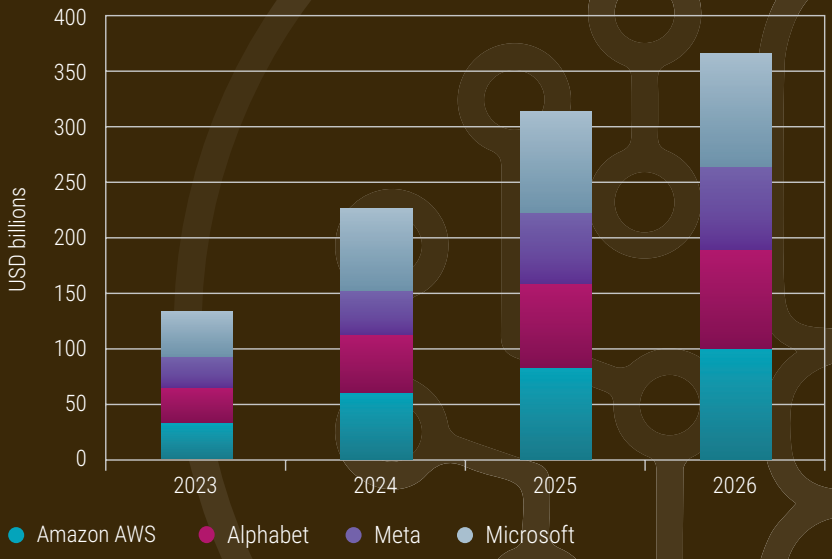
Source: Epoch AI, March 2025

Over the last few years there has been a Cambrian explosion in AI model development. Although OpenAI's ChatGPT was among the first to market, they were not alone. Researchers at Epoch AI have tracked more than 200 notable AI models trained with at least 100 billion trillion (1023) floating point operations (FLOPs). While DeepSeek captured the market's attention earlier this year, there are dozens of competing AI models in China including Doubao, the model created by TikTok parent ByteDance, and Yi, released by AI pioneer Kai-Fu Lee's 01.AI. Similarly in the US, AI models released by large tech firms like Alphabet and Meta compete with startups from Anthropic's Claude to X.AI's Grok. Looking ahead, the AI race is shifting from base models toward applications that make use of this emerging technology.

Expanding AI

"Every cloud has a silicon lining" might be an apt update to the well-known adage. While investors had been concerned that the pace of investment into AI infrastructure might slow down, during earnings calls in the first months of 2025, the largest cloud computing providers raised their outlooks for capital spending this year. The message from Alphabet, Amazon, and Microsoft was consistent, with each company noting that demand for AI and cloud computing services outstripped their capacity to provide them. Morgan Stanley estimates that global cloud computing capital spending will reach USD 353 billion in 2025, a figure that is nearly USD 38 billion greater than their previous estimate. Those investments should provide continued support for a wide range of technology suppliers from Nvidia's AI accelerators to SK Hynix's memory chips.

Figure 2: Cloud computing capital spending trends

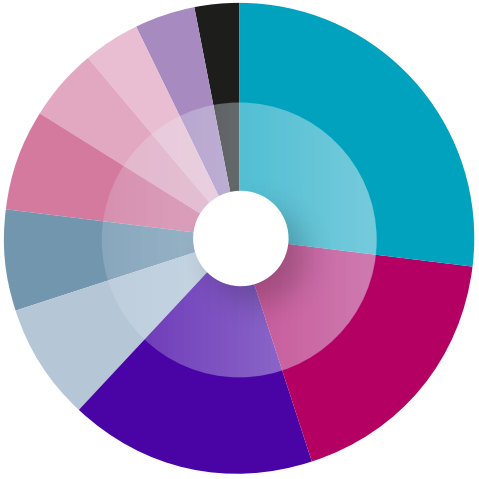


Source: Morgan Stanley, February 2025

Competitive AI

According to a survey by Application Program Interface (API) developer Kong, AI model usage within the enterprise is already making use of the diverse set of model options. Unsurprisingly, OpenAI's GPT models lead the pack, but with 27% share among respondents, it is not the dominant choice. Competitive models from large technology platforms are not far behind with Microsoft's Azure AI taking an 18% share and Google's Gemini holding 17% of the market so far. With AI model development moving rapidly, it is likely shifts in market share are still to come.

Figure 3: Enterprise IT adoption of AI models



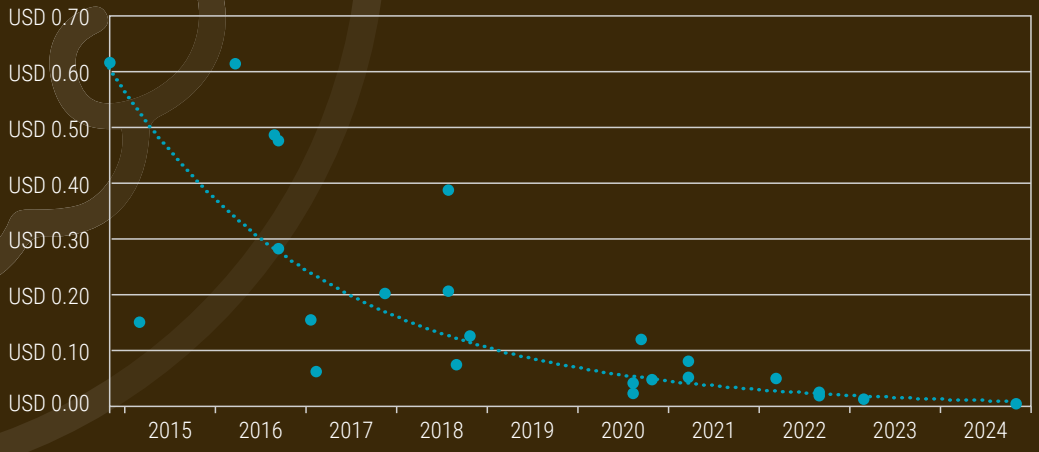
OpenAI GPT	27%
Microsoft Azure AI	18%
Google Gemini	17%
Meta Llama	8%
Amazon Bedrock	7%
Claude	7%
Cohere	5%
Mistral	4%
Other	4%
None	3%

Source: Kong, September 2024

Economic AI

Since DeepSeek's launch in January 2025, the market has been concerned that lower cost technology would undermine the economics of AI models produced by US technology leaders. Although subsequent research has found DeepSeek's cost advantage was highly exaggerated, the trend toward increasingly efficient technology is an industry standard. For instance, over a 30-year period, the cost of a transistor, a solar module, and a lithium-ion battery each fell by more than 99%. The cost of sequencing DNA fell by more than 99% in just a decade between 2003 and 2013. For AI, price improvements are driven by a combination of advances in both software and semiconductors. Although the price of AI-dependent graphical processor units (GPUs) has risen, the amount of data those semiconductors process has jumped exponentially. As a result, the price per floating point operation per second of an Nvidia GPU has also fallen by more than 99% in the last ten years. While the chart of GPU price performance below appears to show slowing progress, even in the last two years the cost of a single calculation has fallen by nearly 75%.

Figure 4: Price per Nvidia GPU floating point operation per second

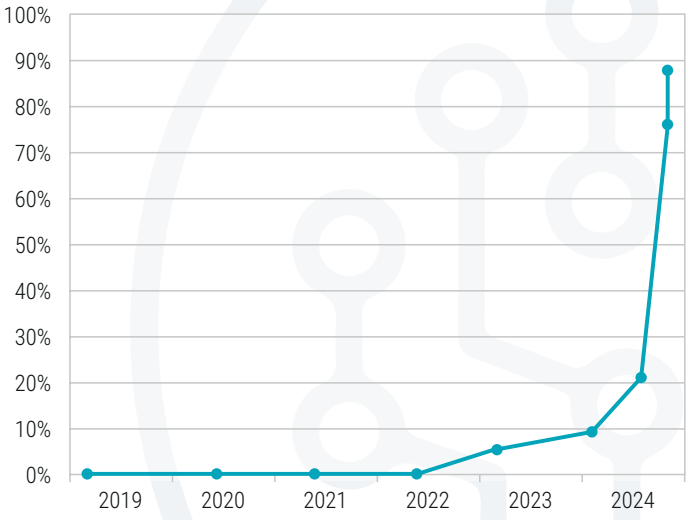


Source: Epoch AI, February 2025

Testing AI

A key goal for AI is to achieve what researchers call 'artificial general intelligence' (AGI). While there is some debate as to what that means, the ARC Foundation (which developed an AGI test) defines the concept as "a system capable of efficiently acquiring new skills and solving novel problems for which it was neither explicitly designed nor trained." Until last year, most AI models scored poorly on ARC's AGI test, but that changed with the release of OpenAI's so-called reasoning models. In September 2024, Open AI's o1 preview model scored 21% on the AGI test, and in December a highly tuned version of their o3 model scored 87.5%. That performance comes at a price, according to ARC, the cost per task of these highly tuned reasoning models approaches USD 20. However, in January DeepSeek released a model that while only scoring 20.5%, apparently achieved that result for a mere USD 0.05 per task.

Figure 5: OpenAI model score on ARC AGI test

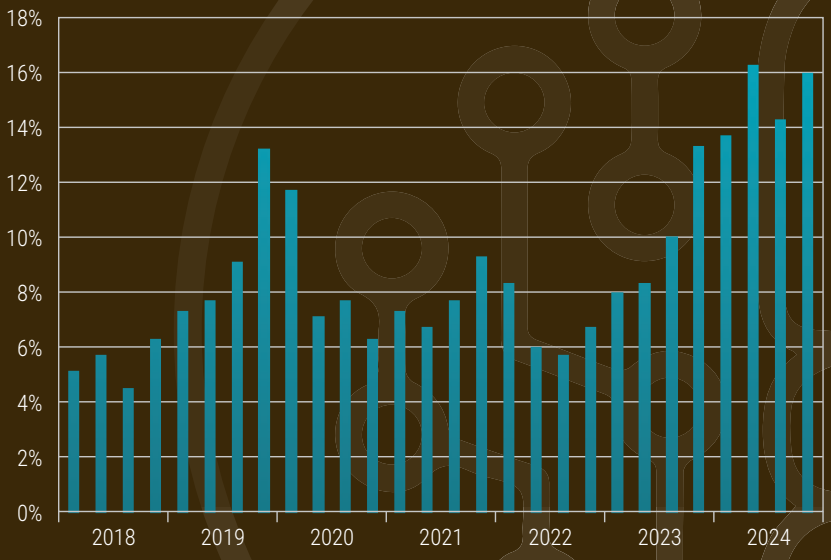


Source: ARC Foundation, December 2024

Prioritizing AI

Amid continued questions concerning the return on investment of AI spending, corporate chief information officers (CIOs) are putting the technology at the top their priority lists. According to Morgan Stanley's 4Q24 CIO survey, 16% of CIOs cite AI as the segment receiving the greatest budget increase in 2025. The survey also noted that security concerns remain top of mind, with 12% of CIOs planning to allocate the largest budget increase to the segment this year. Within AI, applications that enable AI to take action rather than merely answer questions are showing promise. These AI agents are working their way into existing software to automate tasks that often involve data entry or the manual process of integrating information from multiple applications.

Figure 6: CIO prioritization of AI/ML project spend growth

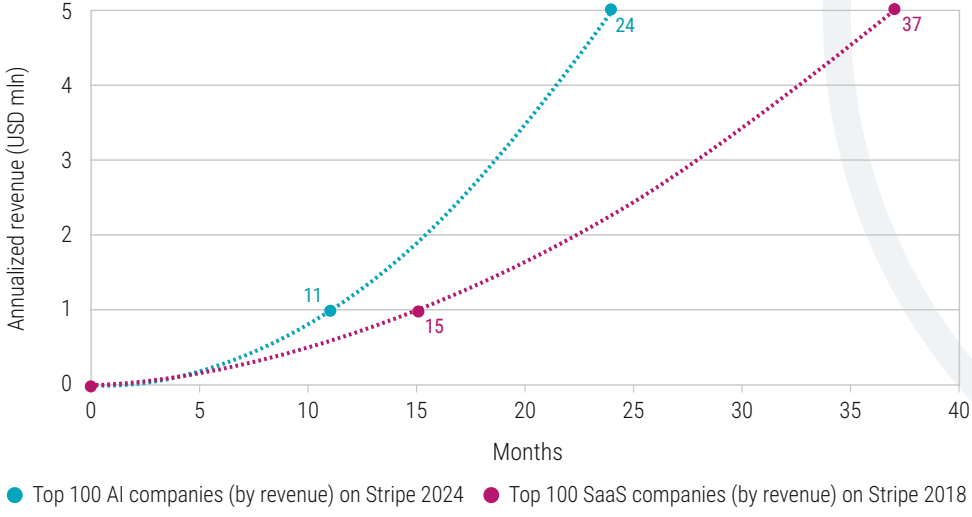


Source: Morgan Stanley, January 2025

Scaling AI

One of the biggest questions facing AI-related companies is the return on investment. Beyond providers of foundational technologies like Nvidia's AI accelerators, and cloud computing services from Amazon, Google and Microsoft, data on AI revenue has been inconsistent. Established enterprise software providers have noted rising adoption, with ServiceNow for instance reporting that 12% of its customer base had begun to employ their Now Assist agent, and Workday reporting that over 30% of customer expansion deals included an AI solution. Encouragingly, it's not only larger tech companies leveraging the technology, but also startups. According to the payments processor Stripe, in 2024, the median time for AI startups to reach annualized revenues of USD 5 million was 24 months, compared to 37 months for Software as a Service (SaaS) startups in 2018.

Figure 7: SaaS and AI startups' median time to annualized revenue milestone

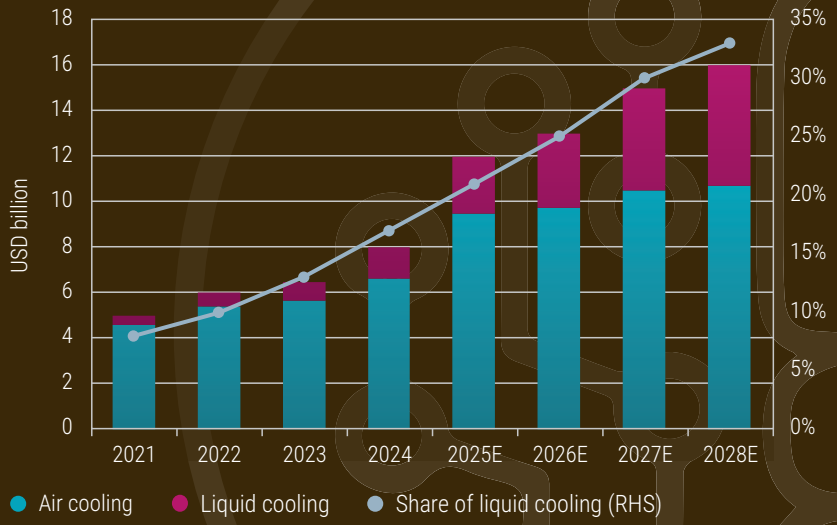


Source: Stripe, February 2025. The value of your investments may fluctuate. Past results are no guarantee of future performance.

Cooling AI

Data centers use both air and liquid cooling to prevent overheating and optimize server performance. But changes in server cooling are needed considering how AI servers have much higher thermal density. Moreover, these AI servers have higher power density, uneven heat distribution and substantial load variations. Air cooling methods are not adequate anymore and a shift to liquid cooling is underway. As AI computing usage increases, the demand for liquid cooling has surged substantially. Technology consultancy firm Omdia forecasts that worldwide data center cooling sales will double from USD 8 billion in 2024 to USD 16 billion in 2028. The share of liquid cooling is forecast to increase from 17% in 2024 to 33% in 2028.

Figure 8: Worldwide revenues of data center cooling methods

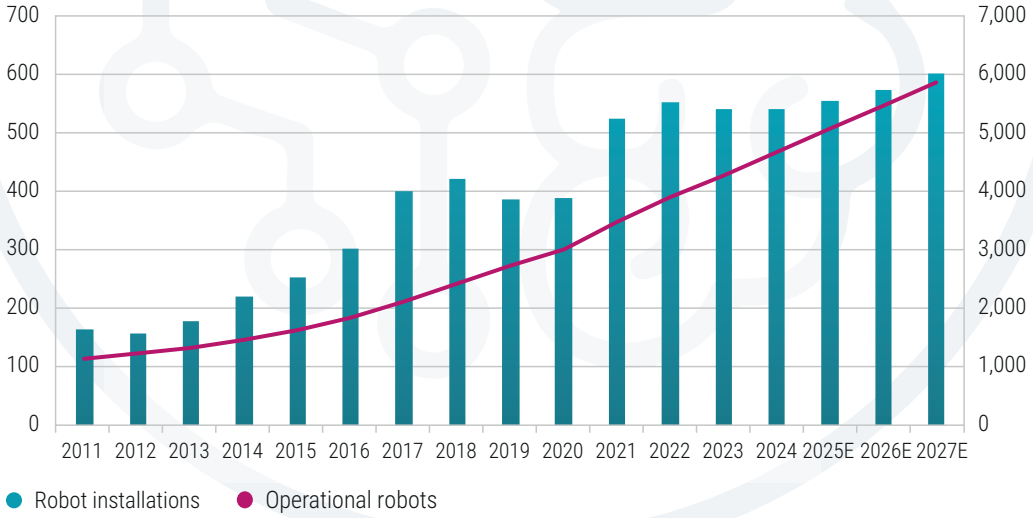


Source: Omdia, October 2024. The value of your investments may fluctuate. Past results are no guarantee of future performance.

Robotic AI

While the steady growth of industrial robotics produces an unexciting chart, behind-the-scenes innovations tell another story. Over the last five years, the global installed base of industrial robots has expanded at an 11.3% CAGR reaching nearly 4.7 million in 2024. Robots are not only getting more plentiful, they are getting smarter too. For instance Google's DeepMind has built a model that enables robots to learn on the job rather than follow pre-programmed instructions. Further, advancements in mechanical engineering are enabling more dexterous and more mobile robotics. CB Insights reports that the venture investment into industrial humanoid robotics tripled in 2024 to USD 1.2 billion. With these trends in mind, Nvidia CEO Jensen Huang, speaking at the Consumer Electronics Show in January, declared robotics as the next 'multi-trillion-dollar' opportunity.

Figure 9: Industrial robot installations and operational installed base

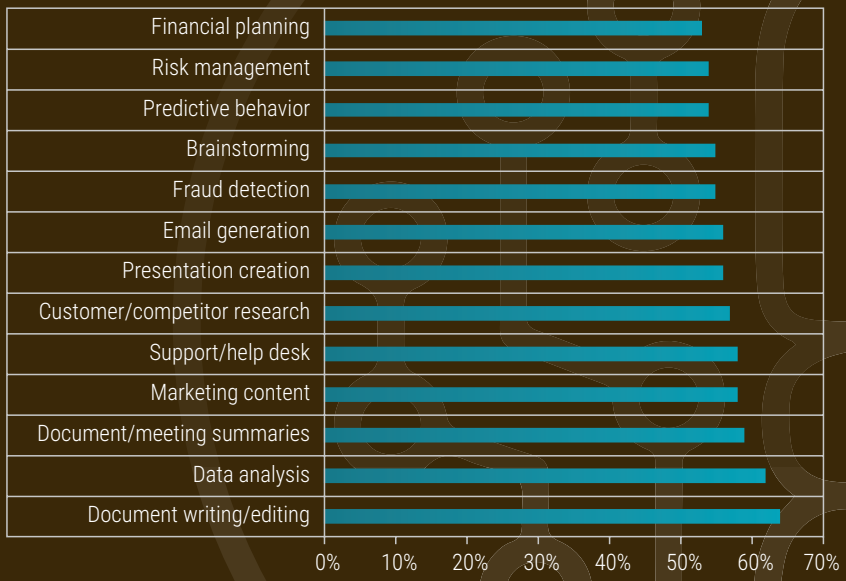


Source: International Federation of Robotics, October 2024

Boring AI

In business there is an old joke of a consultant who borrows your watch to tell you the time, something you could have easily done yourself. Workplace AI tools appear to be following the same playbook. For all the excitement about what the future of AI may hold, and for all the fear about what risks the technology may pose, AI today is very often assisting rather mundane tasks. According to a recent survey published by the Wharton School of Business, weekly users of AI tools in the workplace rose from 37% in 2023 to 73% in 2024. At 64%, the most popular use case for AI in the workplace is the writing and editing of documents or proposals. Building on the previously popular buzzword, 'big data', 62% of survey respondents reporting using AI to help with data analysis. Notably, 94% of purchasing managers reported using AI in 2024, up from 50% last year.

Figure 10: Leading use cases for AI in the workplace



Source: Wharton University, October 2024

Robeco's AI-related strategies

INVESTING IN AI COMPANIES:

Digital Innovations strategy

AI is eliminating slack, accelerating productivity, and reducing costs in diverse sectors. Robeco's Digital Innovations strategy capitalizes on the human ingenuity and technological innovation that are transforming business and reshaping the world around us. It seeks to capture the value creation potential derived from companies supplying foundational technology and enabling the modernization of enterprise and industry.

The investment universe spans a broad range of sectors such as:

- Semiconductors
- computing hardware
- Cloud infrastructure
- cybersecurity
- Software
- Robotics
- Precision engineering
- Information technology services

INVESTING WITH THE HELP OF AI:

Dynamic Theme Machine

The Dynamic Theme Machine is a quantitative thematic strategy that uses artificial intelligence to detect and invest in emerging and established themes. The strategy seeks to capitalize on long-term trends, themes, or macroeconomic developments that are expected to impact the economy, society, and the environment. It rotates through themes, buying attractive ones and selling those in decline.

Some of the leading themes (as per Q1 2025) in this strategy:

- Digital advertising and media streaming
- AI and cloud technologies
- Cancer treatments
- Mental health and neurology
- Biological research and technology

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