COATUE

The AI Revolution

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Coatue

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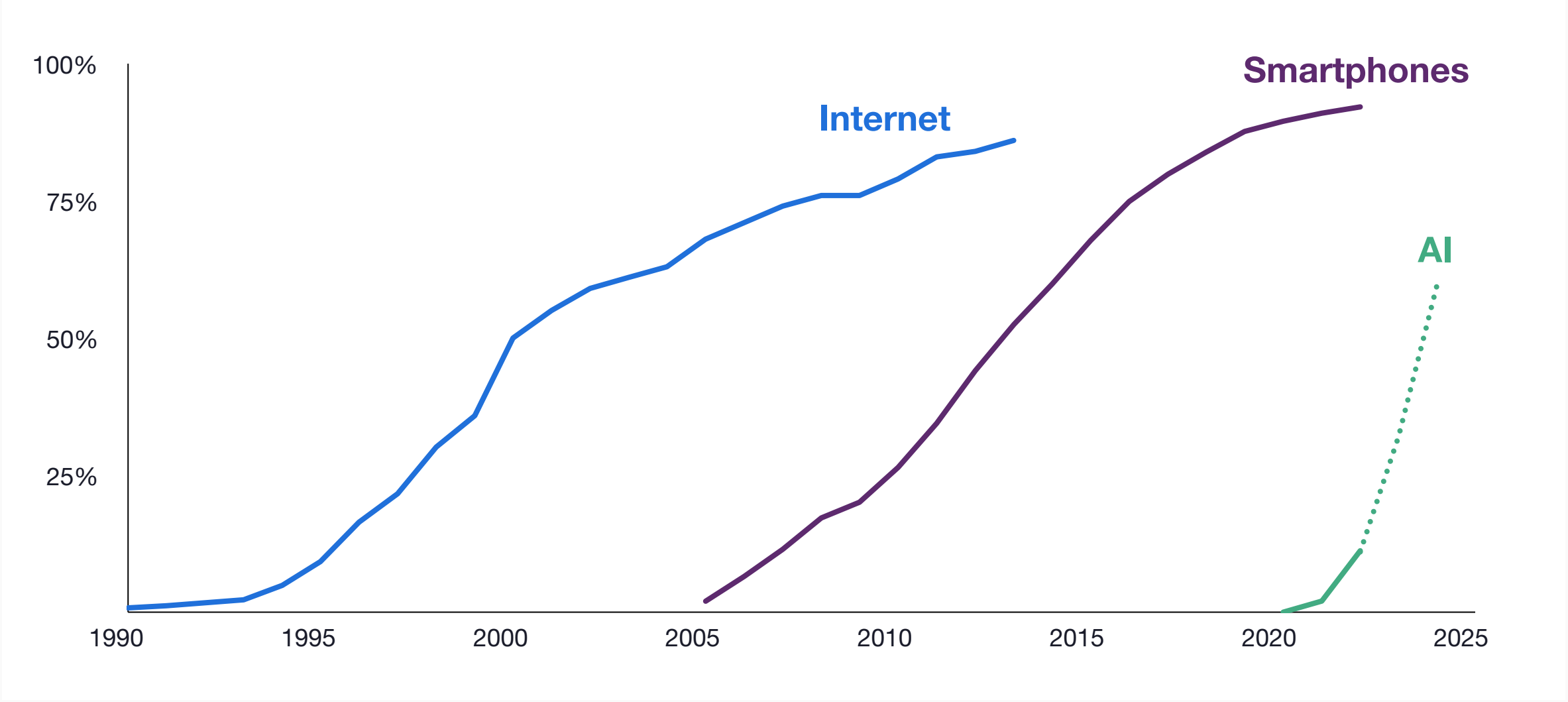
Key Topics

- **Where we are in AI today**
- AI could break through the hype and improve our world
- We believe open-source is the lifeblood of AI
- AI is transforming the tech ecosystem
- Coatue view: the best of AI is yet to come

We're at Day 1 of AI…and riding on top of past waves

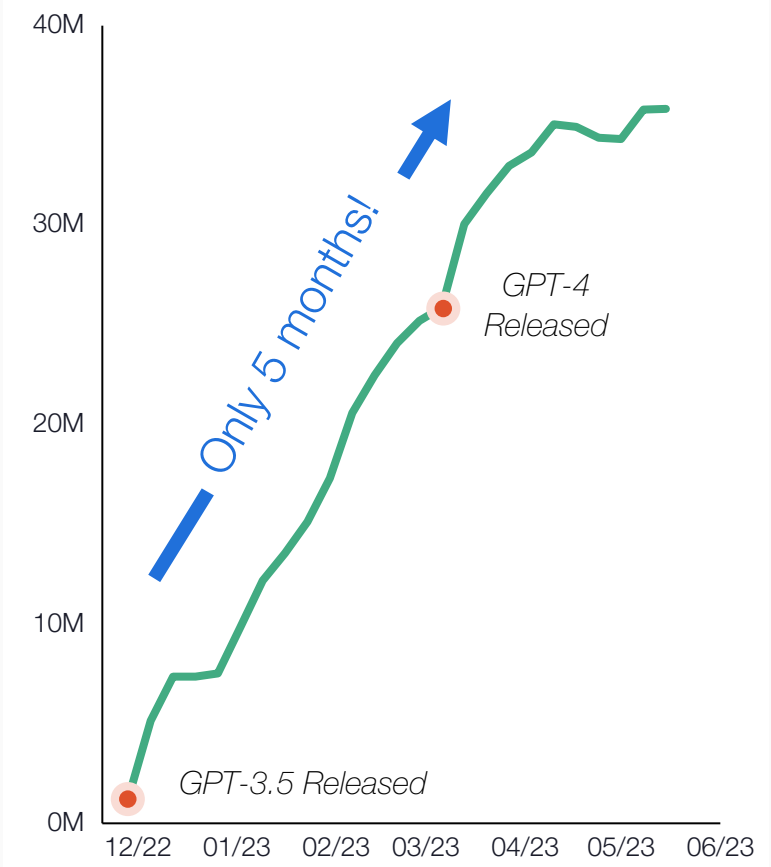
→ **% US Technology Adoption**



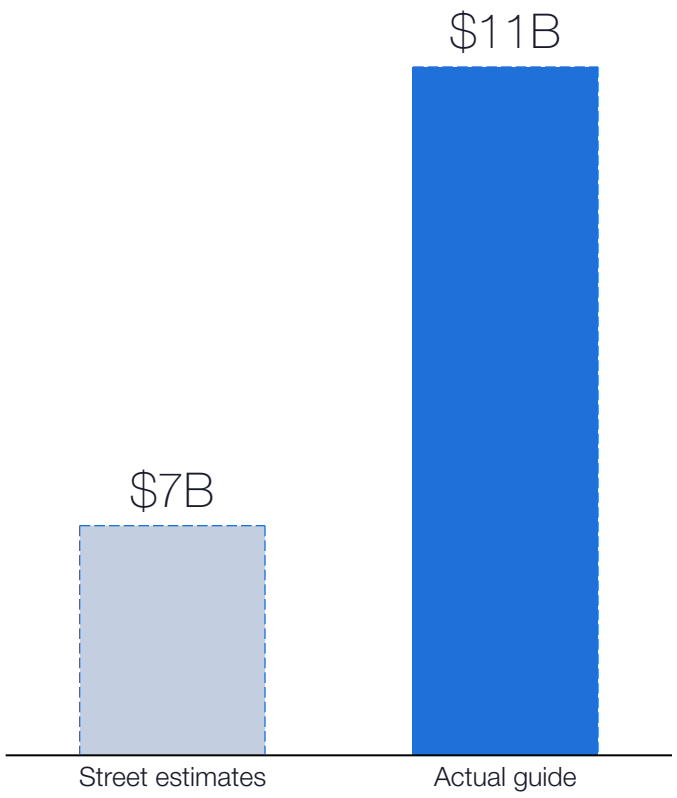
Source: World Bank as of September 2023, Statista as of September 2023, Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

In the first half of 2023, the AI ecosystem exploded! (1/2)

⟶ ChatGPT weekly unique visits



⟶ NVDA 2Q Earnings

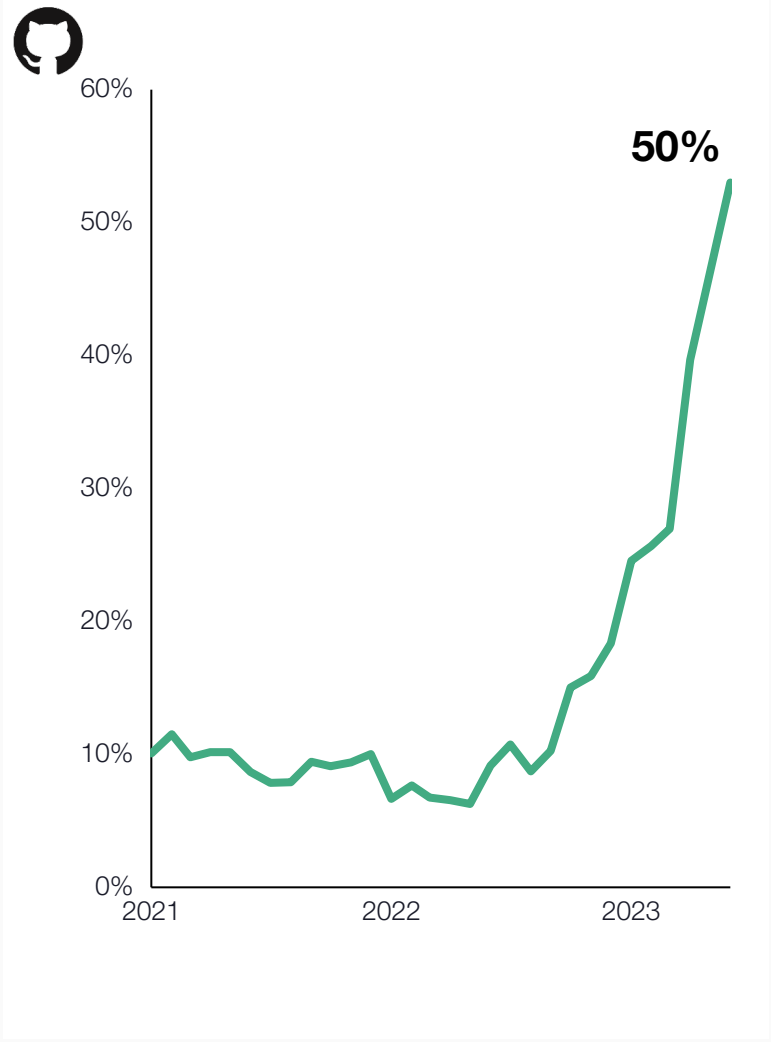


⟶ AI Basket Performance YTD

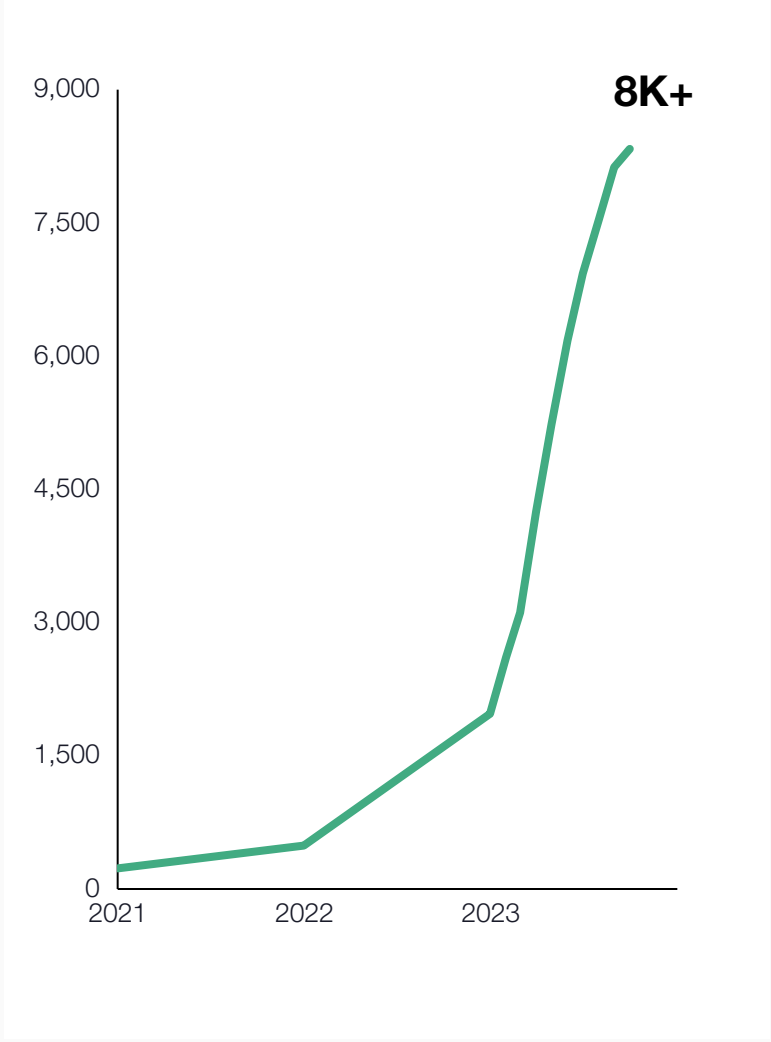
Source: Bloomberg; Coatue opinion and analysis as of October 2023. AI Basket represents GS's AI basket. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

In the first half of 2023, the AI ecosystem exploded! (2/2)

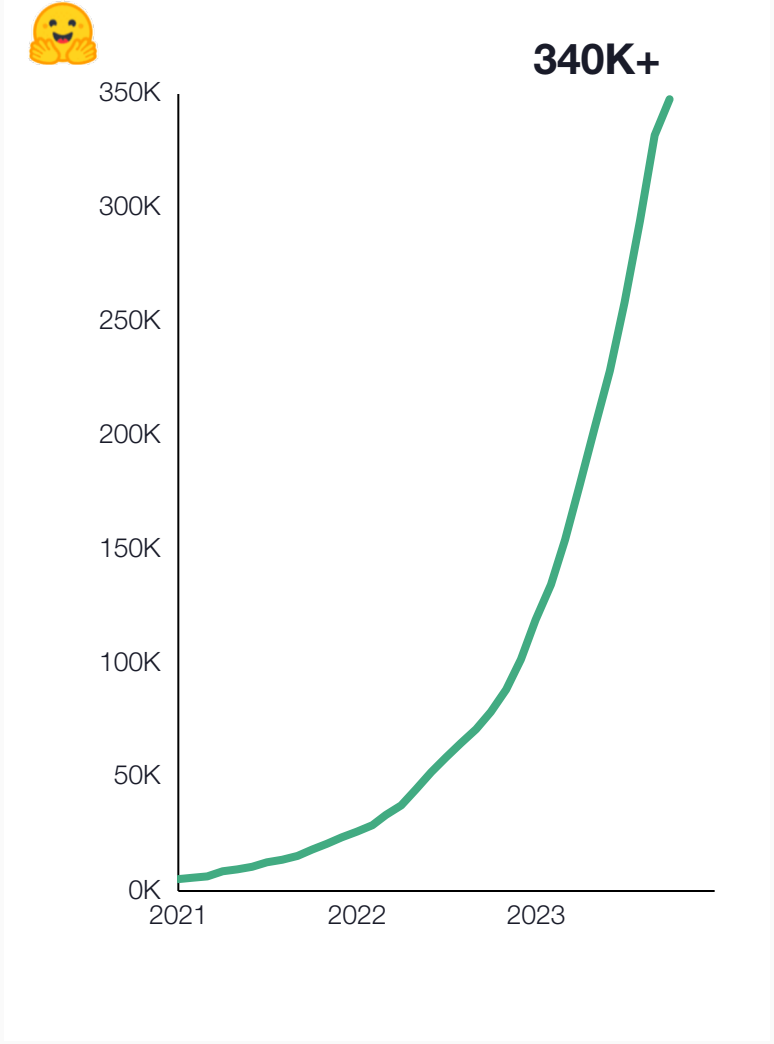
⟶ % of trending Github repos in AI/ML



⟶ New AI applications over time



⟶ Number of models on Hugging Face

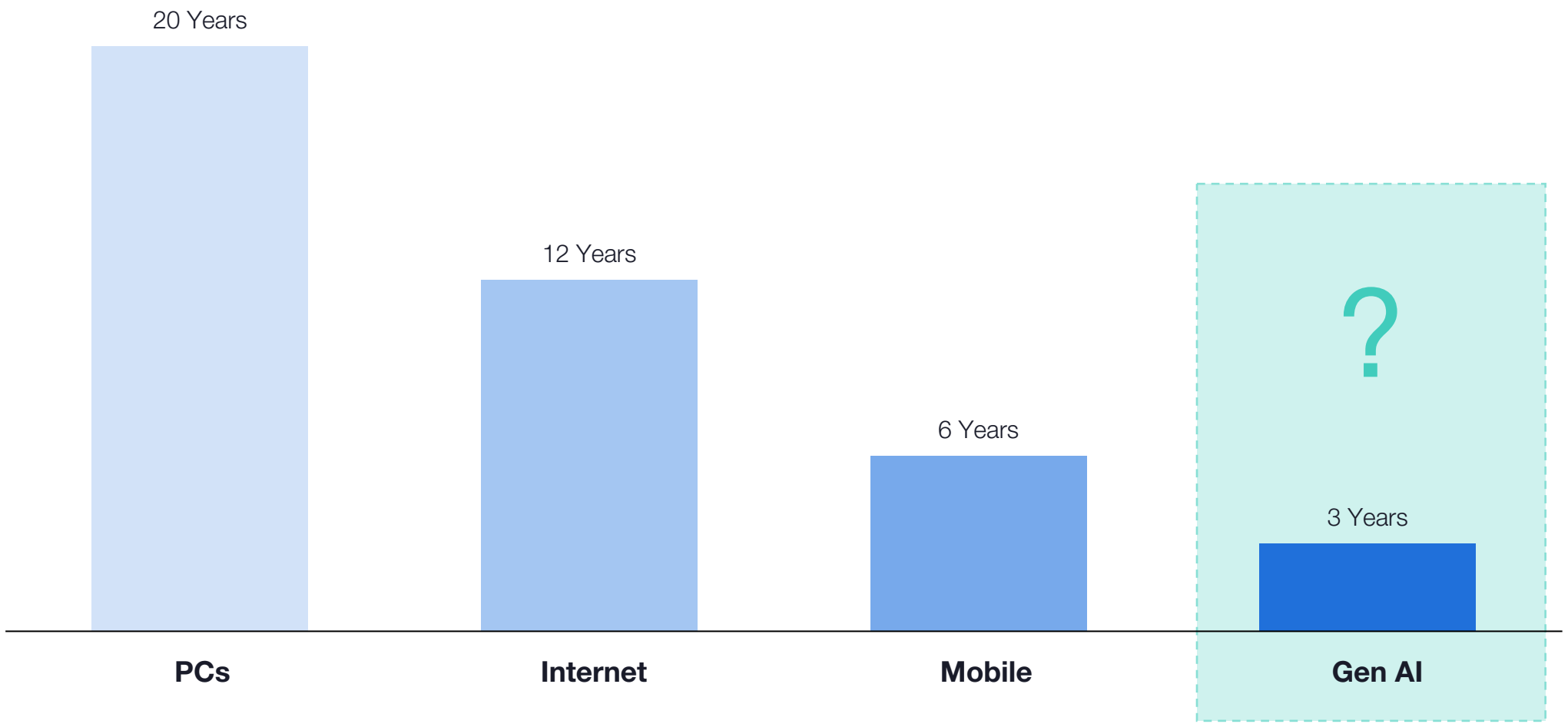


Source: GitHub as of June 2023, ThereIsAnAIForThat.com as of September 2023, Hugging Face as of September 2023, and Coatue analysis and opinion as of September 2023. Data visualized begins in 2021. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Adoption has been twice as fast with each platform shift

⟶ Halving of penetration time with new technology waves

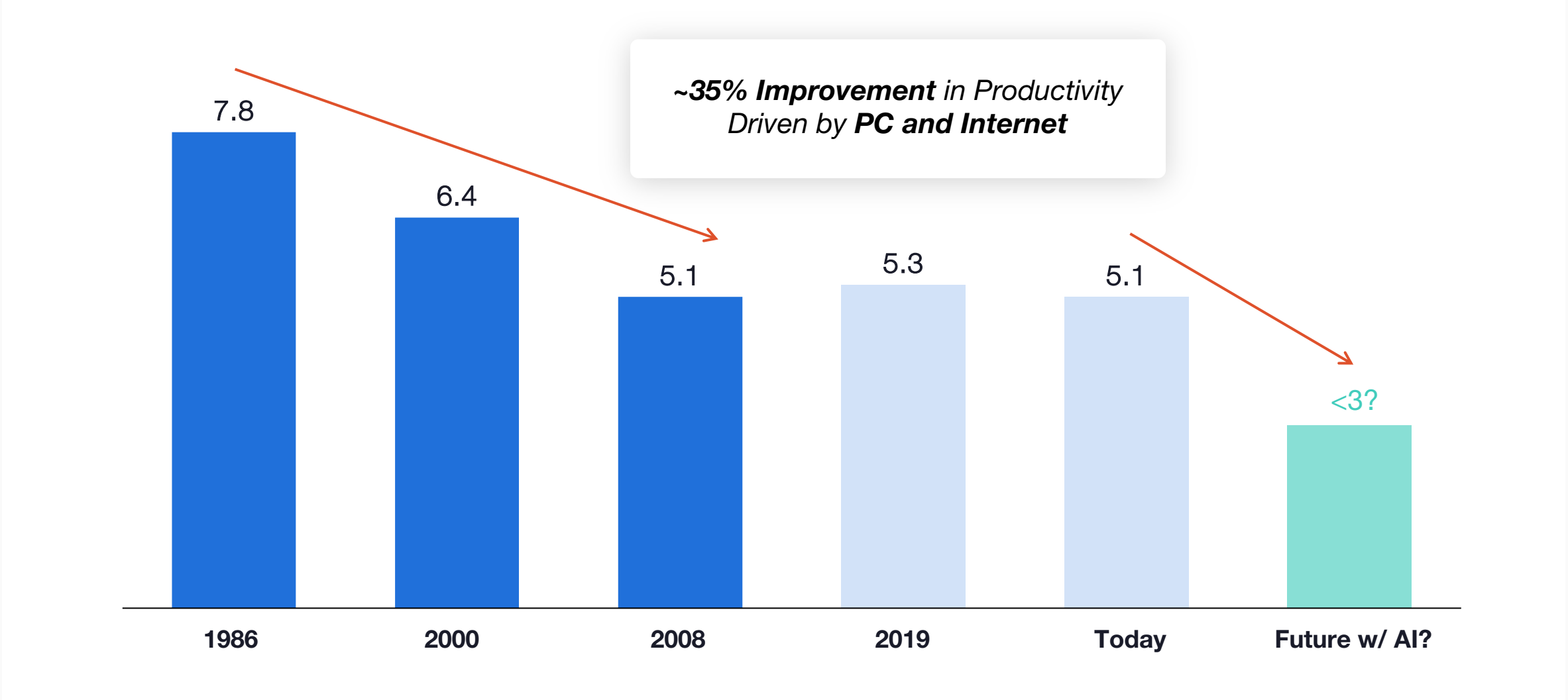
# of years to reach 50% user penetration in the US



Source: Morgan Stanley Research as of September 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI has potential to drive the economy for years to come

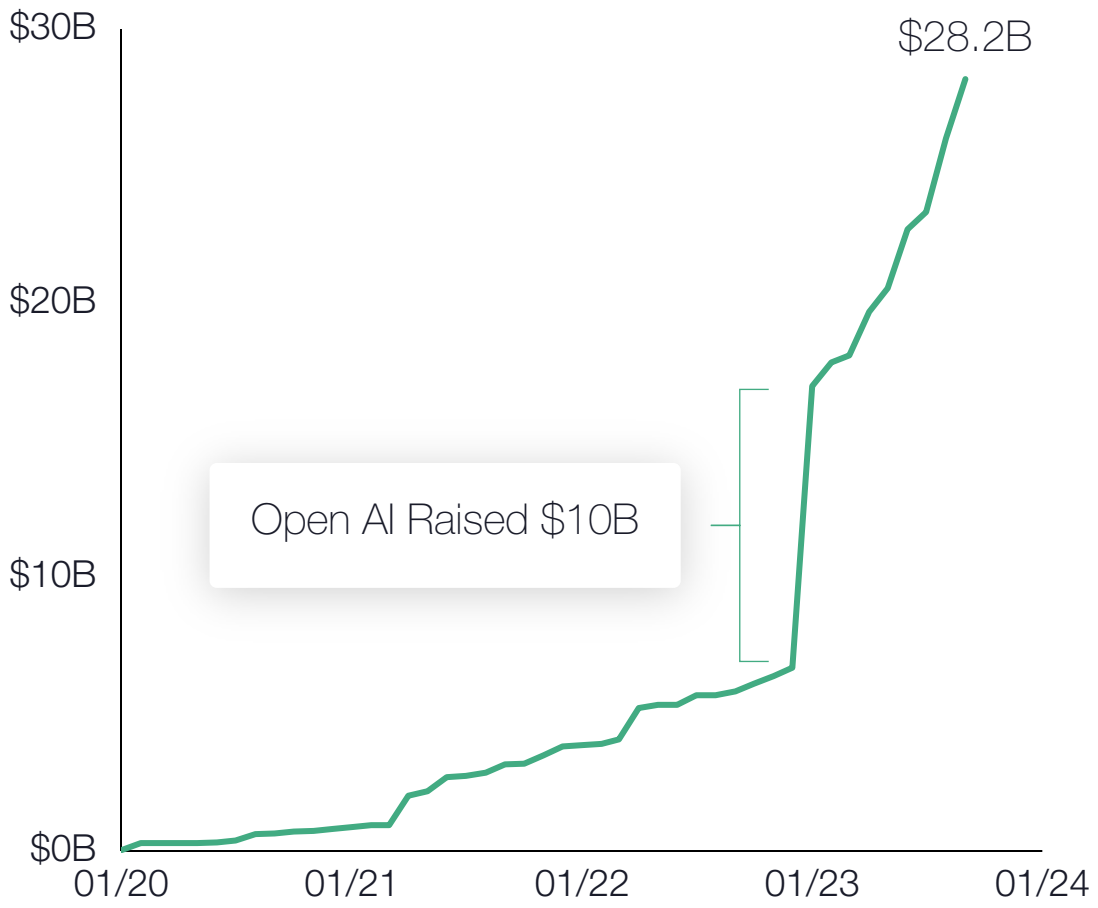
⟶ **# of employees per $1M of revenue (inflation adjusted – S&P 500 companies)**



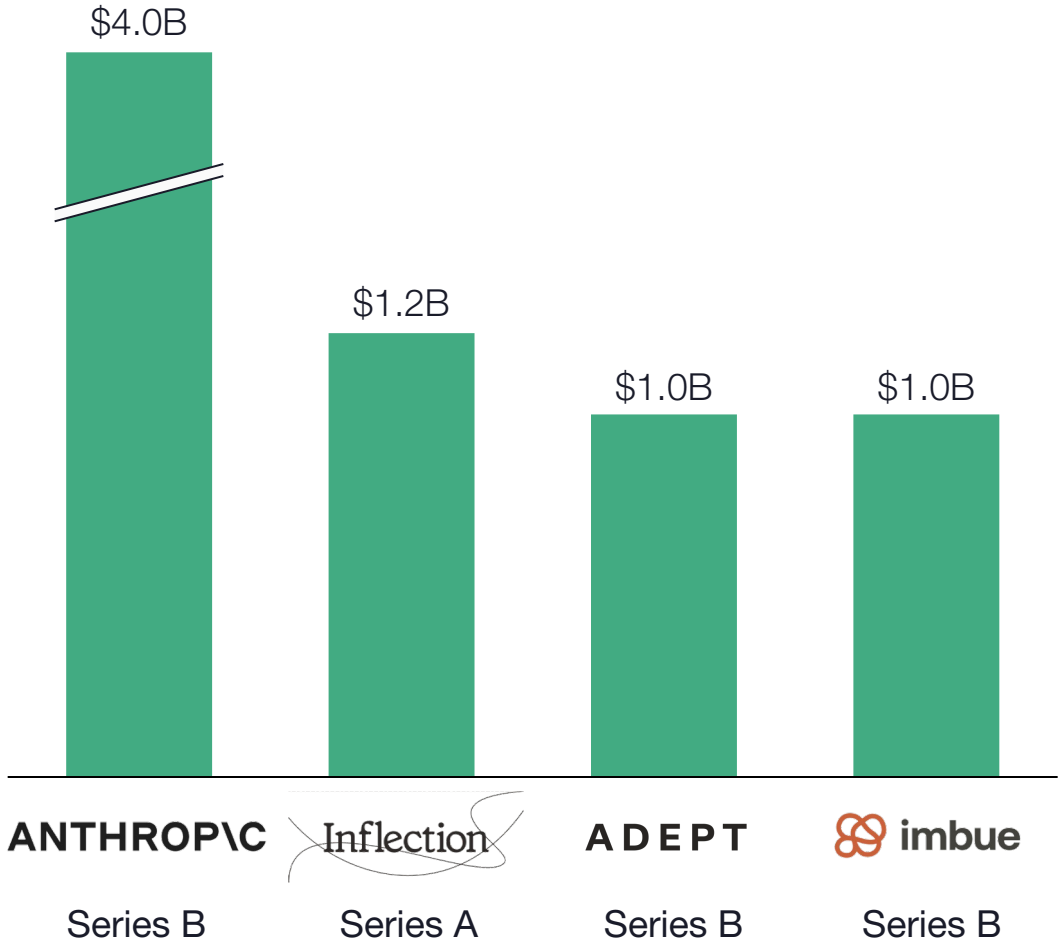
Source: Bloomberg, CapitalIQ, and Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

We've seen massive investment in AI

→ Cumulative funding in private AI companies since 2020



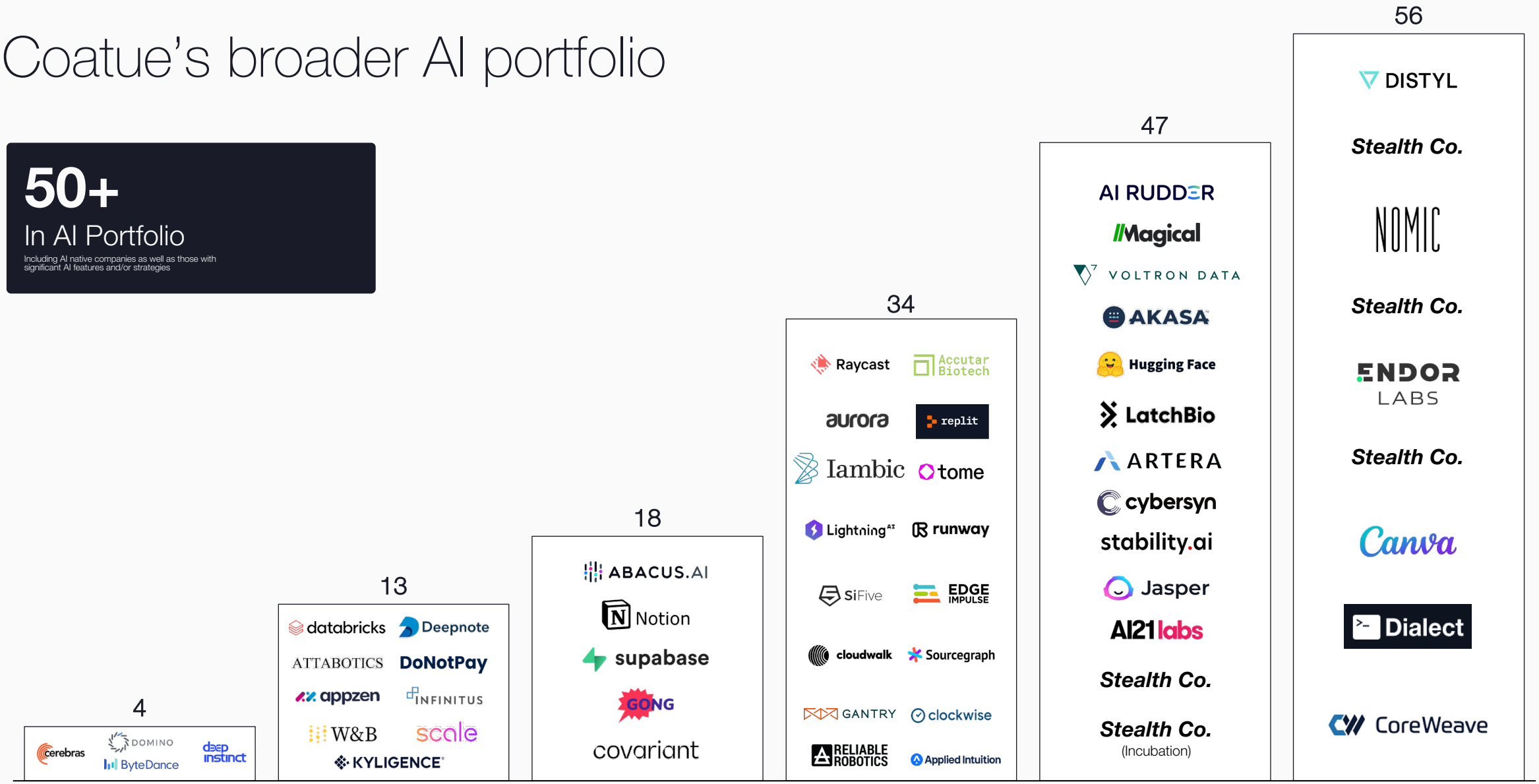
→ Valuation before public product launch



Source: Coatue analysis of Pitchbook data as of November 2023. Does not include funding raised before 1/1/2020. Companies included herein based on Pitchbook round data that Coatue categorizes as an "AI Company" which may include those with AI embedded in a product rather than it being their core competency, and includes all labeled companies in ecosystem, of which may include Coatue portfolio companies. This categorization is subjective and focused on "Gen AI" technologies, and may not be exhaustive of all companies that others may construe as Gen AI. Categorization could be impacted at any time by market factors, changes in laws and other factors. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Coatue's broader AI portfolio

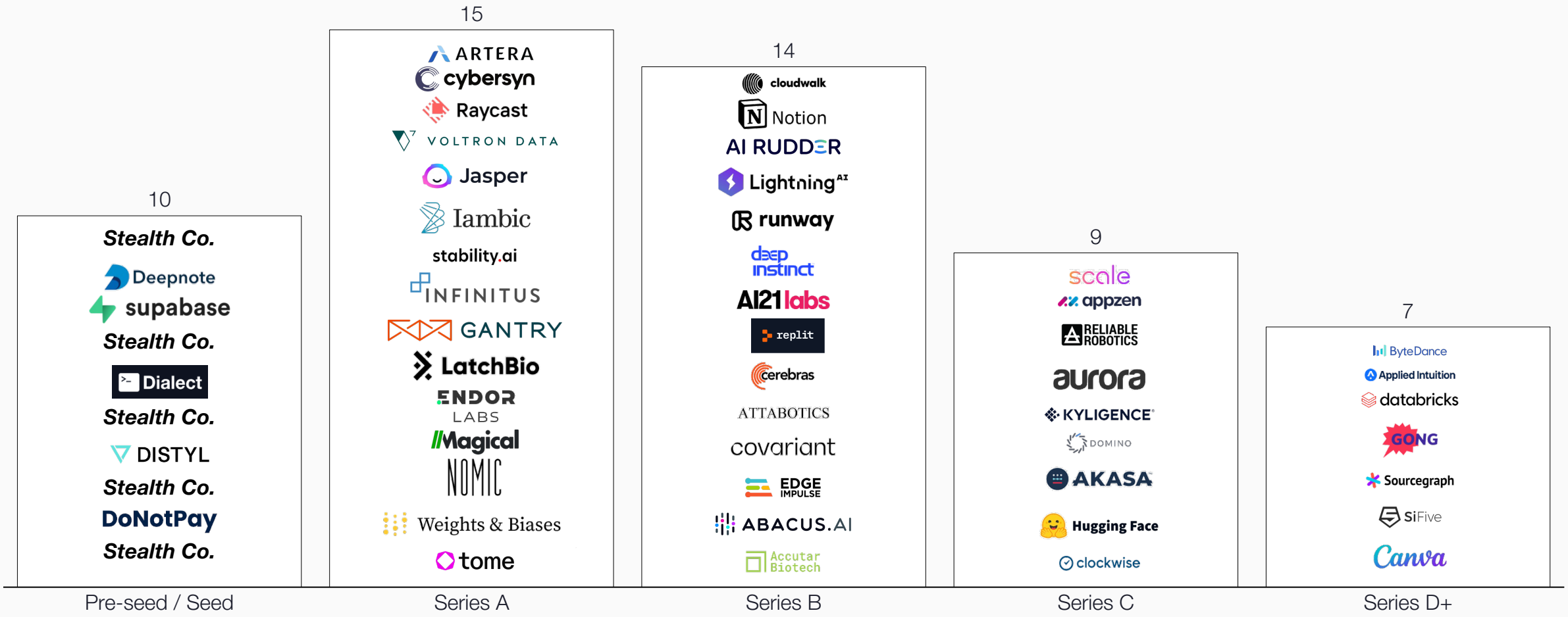
50+
In AI Portfolio
Including AI native companies as well as those with significant AI features and/or strategies



Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Companies included herein based on current investments that Coatue categorizes as an "AI Company" which may include those with AI embedded in a product rather than it being their core competency. In addition, the original thesis for some of these companies may not have originally been about AI. Categorization could be impacted at any time by market factors, changes in laws and other factors. Positions in companies above may be held across multiple funds and are not indicative of the performance achieved in one specific fund. Coatue makes no guarantee regarding the completeness of this information; may not represent the entire universe of AI companies in the portfolio. See Coatue.com for a full list of Coatue portfolio companies. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

We've backed AI founders across stages

# of Coatue AI portfolio companies based on round when Coatue first invested



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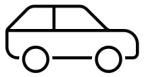
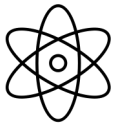
- Coatue view: the best of AI is yet to come

Coatue View: AI is not just hype

Characteristic of hype cycles	Coatue view	Historic Examples
Value Accrual Value accrual misaligned with investment	• *Comparison*: Historic cycles like fiber and cloud represent two different outcomes for underlying infrastructure • Most investment in AI today is within the model layer, but **it's too early** to declare who will be the **AI model winners**	 1990s Fiber
Capabilities Overestimating timeline & capabilities of technology	• *Comparison*: Self-driving cars finally arriving, but after 15+ years of work • **AI is already useful within ~5 years.** We are in early innings of adoption and expect models to improve, but AI regulation is likely and is a challenge to implement well	 Autonomous vehicles
Value Accrual Lack of widespread utility due to maturity of technology	• *Comparison:* Quantum computing hype was promising in theory but has not yet proven widespread practical utility • **AI already proving significant utility across domains**	 Quantum computing

Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Comparison: Some enabling technologies become a public good

Fiber Infrastructure

1990s

Telco Co's raised $1.6T of equity & $600B of debt

Bandwidth costs decreased 90% within 4 years

COVAGE · NorthStar · telligent (A VERINT Company) · ELECTRIC LIGHTWAVE

WORLDCOM · 360networks · NEXTLINK (INTERNET MADE EASY) · BROADWIND (THINK BIG.)

UUNET · MFS Communications · Global Crossing · Level (3) COMMUNICATIONS

Most of these companies no longer exist today…

Source: 25iq as of September 2023, Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

…While cloud infrastructure became a huge market

Cloud Infrastructure
2010s

Entirely new computing paradigm

Most were already public companies with resources to build out data centers

Big 4 hyperscalers generate ~$150B+ in revenue annually

Source: Public filings, Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Where did value accrue in the cloud stack?

Cloud Stack	Example Companies	Est. TAM	% of total in stack[1]
SaaS Apps	salesforce, Adobe	~$260B	40%
PaaS	CONFLUENT, snowflake	~$140B	22%
IaaS	amazon web services, Azure	~$200B	30%
Cloud Semis	AMD, intel	~$50B	8%

Source: (1) Note the stack is not an exhaustive look at the cloud stack overall, and merely is a simplified selection of categories that broadly cover the cloud stack. Data on TAM is from Gartner as of April 2023 (including SaaS, PaaS, and IaaS categorizations and TAM) and Coatue analysis and opinion of Cloud Semis as of 2021. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

In AI, funding concentrated in model layer for now

AI Stack	Example Companies	Total funding	% of total in stack[1]
Apps	character.ai, replit	~$5B	17%
Models	OpenAI, ANTHROPIC	~$17B	60%
AI Ops	Hugging Face, Weights & Biases	~$1B	4%
AI Cloud	databricks, Lambda	~$4B	13%
AI Semis	cerebras, SambaNova Systems	~$2B	6%

Source: (1) Note the stack is not an exhaustive look at the AI stack overall, and merely is a simplified selection of categories that broadly cover the AI stack. Coatue analysis of Pitchbook data as of November 2023. Does not include funding raised before 1/1/2020. Companies included herein based on Pitchbook round data that Coatue categorizes as an "AI Company" which may include those with AI embedded in a product rather than it being their core competency. This categorization is subjective and focused on "Gen AI" technologies, and may not be exhaustive of all companies that others may construe as Gen AI. Categorization could be impacted at any time by market factors, changes in laws and other factors. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

The jury is out on which model companies will win

AI Models
2020s

Private AI model companies raised ~$17B in venture funding since 2020

Open-source models are becoming more ubiquitous

?

ADEPT

OpenAI

ANTHROP\C

imbue

Inflection

co:here

ALEPH ALPHA

Outcome TBD

Source: Pitchbook data as of November 2023, Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Comparison: AI advancing much faster than previous waves

Levels of autonomy	Autonomous vehicles	Generative AI
L5	Fully autonomous	Superhuman reasoning & perception
L4	Highly autonomous	AI autopilots for complex tasks
L3	Self-driving with light intervention[1]	AI co-pilot for skilled labor
L2	Tesla autopilot	Supporting humans with basic tasks
L1	Cruise control	Generating basic content

15 Years

~5 Years

GitHub Copilot

replit

ChatGPT

Speak

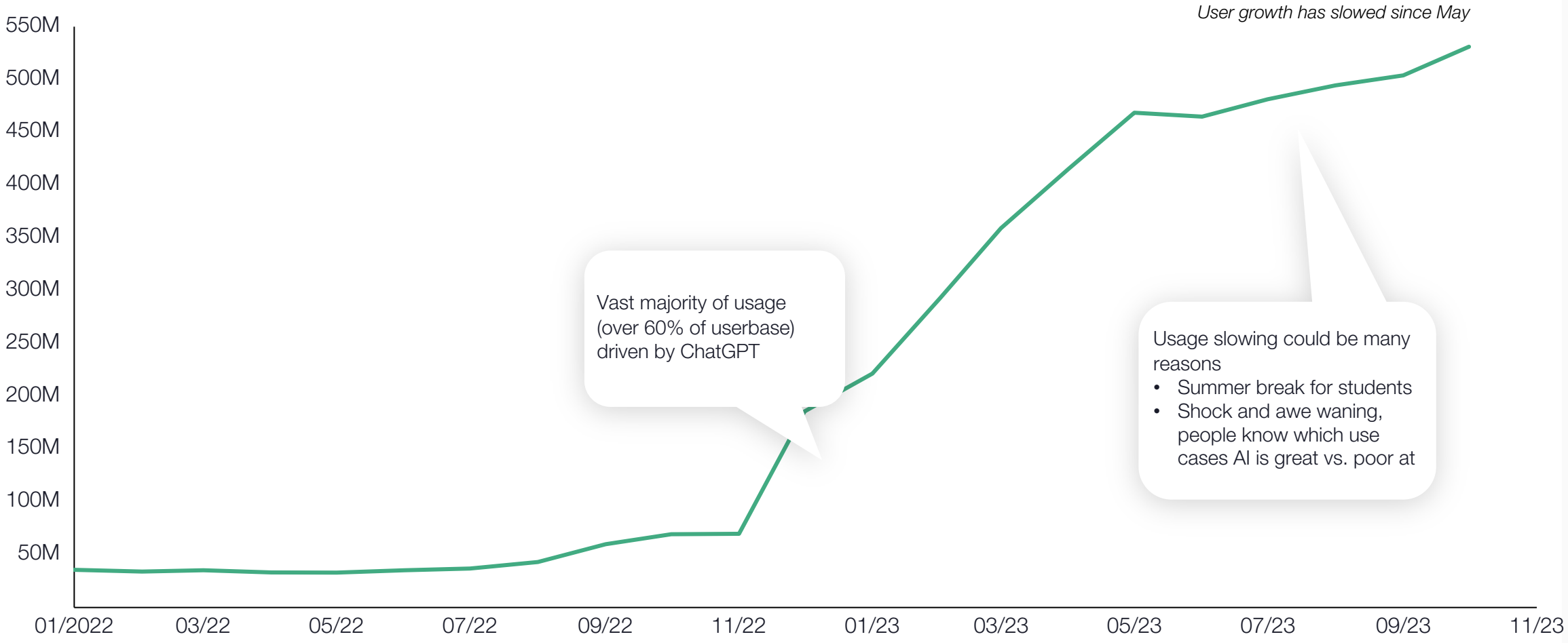
Midjourney

Source: 1) Mercedes received Level 3 ruling this year (alongside Cruise/Waymo L4 becoming mainstream this year, Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Has initial AI enthusiasm slowed down?

→ AI usage worldwide started flattening during summer

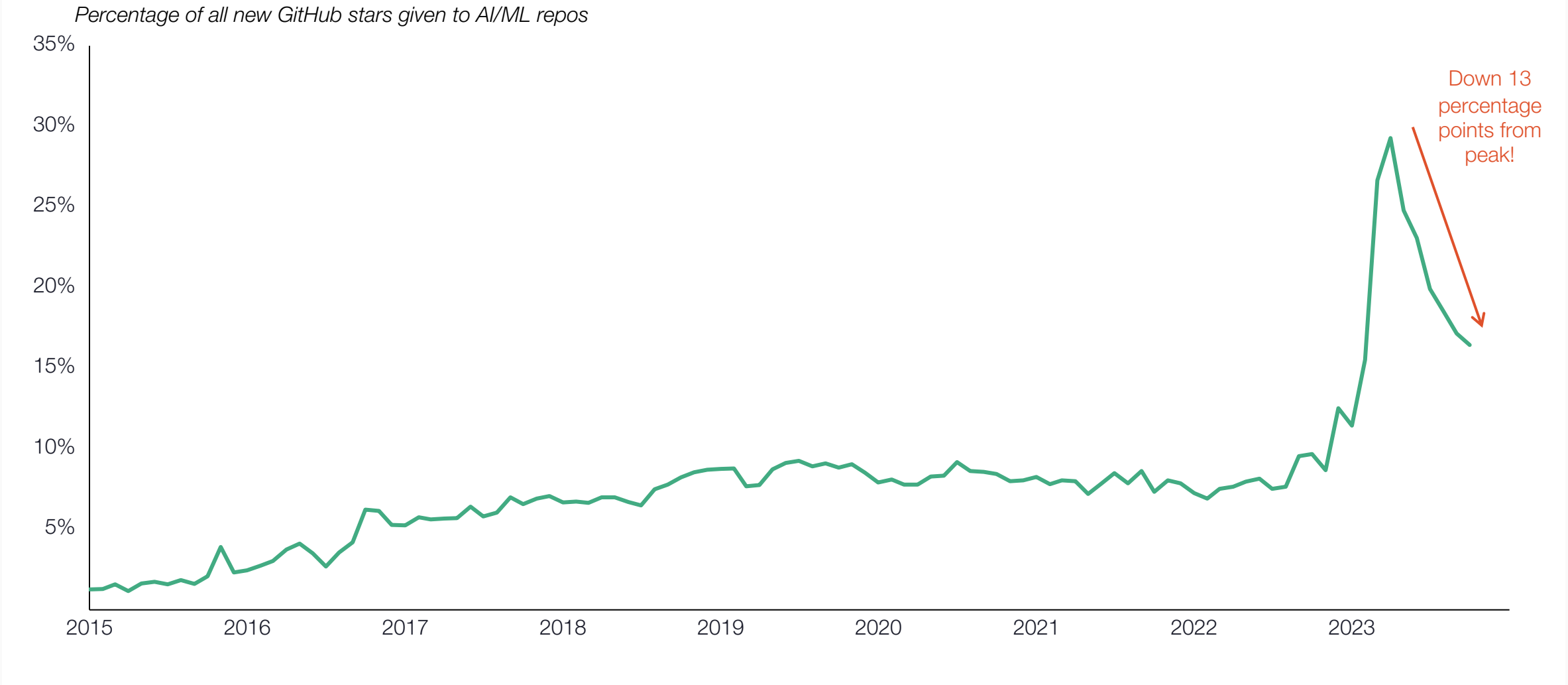
Approximate global AI applications users count by month



Source: Coatue analysis and opinion as of November 2023. Non-exhaustive set of apps represented in sample set.For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Early developer excitement waning and washing out AI "tourists"

⟶ Excitement in AI/ML on GitHub, measured by stars, has declined since April 2023



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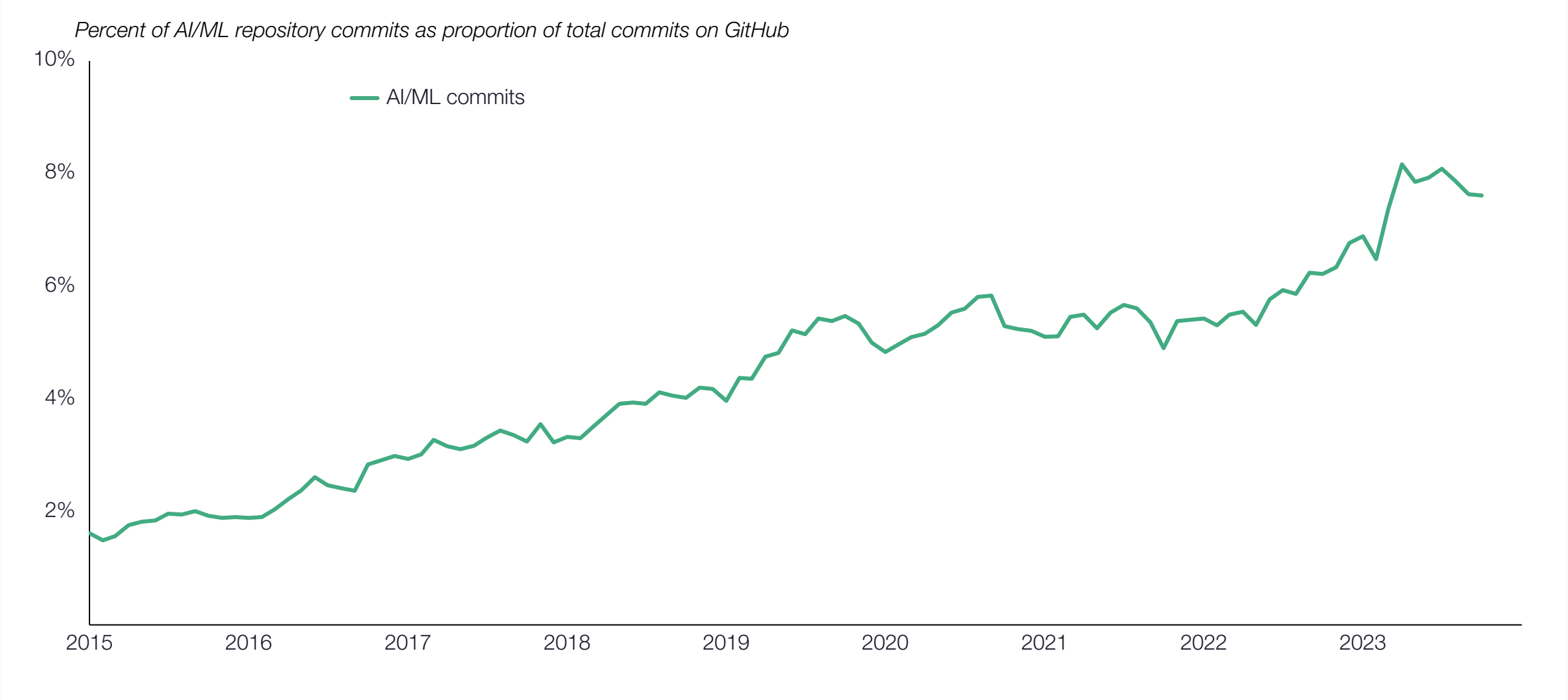
Serious AI builders remain

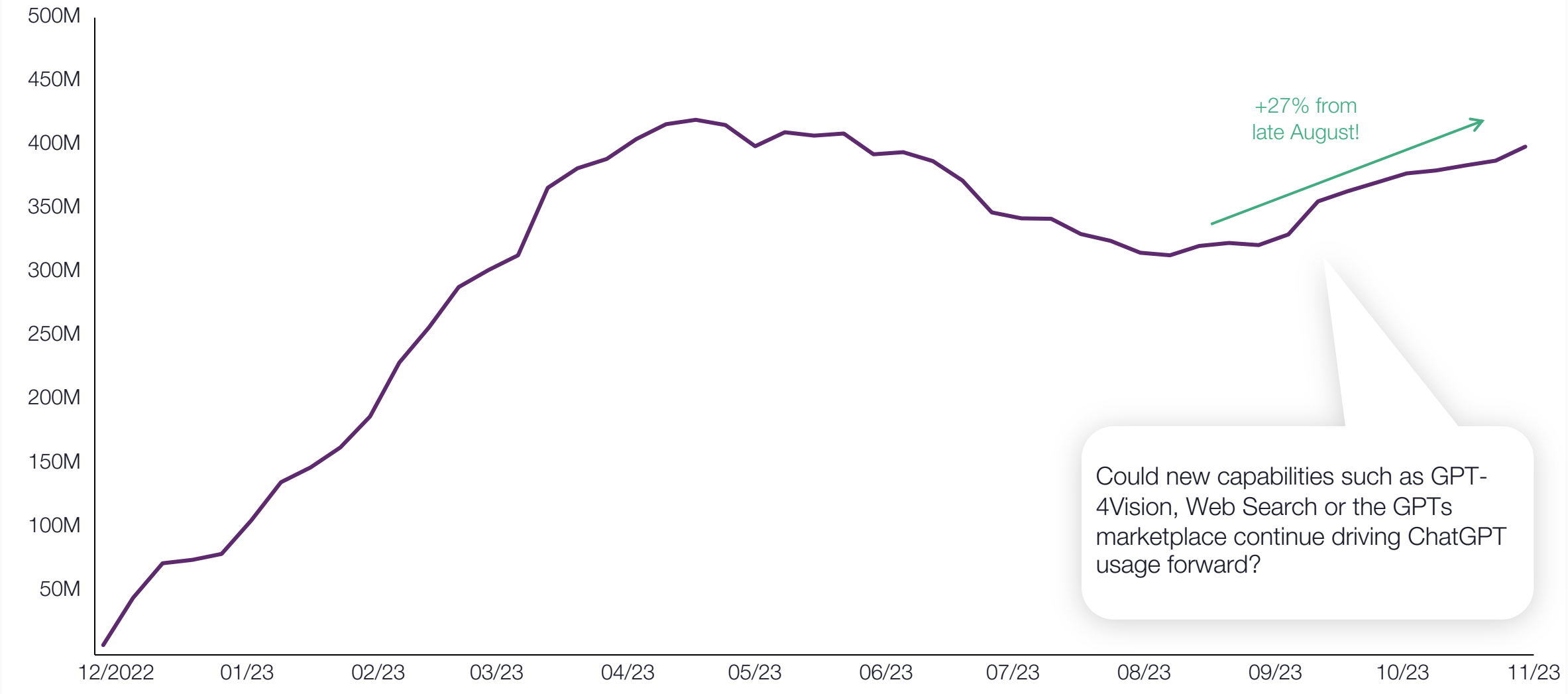
→ AI/ML commits have not declined as much since April 2023



Source: GitHub as of November 2023, Commit means a discrete change to one or more files in a GitHub repository. Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

ChatGPT usage has rebounded, new capabilities have shipped

ChatGPT weekly web visits worldwide since launch



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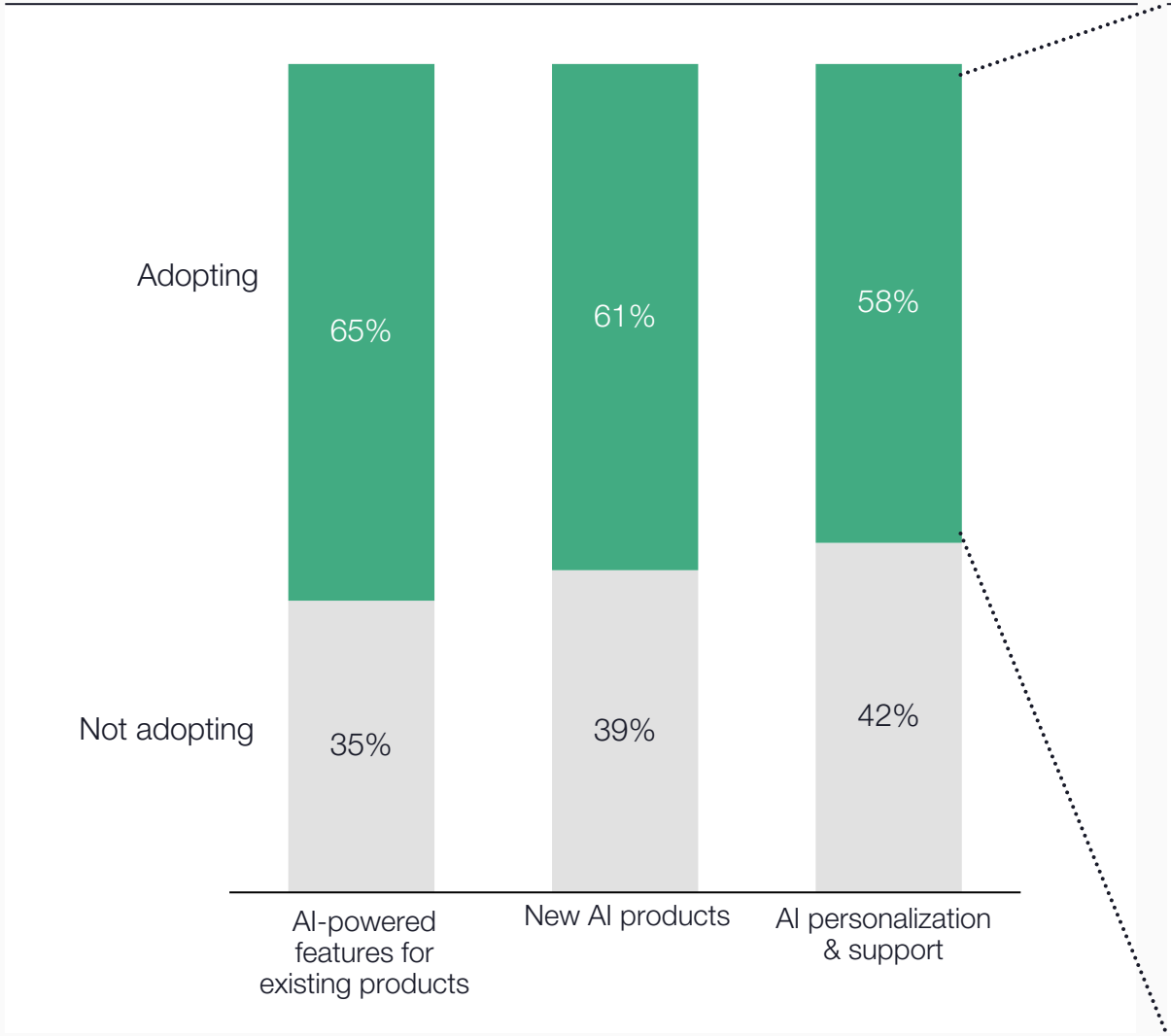
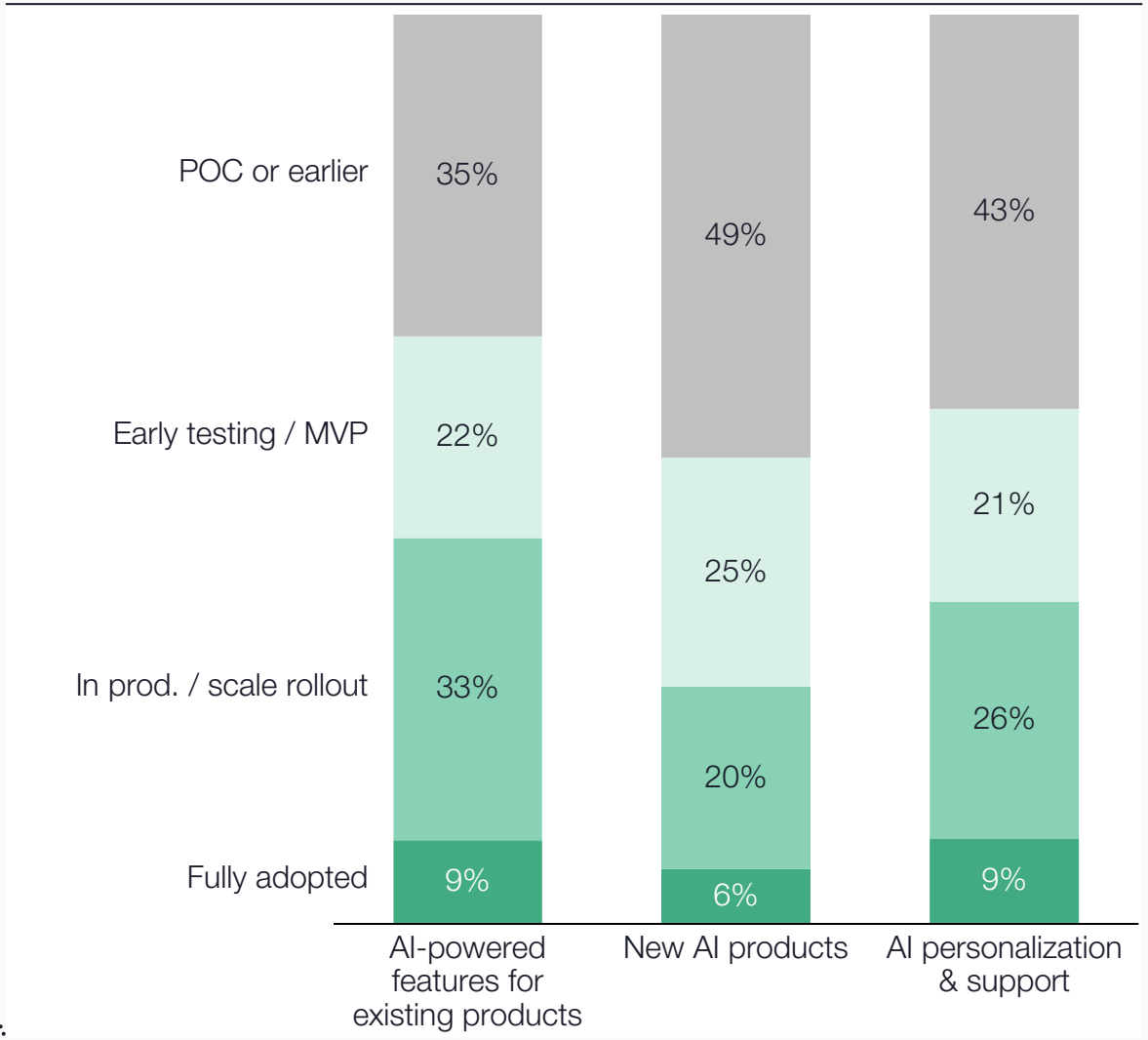
We believe it's first innings of enterprise AI adoption

~60%+ of surveyed enterprises plan to adopt AI



Less than 10% have fully adopted; timeline is long

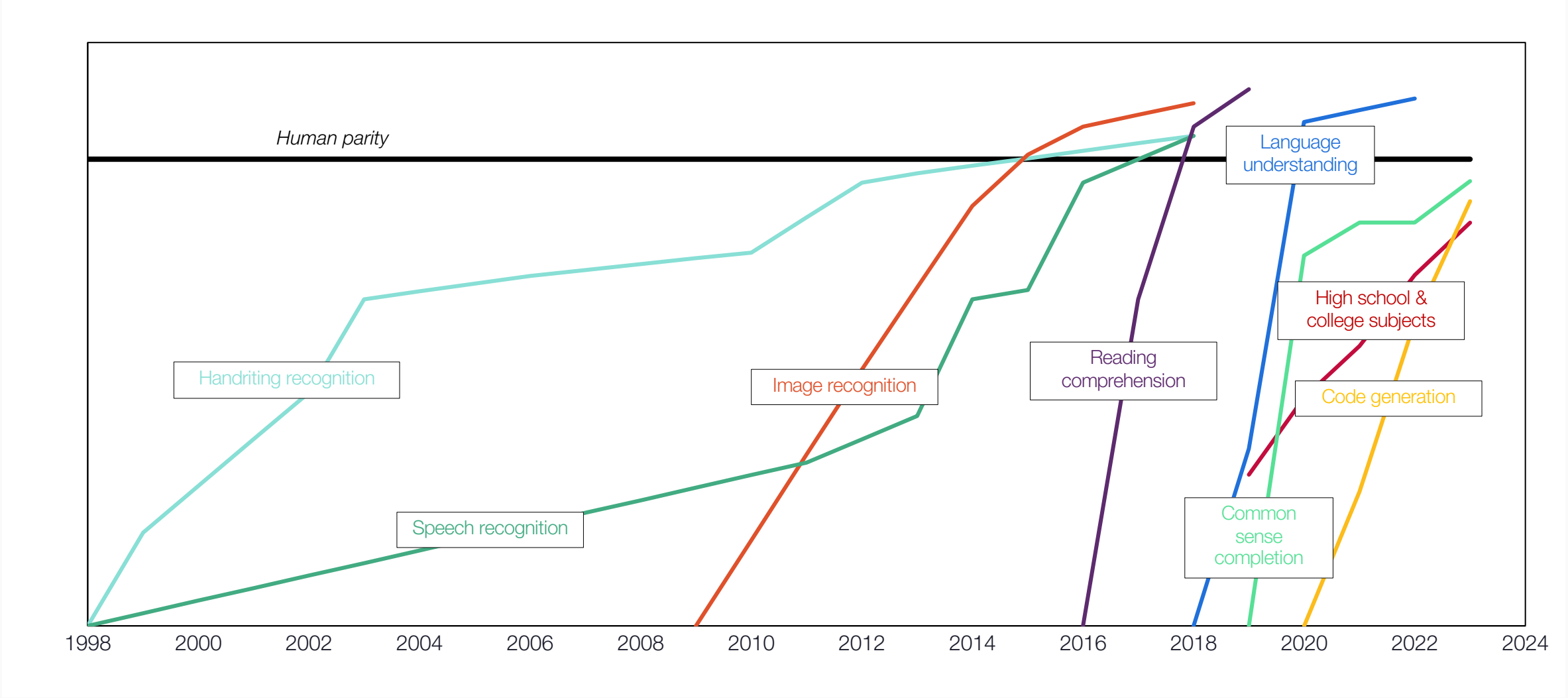


COATUE

Source: Survey of ~600 enterprise executives as of 2023, and Coatue analysis and opinion as of November 2023 For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

We are optimistic: AI is getting better, faster

⟶ Speed for models to reach human level accuracy on benchmarks has decreased

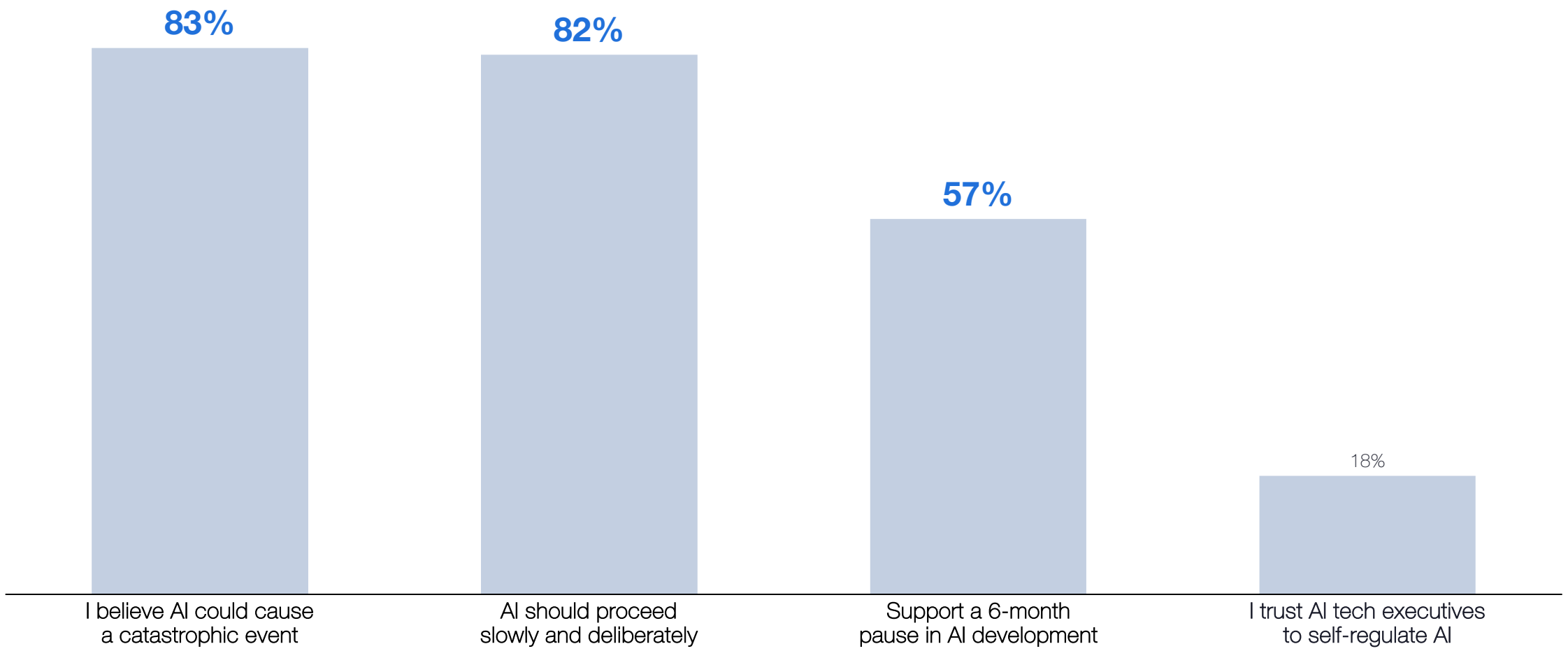


Source: Directional data taken from Contextual.ai, Time, and PapersWithCode as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI regulation may be more likely than most think

→ Initial polls suggest many Americans concerned about AI

% of surveyed respondents, AI Policy Institute



Source: AI Policy Institute and YouGov as of November 2023, Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

EU's AI Act is among first examples of regulation

→ Most models fall short of meeting requirements from EU AI Act, per Stanford study

Center for Research on Foundation Models | HAI Stanford University Human-Centered Artificial Intelligence

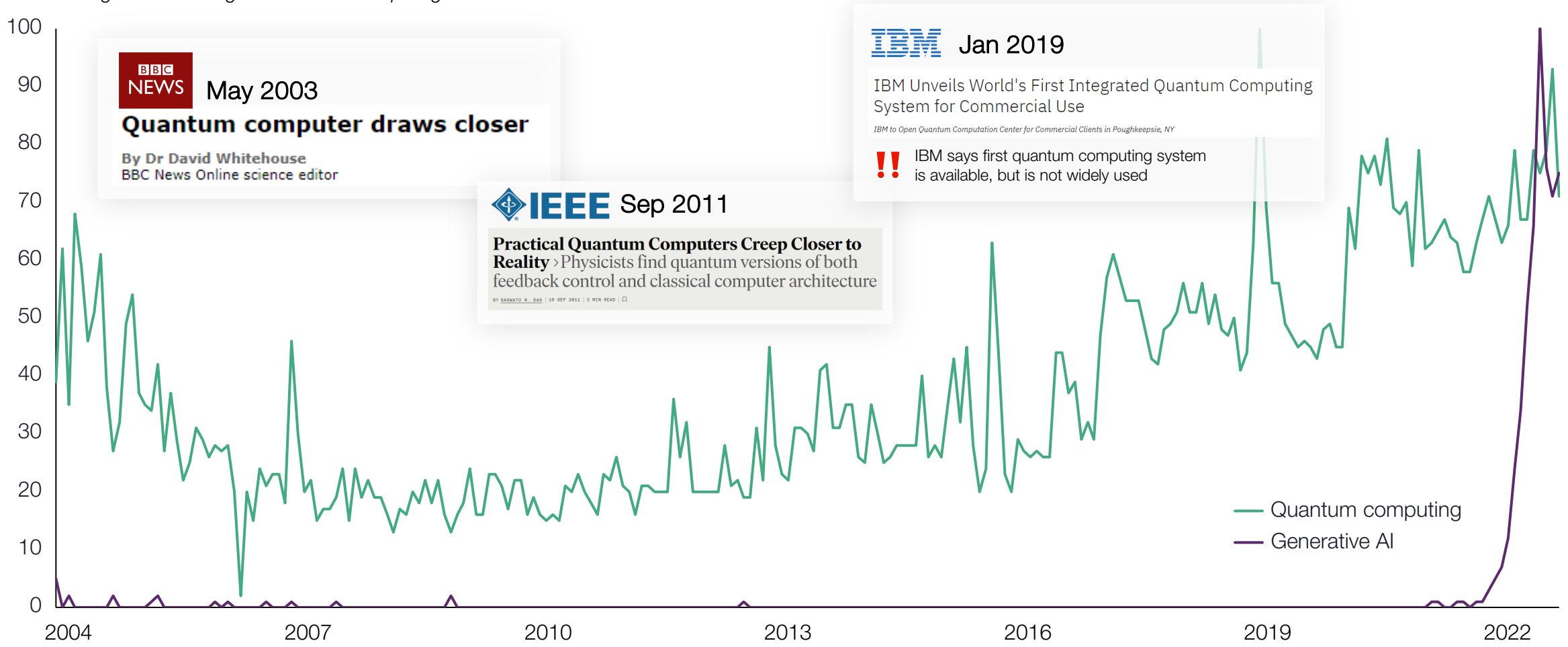
Draft EU AI Act requirements *Non-exhaustive list*	GPT-4	Cohere Command	Claude v1	LLAMA-1	PaLM-2	BLOOM
	OpenAI	cohere	ANTHROPIC	Meta	Google	BigScience
Data sources *"Description of the data sources used in the development of the foundation model."*	◔	◕	✗	✓	◑	✓
Compute *"Description of the training resources used by the foundation model including compute required, training time, and other information related to the size and power of the model."*	✗	✗	✗	✓	✗	✓
Energy *"Design and develop the foundation model, making use of applicable standards to reduce energy use, resource use and waste, as well as to increase energy efficiency."*	✗	◔	✗	✓	✗	✓
Capabilities & limitations *"Description of the capabilities and limitations of the foundation model."*	✓	◕	◔	◑	✓	◕
Risk & mitigations *"The reasonably foreseeable risks and the measures that have been taken to mitigate them as well as remaining non-mitigated risks with an explanation on the reason why they cannot be mitigated."*	◕	◑	◔	◔	◕	◑
Data copyright *"Without prejudice to national or Union legislation on copyright, document and make publicly available a sufficiently detailed summary of the use of training data protected under copyright law."*	✗	✗	✗	✗	✗	◕

Source: Stanford as of November 2023, Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Comparison: Is AI hype justified with real utility?

⟶ Quantum computing interest has steadily grown without real world proof points…what about Generative AI?

Google trend ranking for "Quantum computing" vs" Generative AI"



Source: Google Trends data of September 2023, news clippings as of September 2023, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. No indication or guarantee that quantum computing interest will continue to grow. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI is delivering game-changing value

55%

Time saved for developers using Github Copilot

90%

Time saved from editing video on Runway

45%

Reduction in human-answered customer support requests

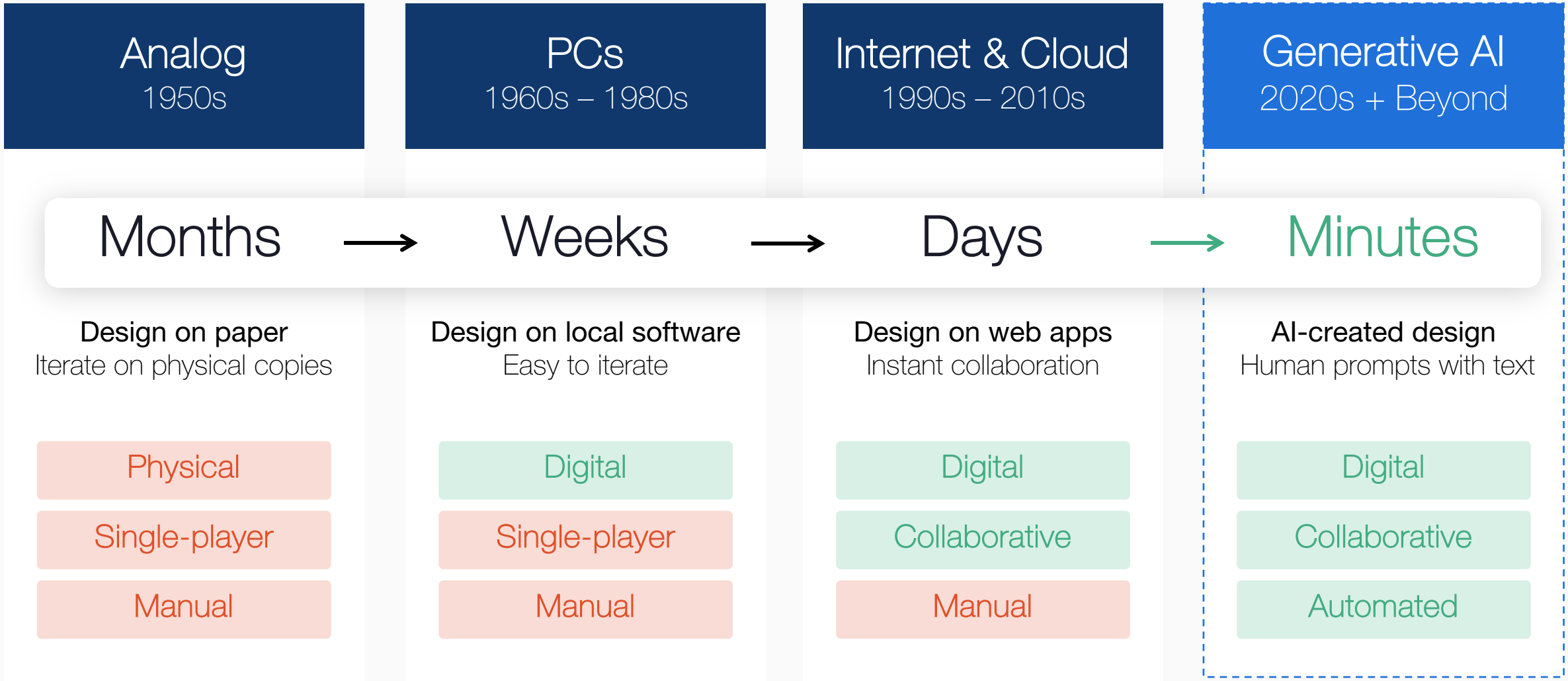
79%

AI chat rated higher quality vs. physician responses

Source: Github as of September 2022, Runway as of September 2203, Arxiv as of April 2023, JAMA as of April 2023, and Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI poised to improve productivity significantly!

Example: Designing Marketing Materials

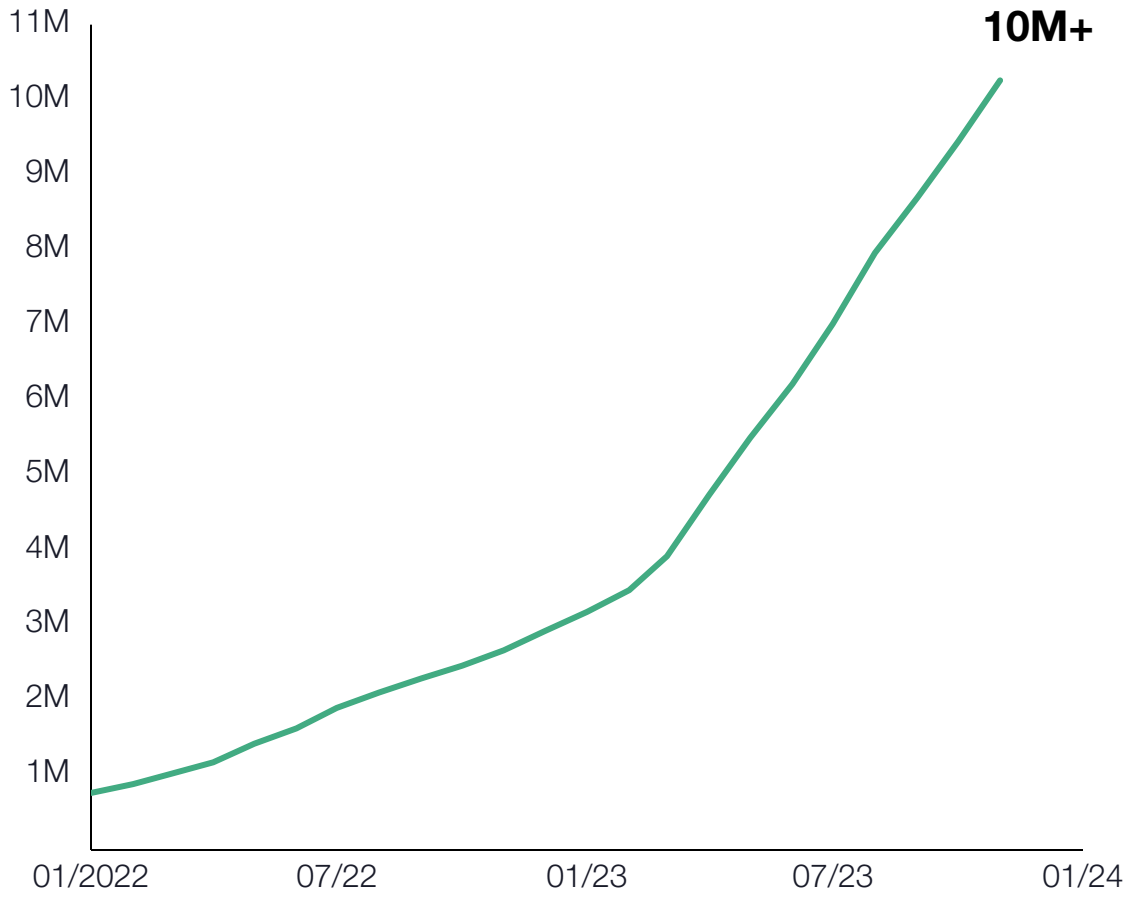


Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

GitHub Copilot makes programming faster

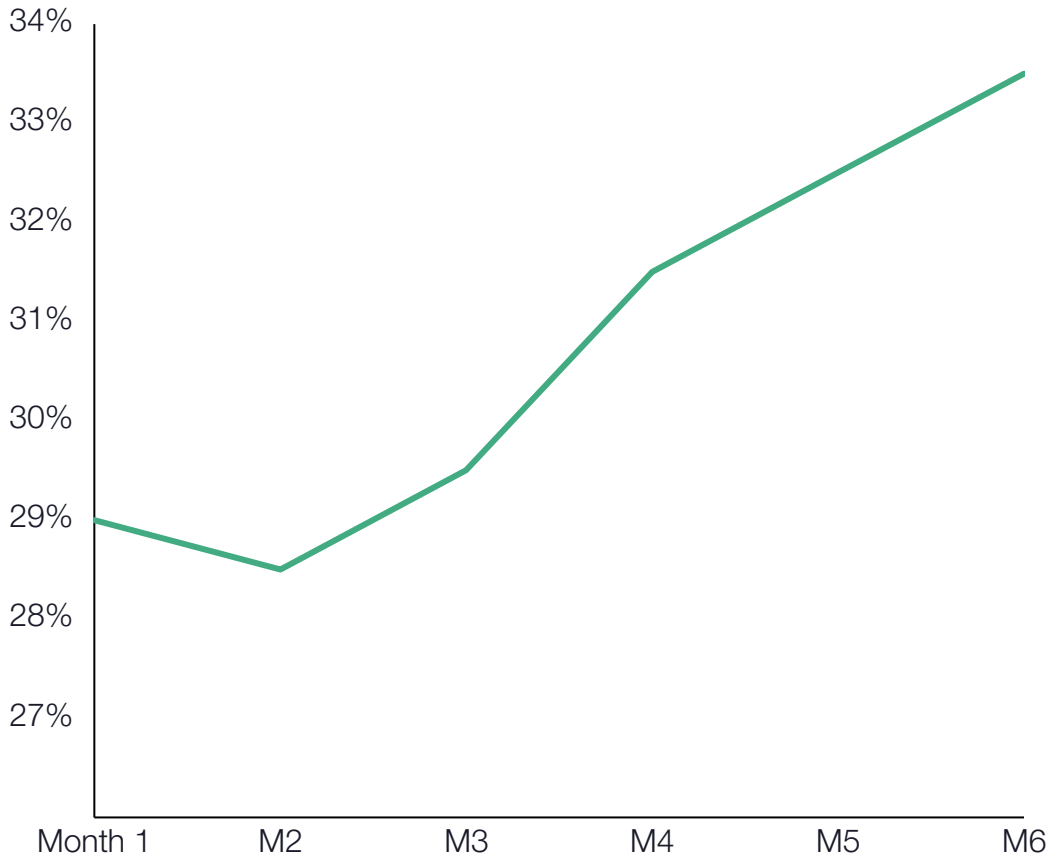
⟶ Over 8M downloads of Copilot extension

Cumulative downloads of GitHub Copilot



⟶ Copilot improving developer productivity over time

Acceptance rate of Copilot suggestions over time



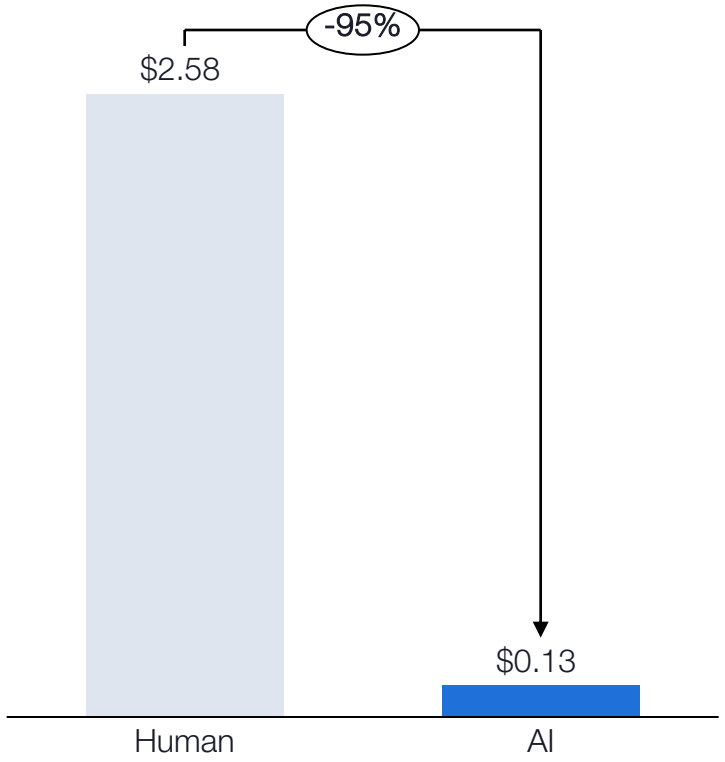
Source: GitHub acceptance rates as of June 2023, and Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Companies have seen huge efficiency gains already

Experience from one Fintech company

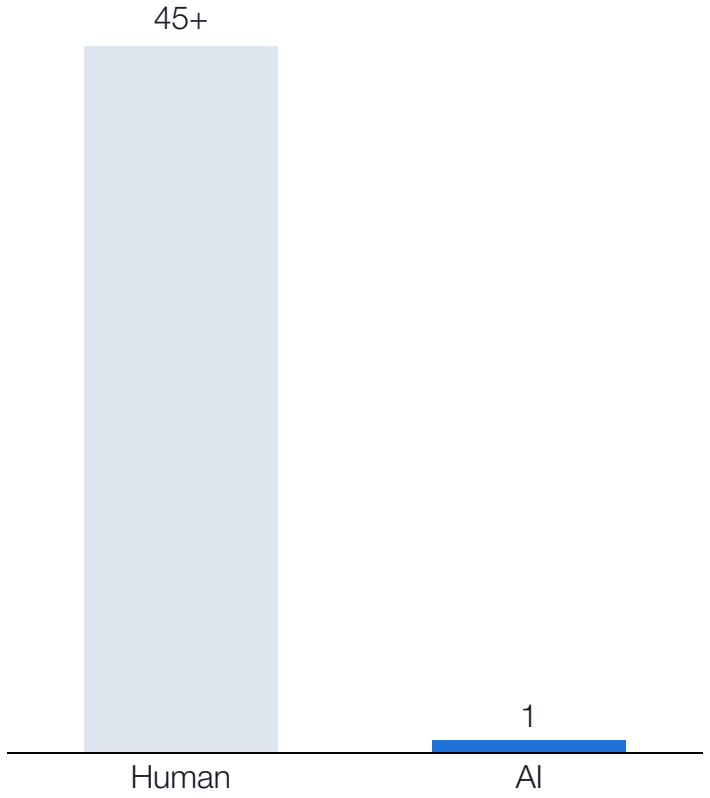
→ AI is cheaper customer support

Cost per support interaction



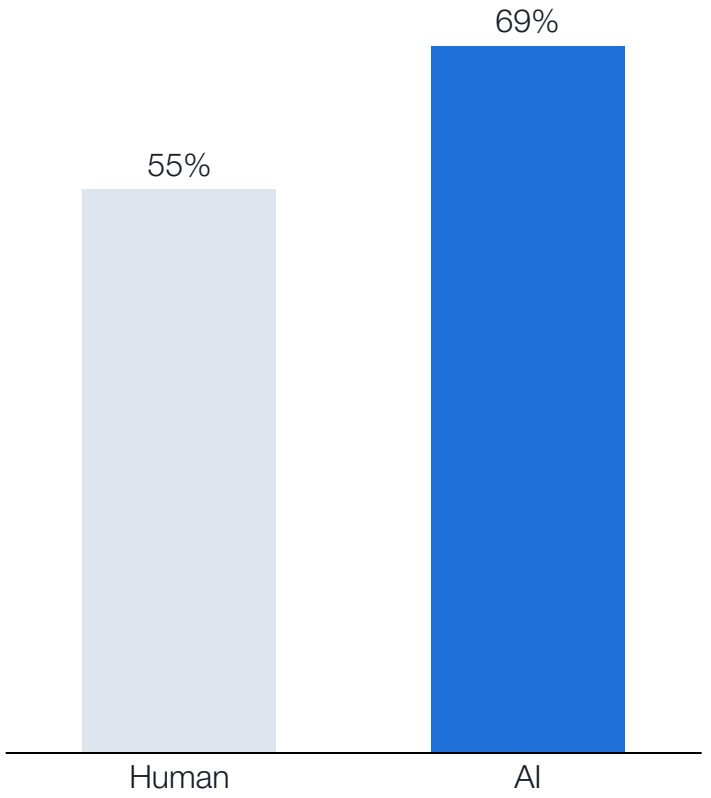
→ AI provides faster responses

Median response time (min)



→ AI makes customers happier

Median customer satisfaction



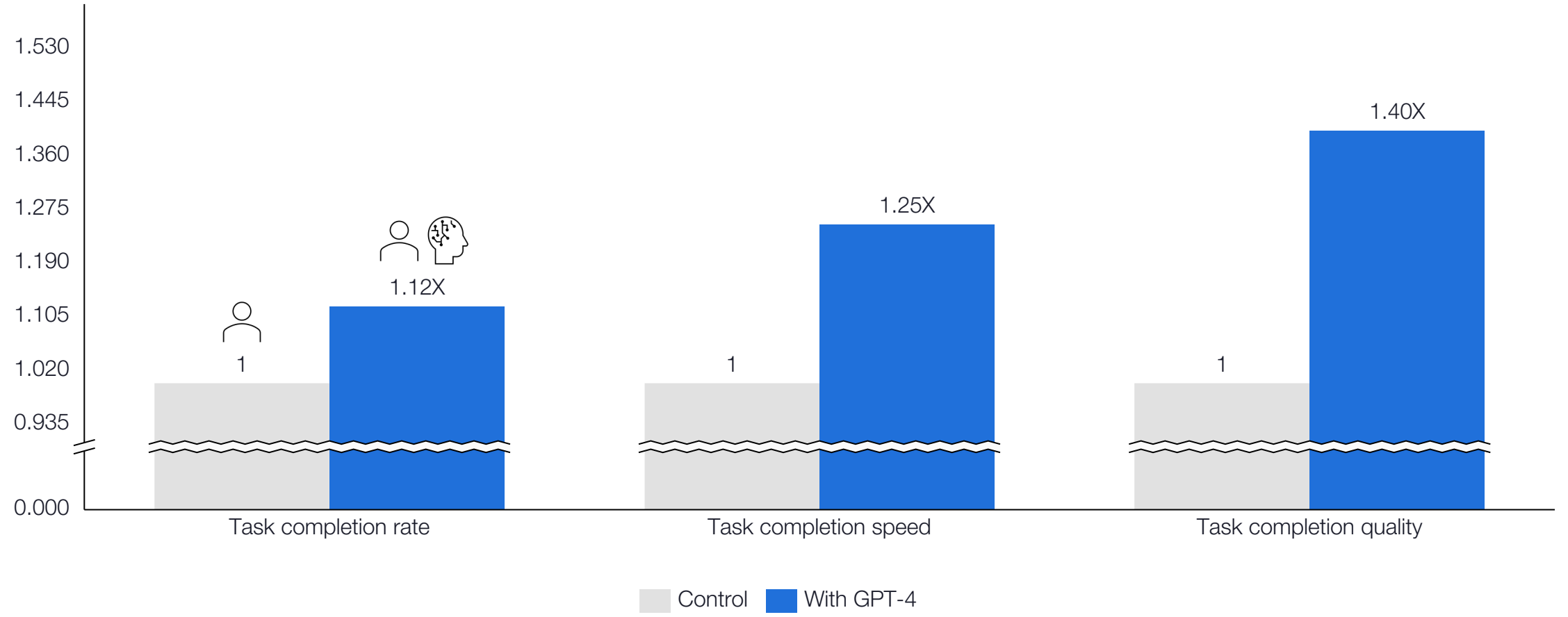
COATUE

Source: Based on one company's internal assessment data – not representative of all companies or guarantee other companies would achieve similar results. Customer satisfaction calculated by number of employees rating the interaction a 4 or 5 out of 5. Data compares against top 8 human employees, based on number of tickets participated in. Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Knowledge work, such as consulting, could be transformed by AI

→ In one study, BCG consultants using AI performed better across all task metrics, including 40% better quality work

Performance improvement on various tasks (1 being control group performance)



Source: HBS & BCG study as of November 2023, Coatue analysis and opinion as of November 2023. Represents experience from one consulting firm in on particular study. Results may not be comparable across all consulting firms, and we are not making a statement that results would translate into different contexts and scenarios. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Key Topics

- Where we are in AI today
- AI could break through the hype and improve our world
- **We believe open-source is the lifeblood of AI**
- AI is transforming the tech ecosystem
- Coatue view: the best of AI is yet to come

How we got here – AI is built in the open

Research

Openly Available Research

- Research from academia & industry has driven advancements in AI
- Collaboration using open-sourced state-of-the-art models has led to rapid pace of innovation

Community

Open Community

- GitHub and Hugging Face underpin the open-source AI community
- Participation in AI has been explosive

Models & Data

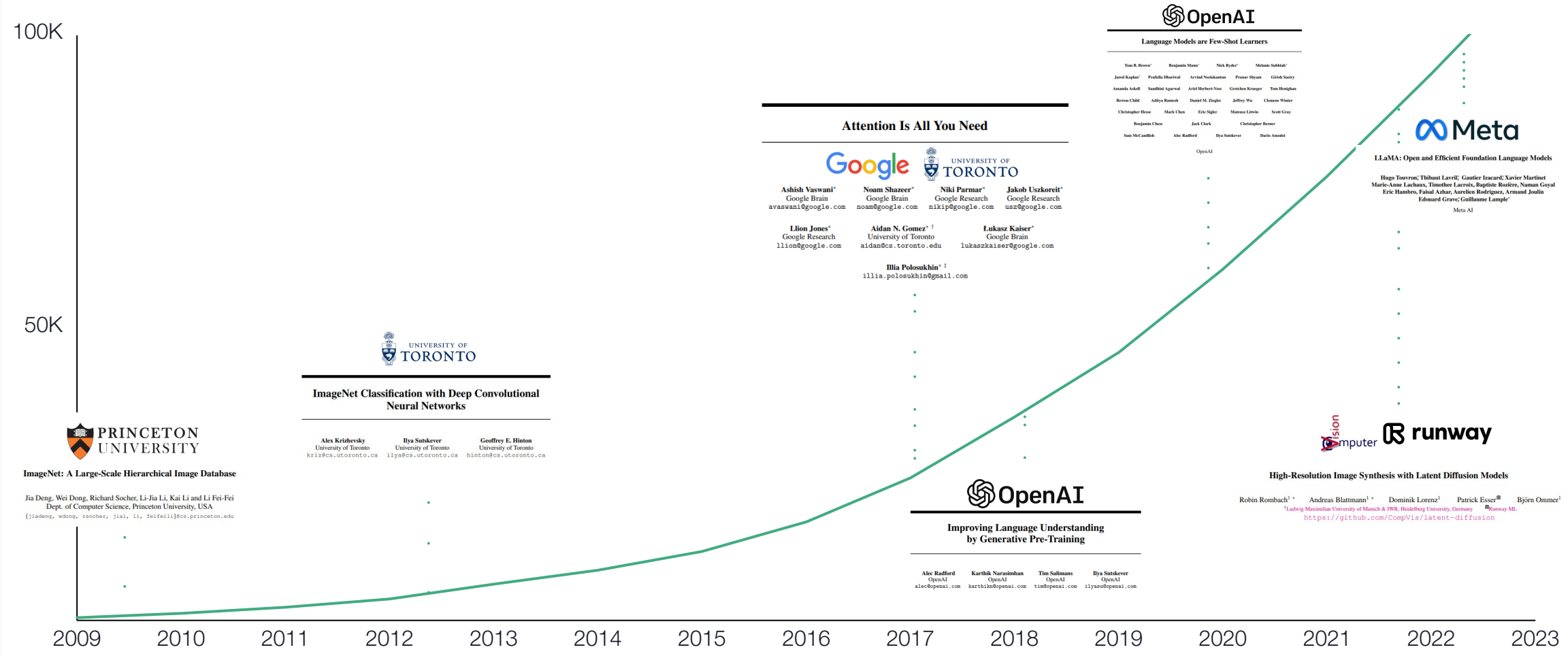
Models & Data

- There are varying degrees of openness across AI today
- Companies realize the value of their own data, and model providers have become more secretive

Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI is a result of open research

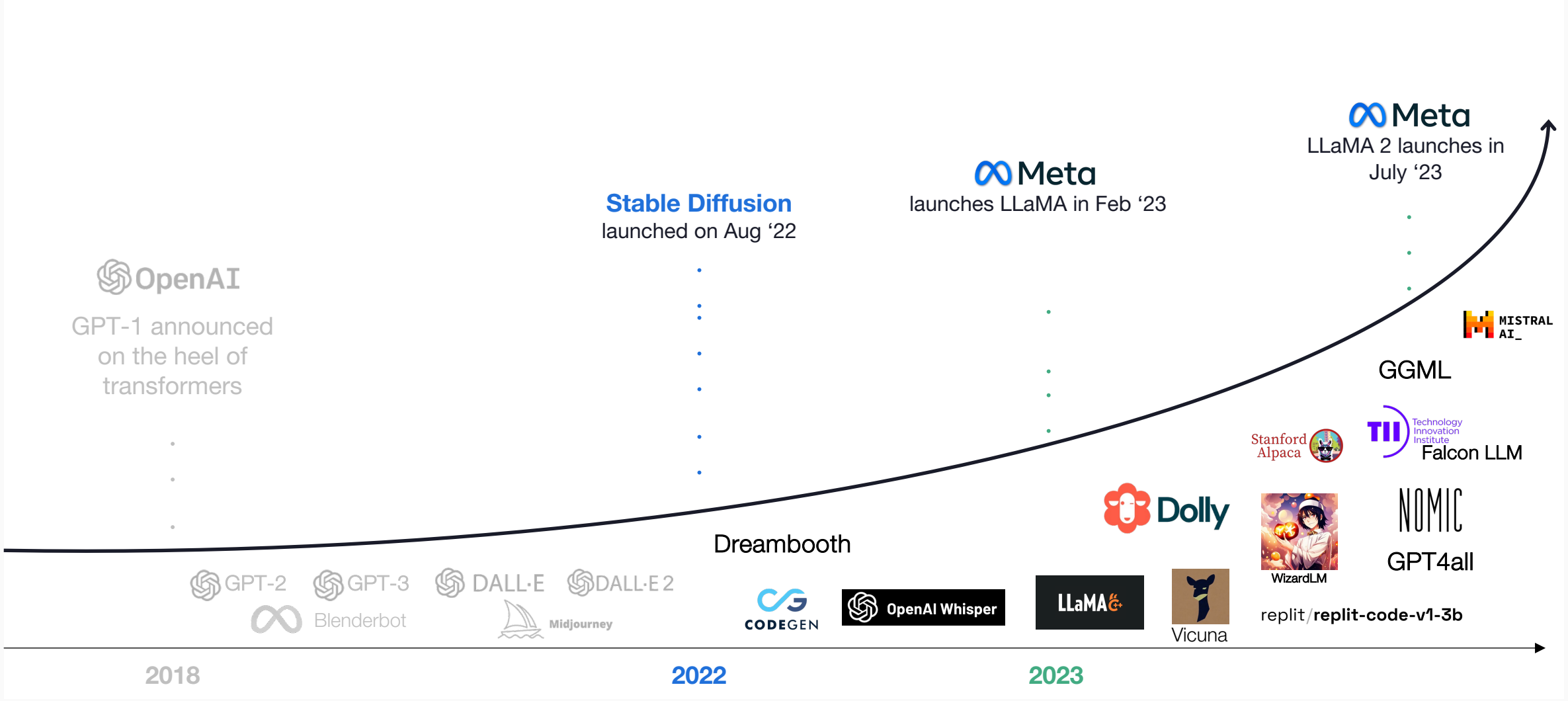
⟶ Cumulative AI/ML publications submitted on Arxiv



Source: Arxiv and Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Open collaboration accelerates innovation in AI

⟶ Illustrative launches of AI models over time (non-exhaustive)



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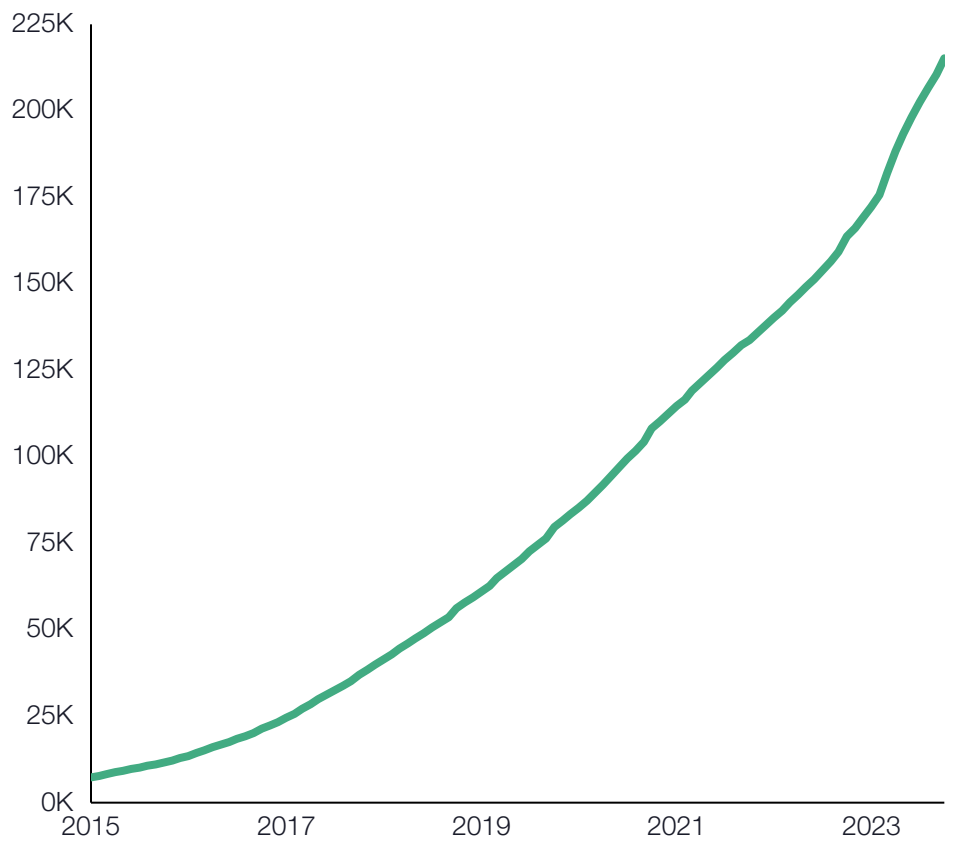
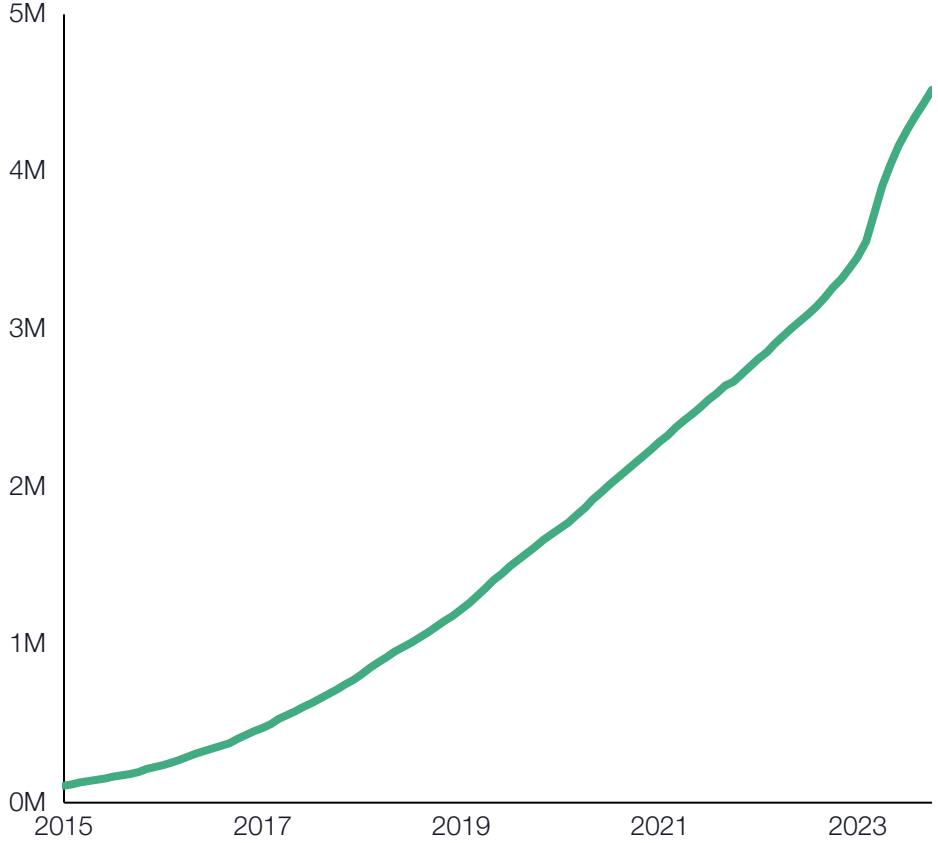
The AI developer community has exploded!

⟶ Software developers are becoming AI engineers



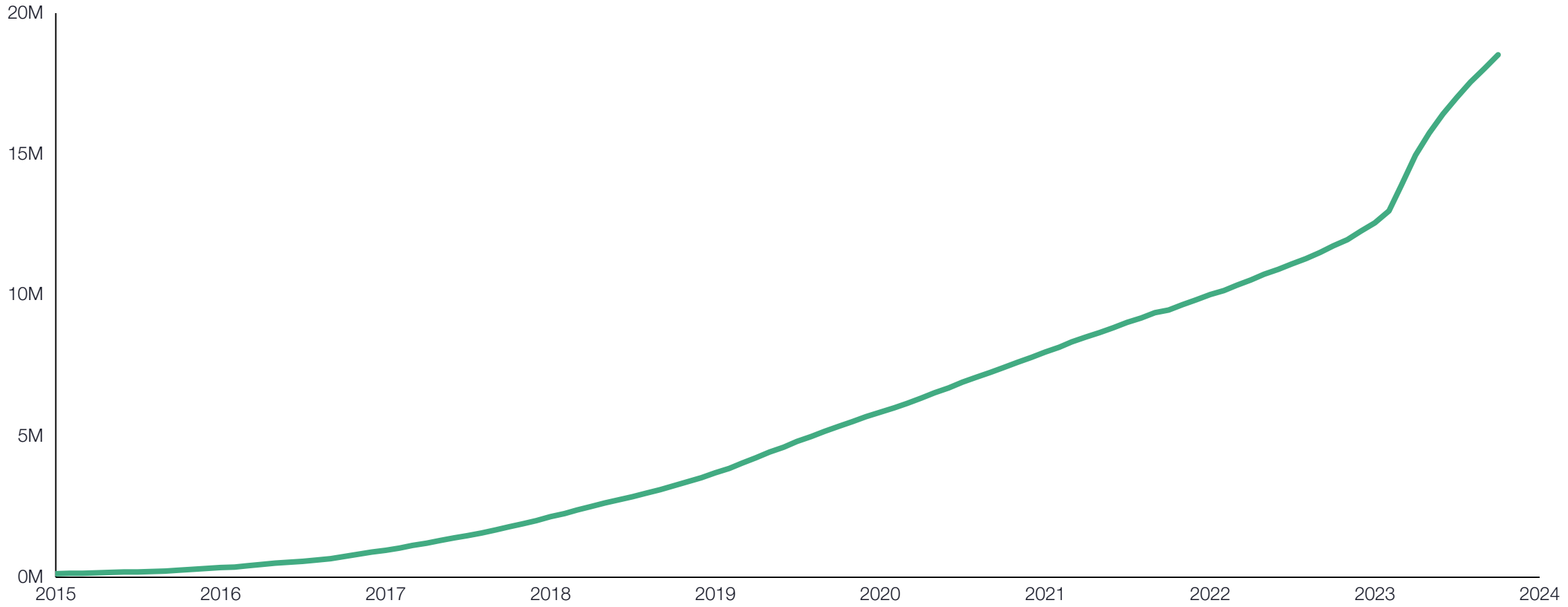
⟶ Hobbyists are getting involved



Source: Developers measured by number of unique people making commits to AI repositories. Engagement measured by unique users adding stars, filing issues, etc. These may not match what GitHub tracks internally and should not be construed as a source of truth. Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

GitHub has been a place to discover new AI/ML projects

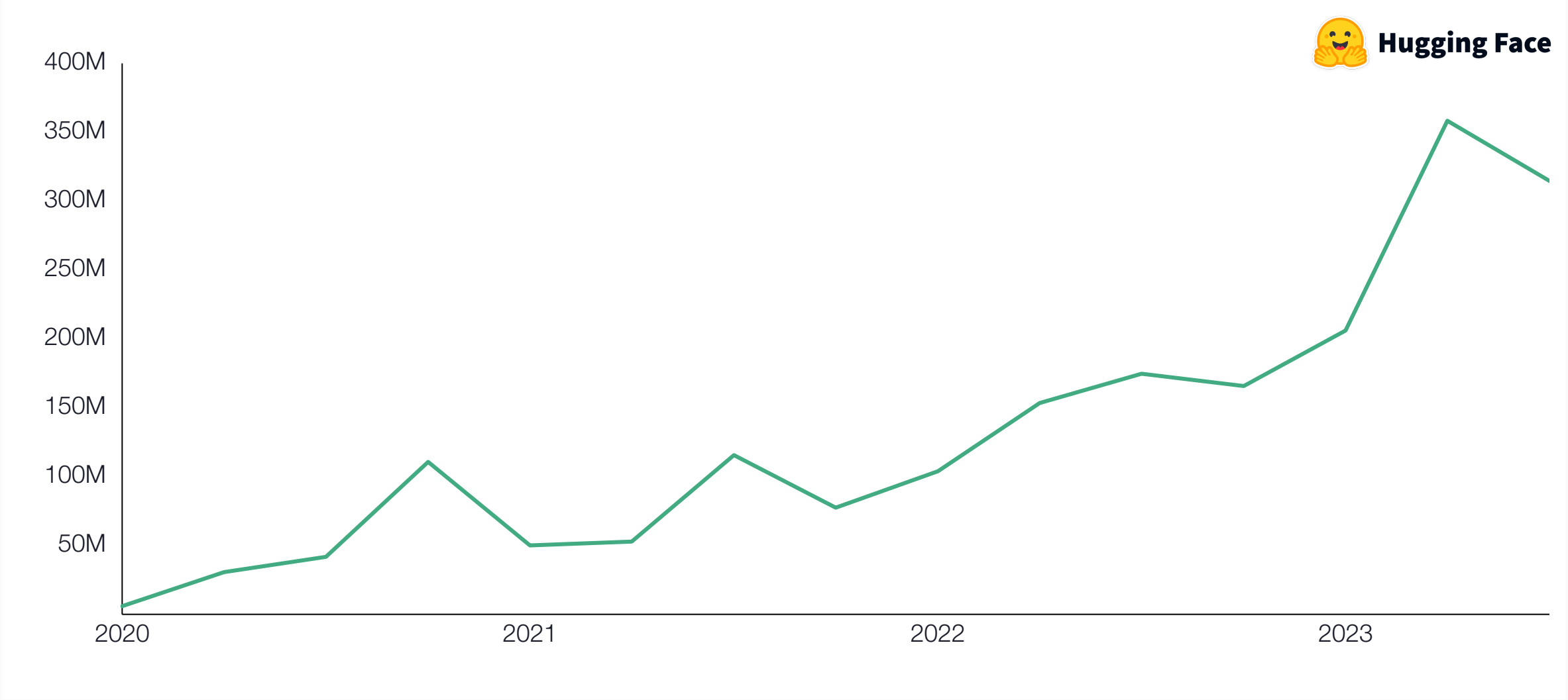
Cumulative GitHub stars given to AI/ML related projects



Source: GitHub as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Open-source AI is inflecting on Hugging Face as well

→ Number of times AI models have been downloaded from Hugging Face



Source: Tracks the quarterly averages of the number of downloads within last month for the Top 30 models on Hugging Face (ranked by number of downloads over the trailing 30 days). Coatue analysis and opinion of Hugging Face data as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

However, AI is not always truly "open" (1/2)

⟶ Coatue's open-source AI model checklist

Dimensions of openness	GPT-2 *Feb 2019*	GPT-3 *Jul 2020*	GPT-4 *Mar 2023*	LlaMA *Feb 2023*	LlaMA-2 *Jul 2023*	Mistral-7B *Oct 2023*
	OpenAI	OpenAI	OpenAI	Meta	Meta	Mistral AI
Model code	✓	✗	✗	✓	✓	✓
Model weights	◐	✗	✗	◐	✓	✓
Training data	✓	✓	✗	✓	✗	✗
Model evaluation	✓	✓	✓	✓	✓	✓
Architectural decisions	✓	✓	✗	✓	✓	✓
Open commercial license	✓	✗	✗	✗	◔	✓

Meta did not release training data specifics for LlaMA-2. Could training data be the next battleground?

Source: OpenAI GPT-3 and GPT4 papers as of September 2023, LLAMA-1 and LLAMA-2 papers as of September 2023, Google PALM details as of September 2023, Mosaic MPT model announcement as of September 2023, Information about each model taken from model publications and research papers. Models were selected based on broad popularity, across open source and proprietary large language models. Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

However, AI is not always truly "open" (2/2)

⟶ Coatue's open-source AI model checklist

Dimensions of openness	Codex *Aug 2021* OpenAI	Codegen *Mar 2022* salesforce	Code v1 *May 2023* replit	Dall-E 2 *Apr 2022* OpenAI	Midjourney *Jul 2022* Midjourney	Stable Diffusion 1.0 *Aug 2022* runway, EleutherAI, stability.ai, LMU, LAION
Model code	✗	✓	✓	✗	✗	✓
Model weights	✗	✓	✓	✗	✗	✓
Training data	◔	✓	✓	✗	✗	✓
Model evaluation	✓	✓	✓	✓	✗	✓
Architectural decisions	◑	✓	✓	✓	✗	✓
Open commercial license	✗	✓	✓	✗	✗	✓

Source: Openal Codex paper as of September 2023, Salesforce Codegen paperas of September 2023, Replit Code model announcement as of September 2023, Dall-E 2 paper as of September 2023, Midjourney website as of September 2023, Stable Diffusion announcement as of September 2023. Models were selected based on broad popularity, across open source and proprietary code and image models. Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Data is *finally* a new currency

⟶ Timeline of companies cracking down on data access in 2023

January 2023

- Announces lawsuit against Stability AI for infringing on copyright and trademark protections

April 2023

- Introduces new rules including mandatory negotiations with publishers for right to use content
- CEO announces plans to begin charging AI developers for access to data on the platform

July 2023

- Reddit turns on API pricing in July. A popular app Apollo would need to pay an estimated $20M / year

$12K for 50M API calls

July 2023

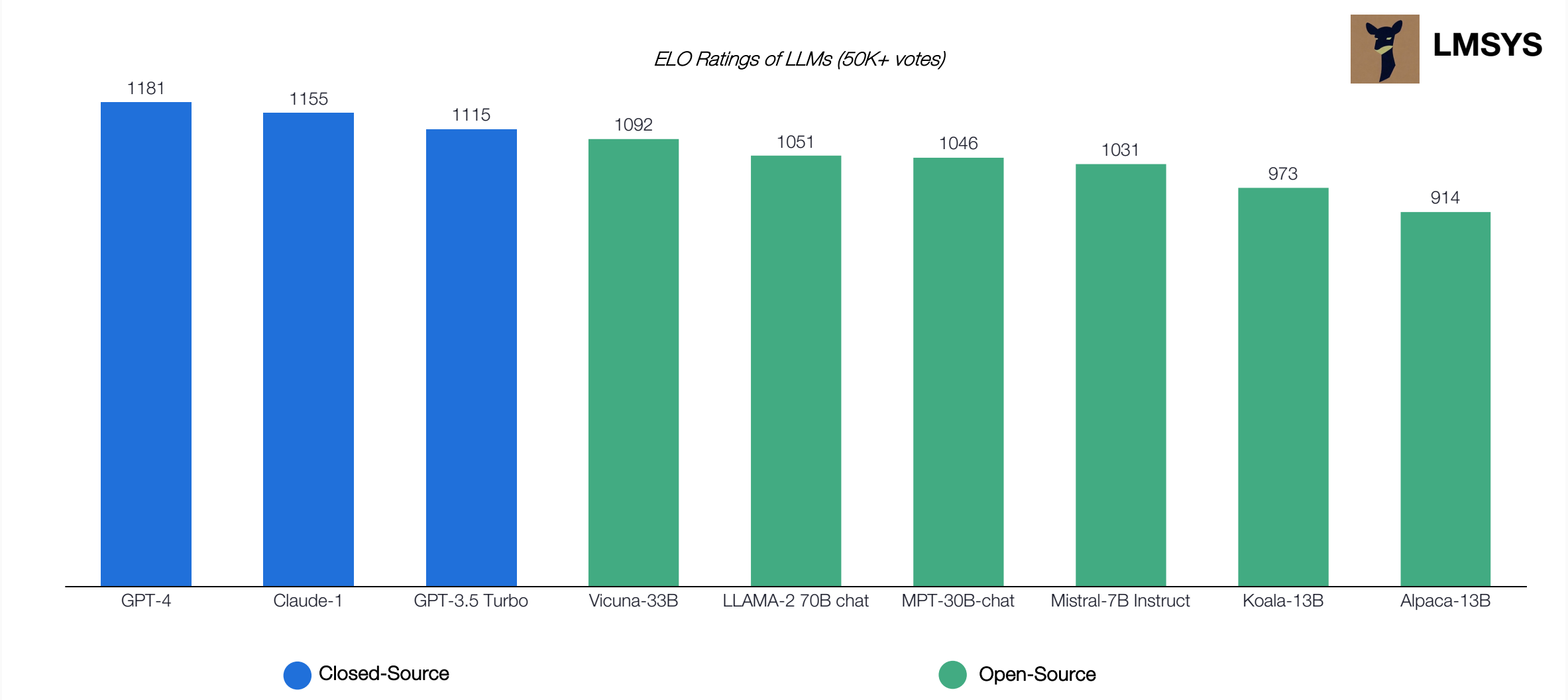
- X announces rate limits and cracks down on data scrapers

$5K for reading 1M posts (monthly)

Source: TheVerge as of January 2023, NewsAndMediaAlliance as of September 2023, 13NewsNow as of June 2023, Reuters as of July 2023, X as of September 2023, Coatue analysis and opinion as of November 2023. For illustrative purposes only. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Despite signs of “closed AI”, open-source models are catching up

⟶ Chatbot rankings based on human feedback

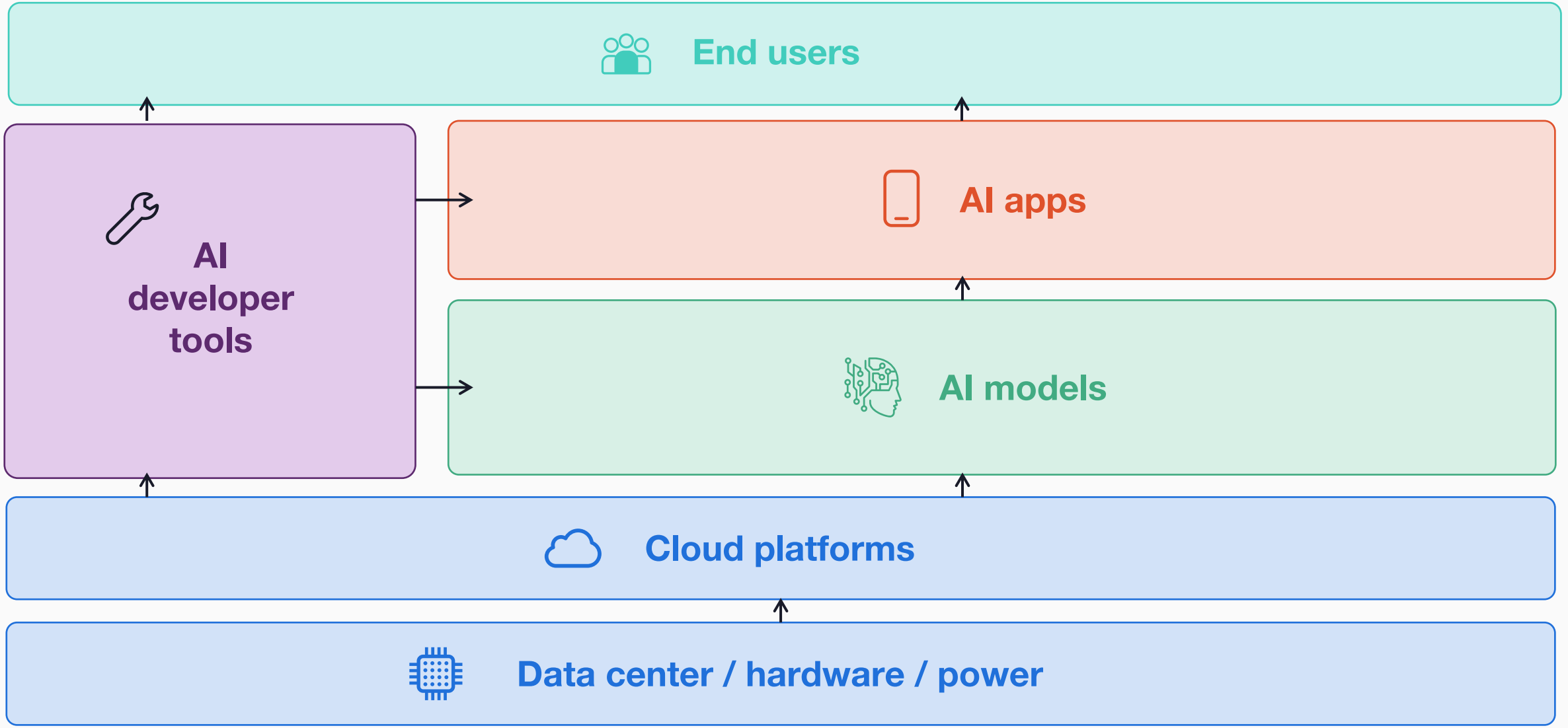


Source: LMSYS as of November 2023, Coatue analysis and opinion as of November 2023. Non-exhaustive list of models from LMSYS, selected to show representative list across different model providers and sizes, and is not in order of LMSYS rankings. For illustrative purposes only. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. There is no guarantee that Coatue’s views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Key Topics

- Where we are in AI today
- AI could break through the hype and improve our world
- We believe open-source is the lifeblood of AI
- **AI is transforming the tech ecosystem**
- Coatue view: the best of AI is yet to come

The new AI-centric technology ecosystem



COATUE

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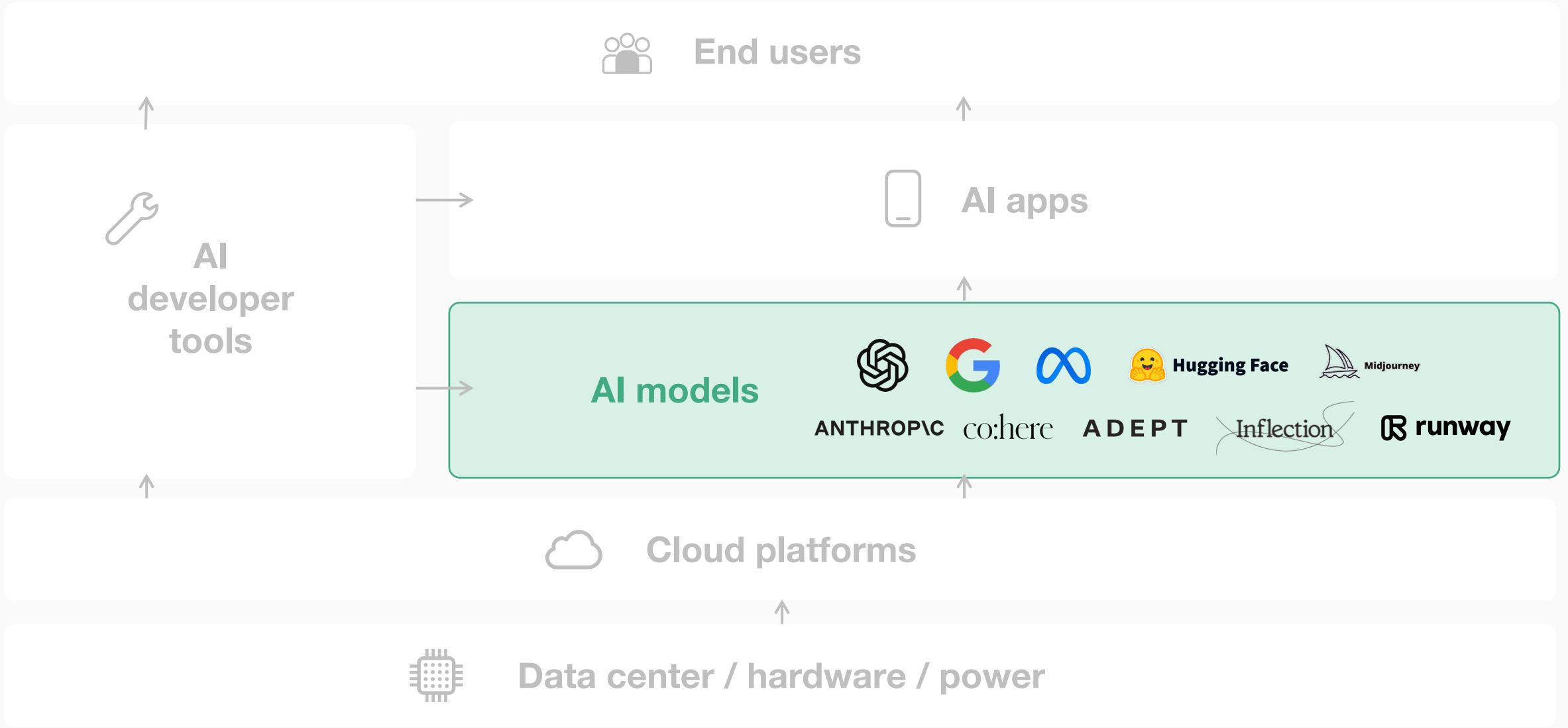
Foundation models are at the center of AI



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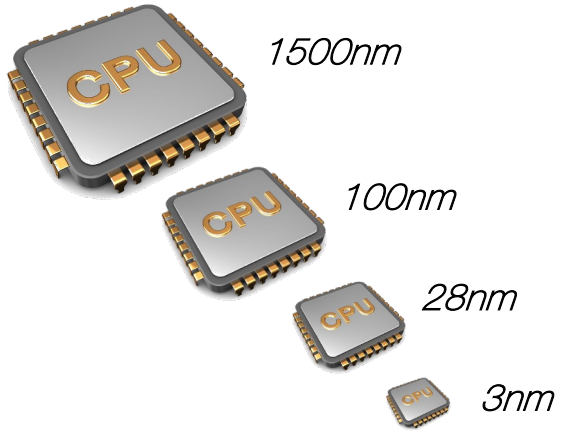
Last 50 years was about building faster & faster “calculators”…



CPU

Serial processing

“1 instruction at a time”

Chips got smaller & more powerful

```
double AttackerSuccess (double q, int z)
{
      double p = 1.0 – q;
      double lambda = z * (q /p);
      double sum = 1.0;
      int i, k;

      for (k = 0; k <= z; k++)
      {
            double poisson = exp(-lambda);

            for (i = 1; i <= k; i++)
            {       sum -= poisson * (1 – pow(q / p, z))
      }
return sum;
}
```

Software

Based on instruction by programmer

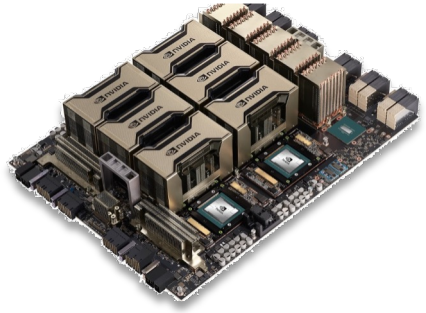
Follows sequential programming logic

Does not require data

Computer or “Calculator”

Source: Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue’s views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

But next 50 years will be about building super-intelligent “brains”

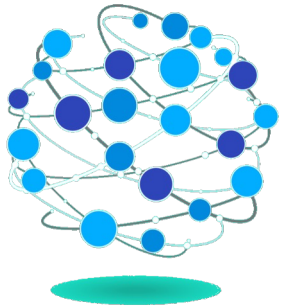


GPU

Parallel processing

Many calculations simultaneously

+



AI Models

Neural networks trained by data

Learns patterns from data

System makes decisions based on model rather than explicit instructions

“Reasoning” is opaque,
not driven by programming logic

=

Brains

Much more than calculators!

Could become connected:

Brain-to-brain network = AI Internet?

Source: Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue’s views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI enables a new platform: Intelligence-as-a-service

Intelligence is the next layer of innovation

Today

Yann LeCun ✓ ∞
@ylecun

"[One of my] opinions on current LLMs: They are "reactive" & don't plan nor reason."

Future

Sam Altman ✓
@sama

"The right way to think of the models we create is a reasoning engine, not a fact database."

IaaS	PaaS	SaaS	IQaaS
Infrastructure-as-a-service	Platform-as-a-service	Software-as-a-service	Intelligence-as-a-service

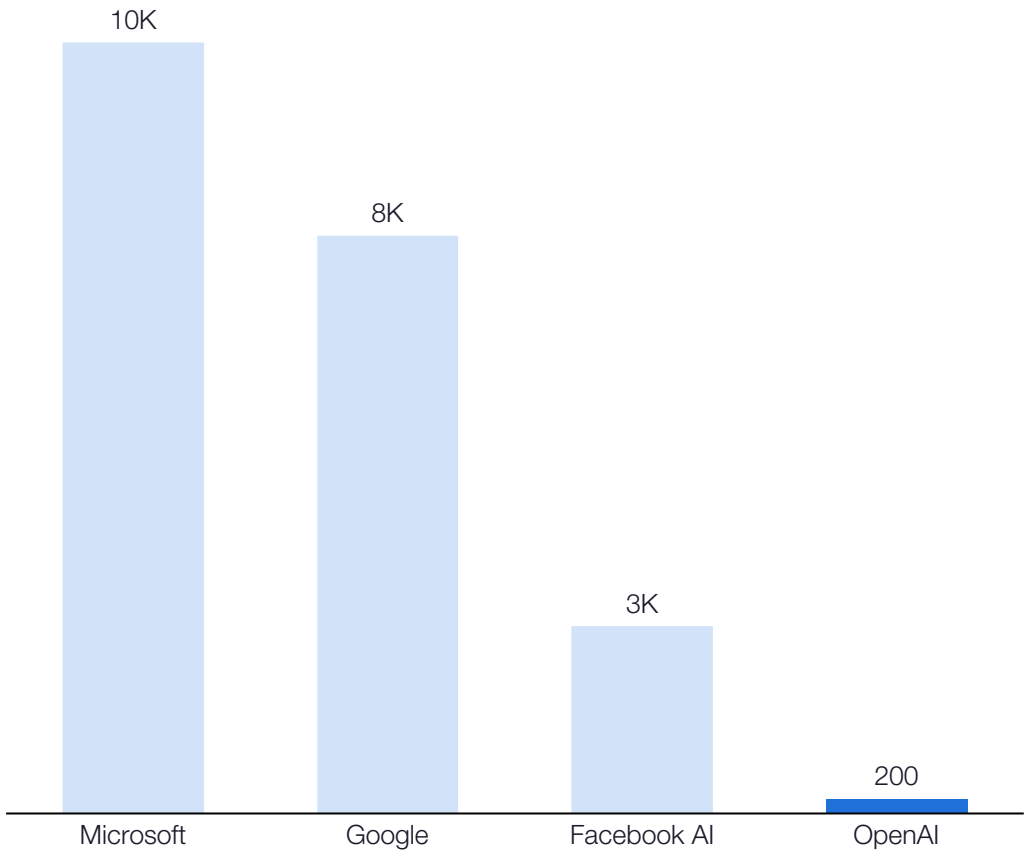
1	**Augment** our capabilities	GitHub Copilot, Poe
2	**Automate** our workflows	Cursor, runway
3	**Change** our existing behaviors	OpenAI GPTs, character.ai

Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

More research & headcount is not enough to win in AI

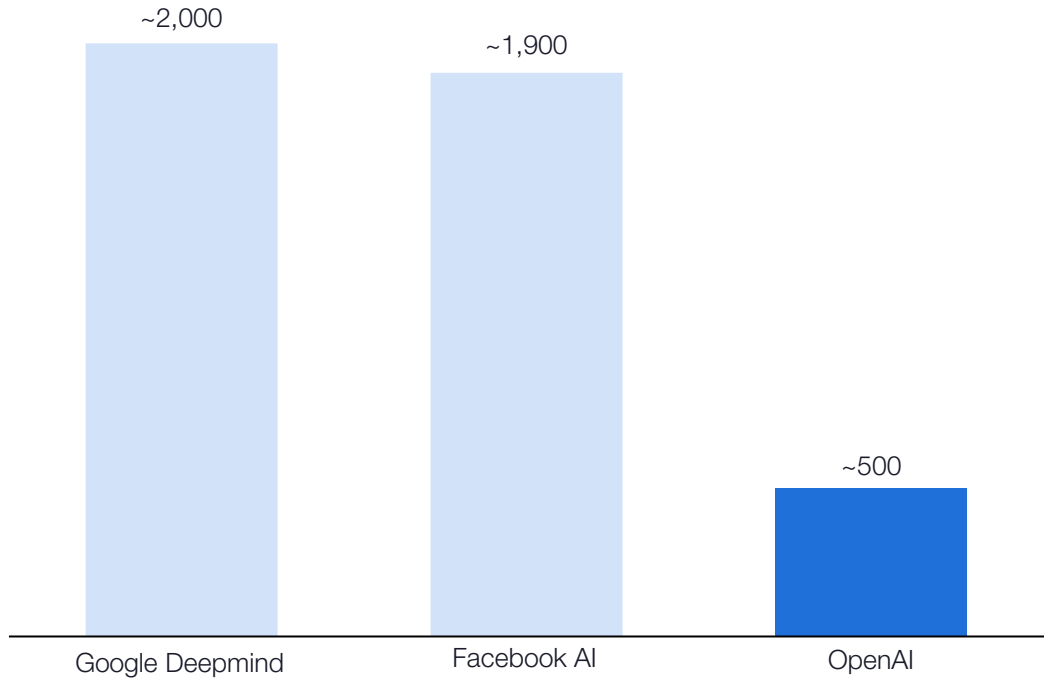
⟶ MSFT leads big research houses in publications

Number of AI/ML related research publications



⟶ OpenAI has shipped faster than larger peers

Number of AI/ML related full-time employees

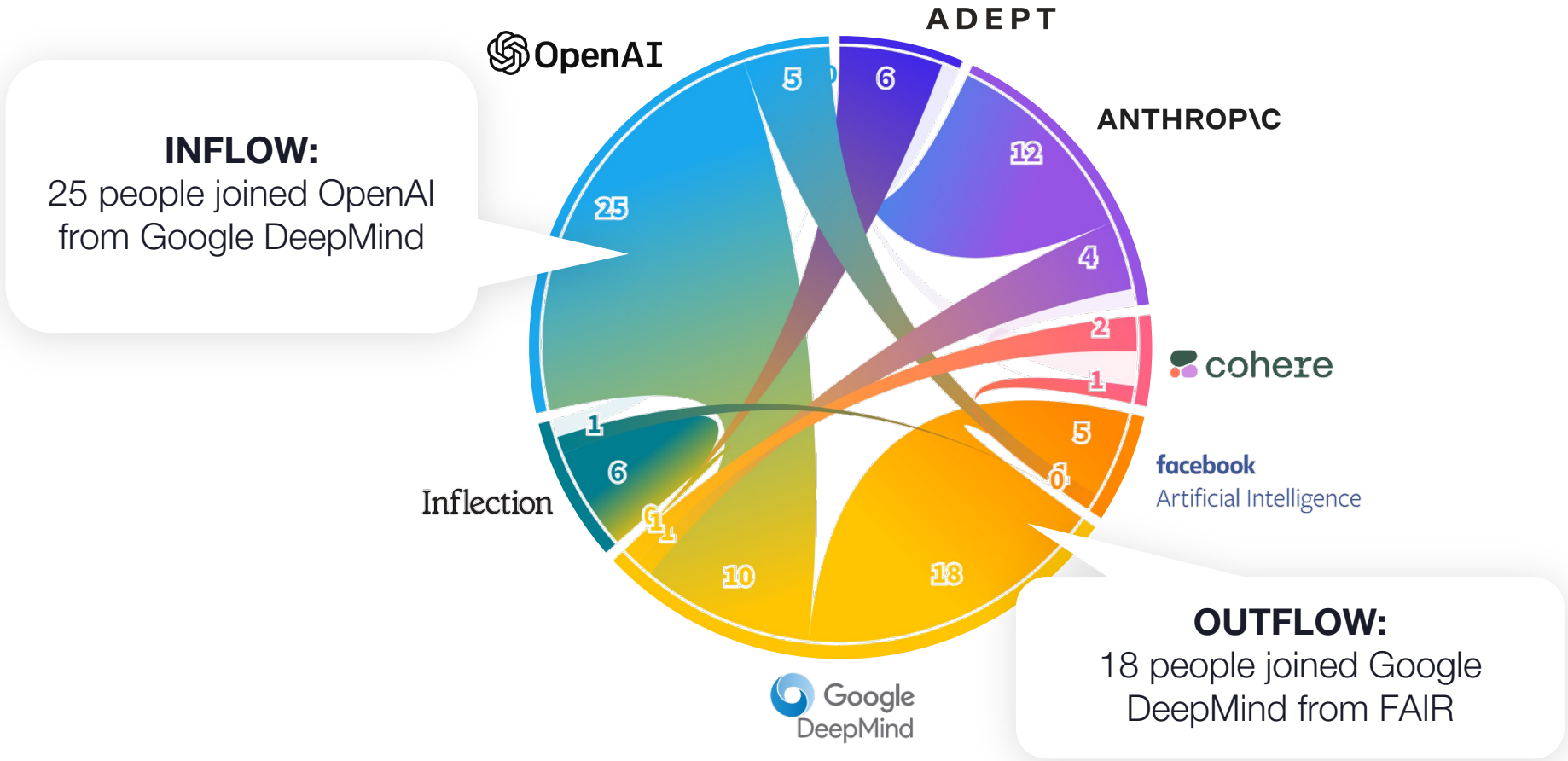


Source: CSET as of September 2023, OpenAI as of September 2023, Coatue analysis and opinion as of November 2023. Deepmind headcount is of all employees based on Coatue tracking. Facebook AI headcount represents all Coatue labeled "ML" engineers at the company, not solely FAIR. OpenAI headcount represents all engineering headcount. OpenAI has shipped Chat-GPT, GPT-4, GPT-4Vision, Dalle-3 in last 12 months, compared to Google shipping Bard, Meta shipping LLAMA-1 and LLAMA-2 as far as major releases. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Talent has historically been concentrated at a few AI model hubs

⟶ Major AI model providers are "poaching" talent from one another

Talent inflows & outflows at major research hubs



INFLOW:
25 people joined OpenAI from Google DeepMind

OUTFLOW:
18 people joined Google DeepMind from FAIR

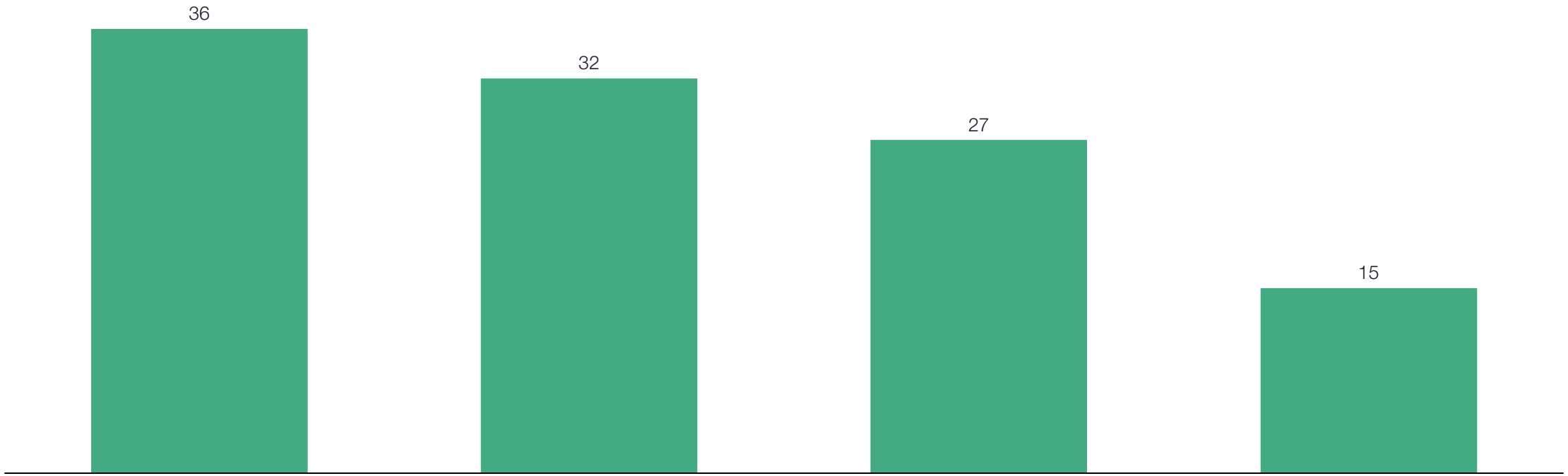
Illustrative only: Represents both direct & indirect (>1 hop) flows of talent

Source: Coatue analysis and opinion as of November 2023. For simplification, DeepMind includes Google Brain. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Many talented people are now leaving to start new companies

⟶ Example AI mafias

Number of founders from AI research houses



Founders from:	Google DeepMind	Google Brain	OpenAI	facebook Artificial Intelligence
Example companies founded:	Inflection	Character.AI	ANTHROP\C	Mistral AI

Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Scaling AI model performance has been a focus of AI researchers

Strategies to scale	Open research questions	Coatue View
More parameters	**Will scaling parameters** continue improving performance?	+ GPT-4 still “king”; scaling experiments likely continuing
Larger datasets	**How much data is optimal** for training models?	+ Larger models need more data; extending data runway & optimizing quality crucial
More compute	Can we **reduce the compute costs** of training & inference?	+ Training & inference is getting optimized; AI at the edge is emerging
Longer training	**Can training for more epochs** improve performance?	? Still an open question

Focus of remainder of section

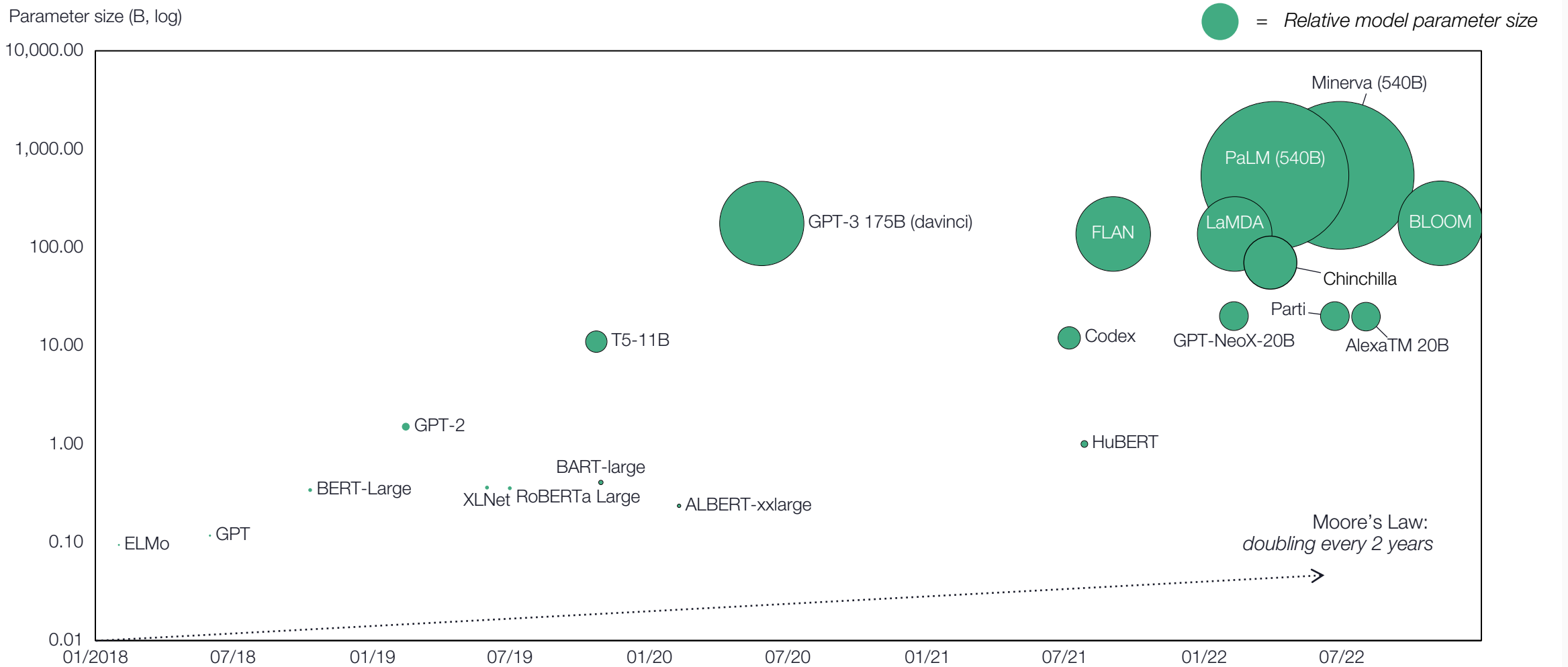
Covered in next section on Cloud, DC, Semis

Not covered; waiting for more data points to emerge

Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue’s views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Through 2022: We saw LLM parameters balloon!

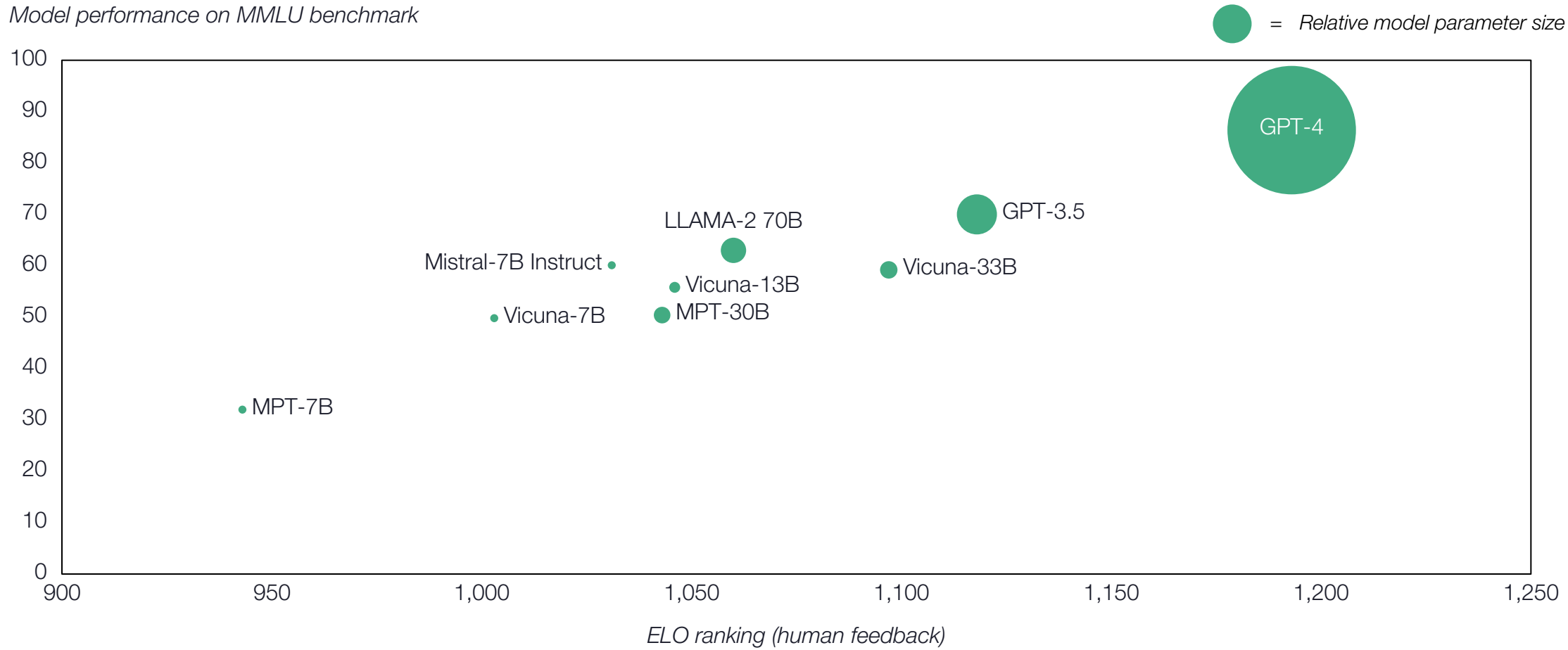
⟶ Illustrative view of parameter sizes of large language models through 2022



Source: Arxiv as of September 2023, Hugging Face as of September 2023, Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Model names listed above are examples of the applicable AI models; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

2023: GPT-4 remains “king”…can we continue scaling?

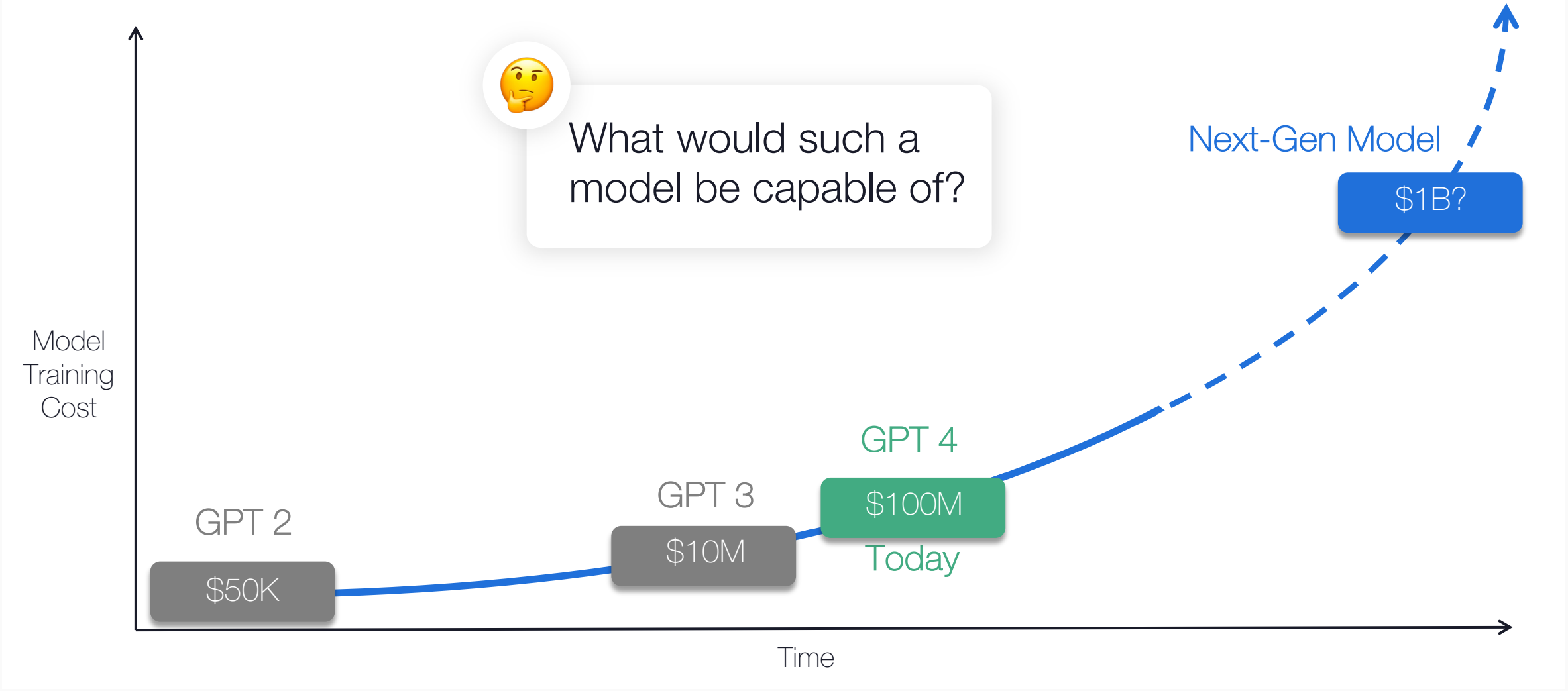
⟶ Comparison of 2023 models across ELO ranking and MMLU benchmarks…GPT-4 is still the best



Source: LMSYS, Hugging Face, Semianalysis, Coatue analysis and opinion as of November 2023. Selected benchmarks are examples and are not exhaustive nor are they representative of objective “truth” about which models are better. For illustrative purposes only. There is no guarantee that Coatue’s views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Model names listed above are examples of the applicable AI models; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

What if there was a $1B training-cost model?

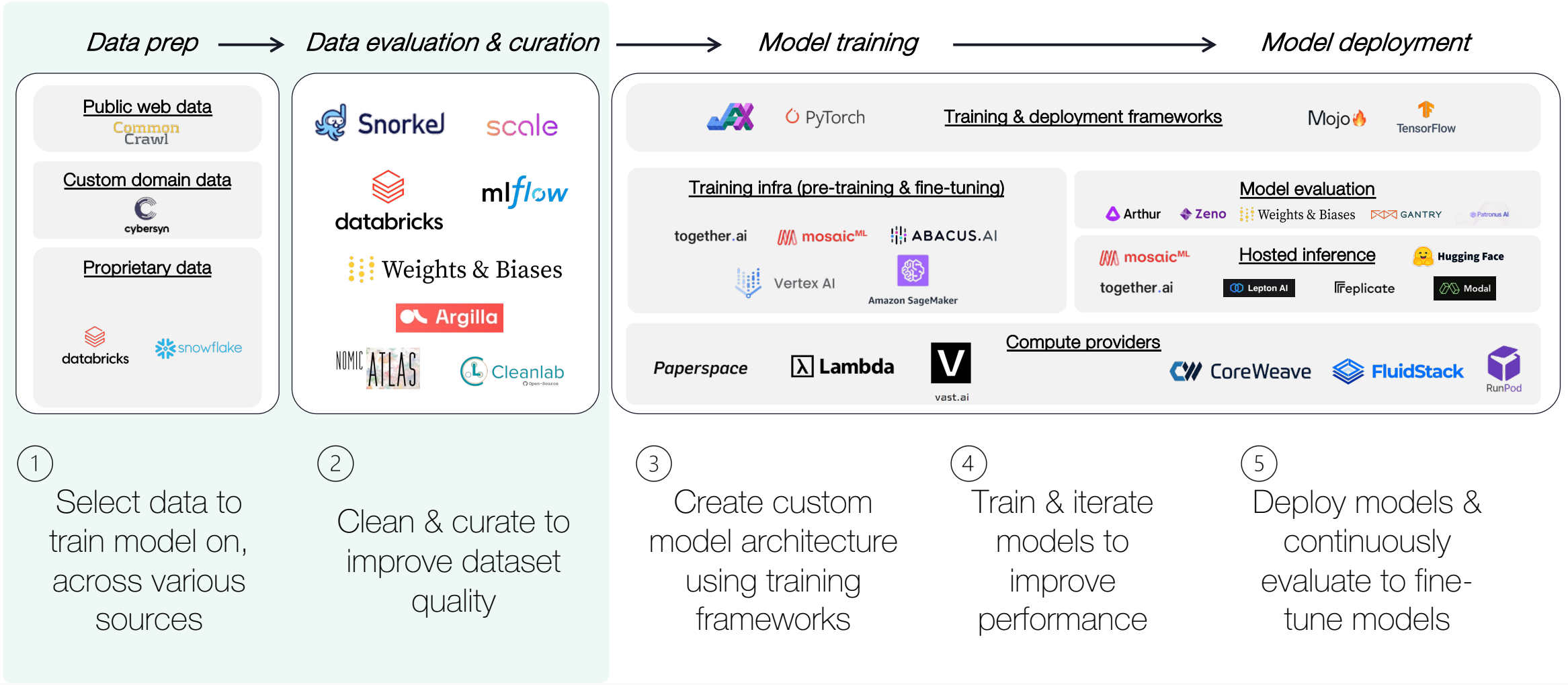
⟶ Model Training Cost Over Time



Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

How AI models are made: Data is a crucial component

→ **Data is upstream in process of developing good models**

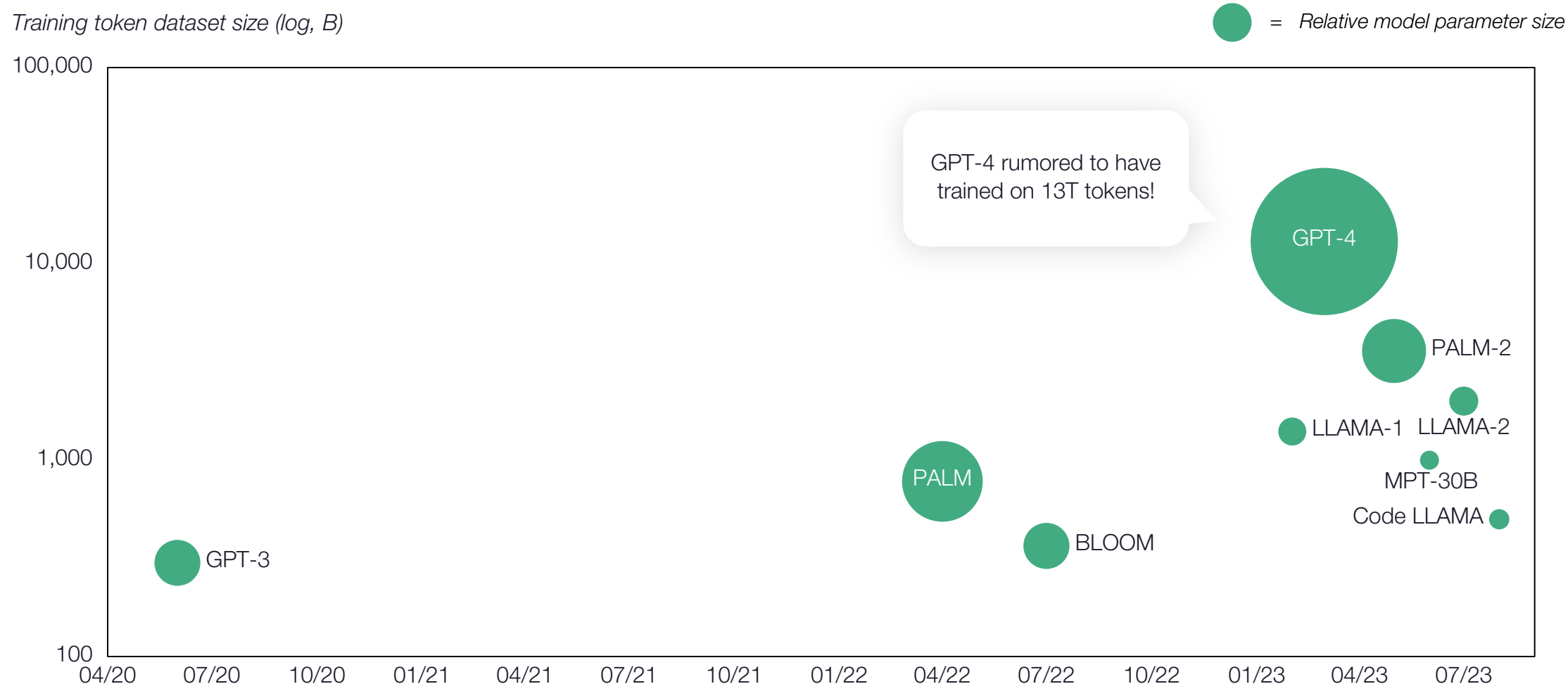


1. Select data to train model on, across various sources
2. Clean & curate to improve dataset quality
3. Create custom model architecture using training frameworks
4. Train & iterate models to improve performance
5. Deploy models & continuously evaluate to fine-tune models

Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Scaling models require scaling datasets

⟶ Number of tokens in training datasets increasing overall

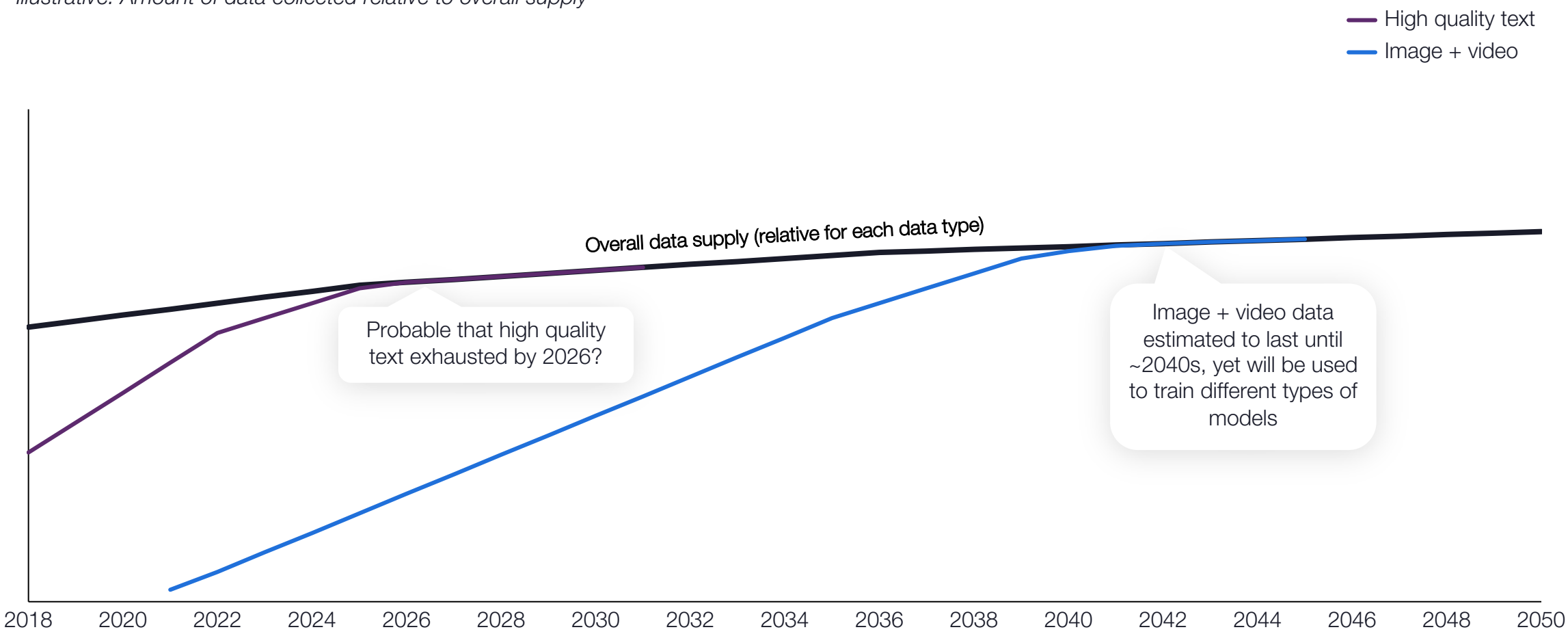


Source: Arxiv, Hugging Face, Meta, Semianalysis, PapersWithCode, CNBC, Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Model names listed above are examples of the applicable AI models; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Data scarcity is a potential wall to scaling models

⟶ High-quality text data could be exhausted soon, images & video have longer runway

Illustrative: Amount of data collected relative to overall supply



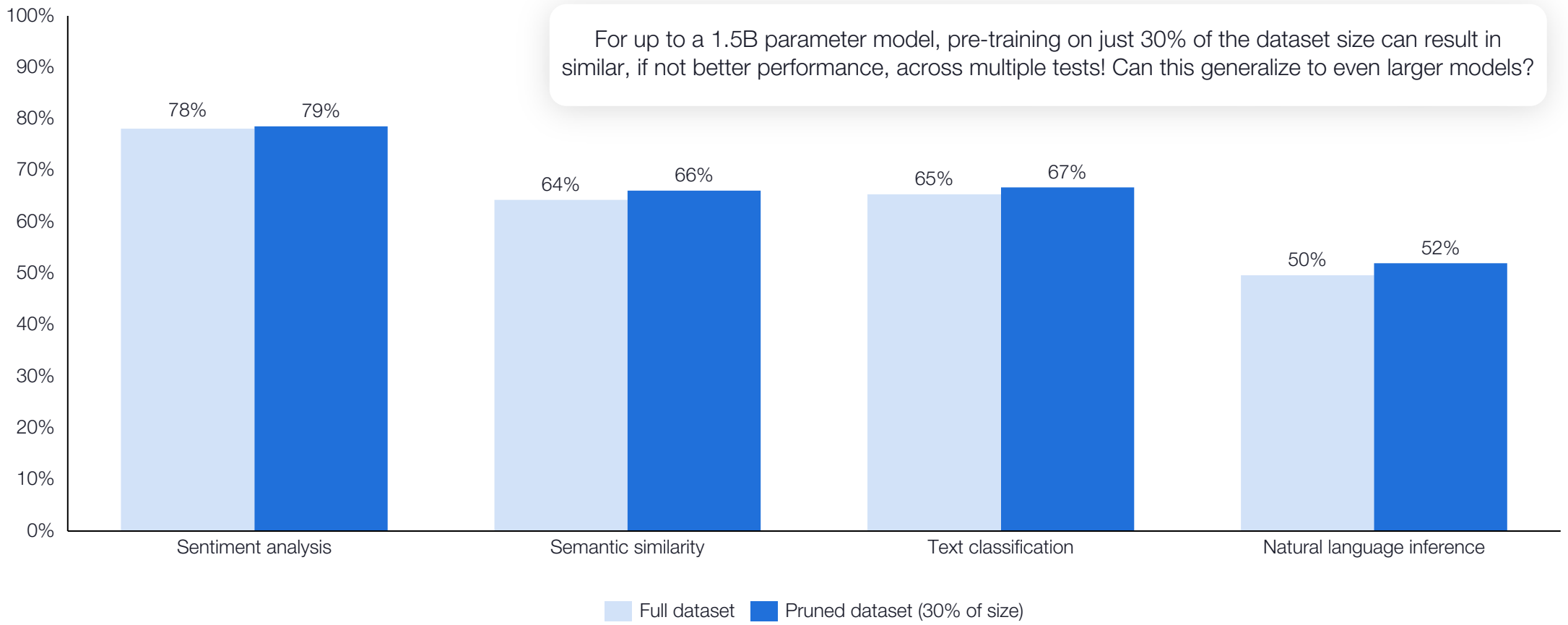
Source: Arxiv (Villalobos 2022), Coatue analysis and opinion as of November 2023. For illustrative purposes only; there is no guarantee that data will be exhausted or that image and video data will have a longer runway. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Data quality is just as important as data quantity

→ Emerging evidence that training on pruned datasets can result in similar performance in language models

Performance on variety of language model benchmarks

cohere

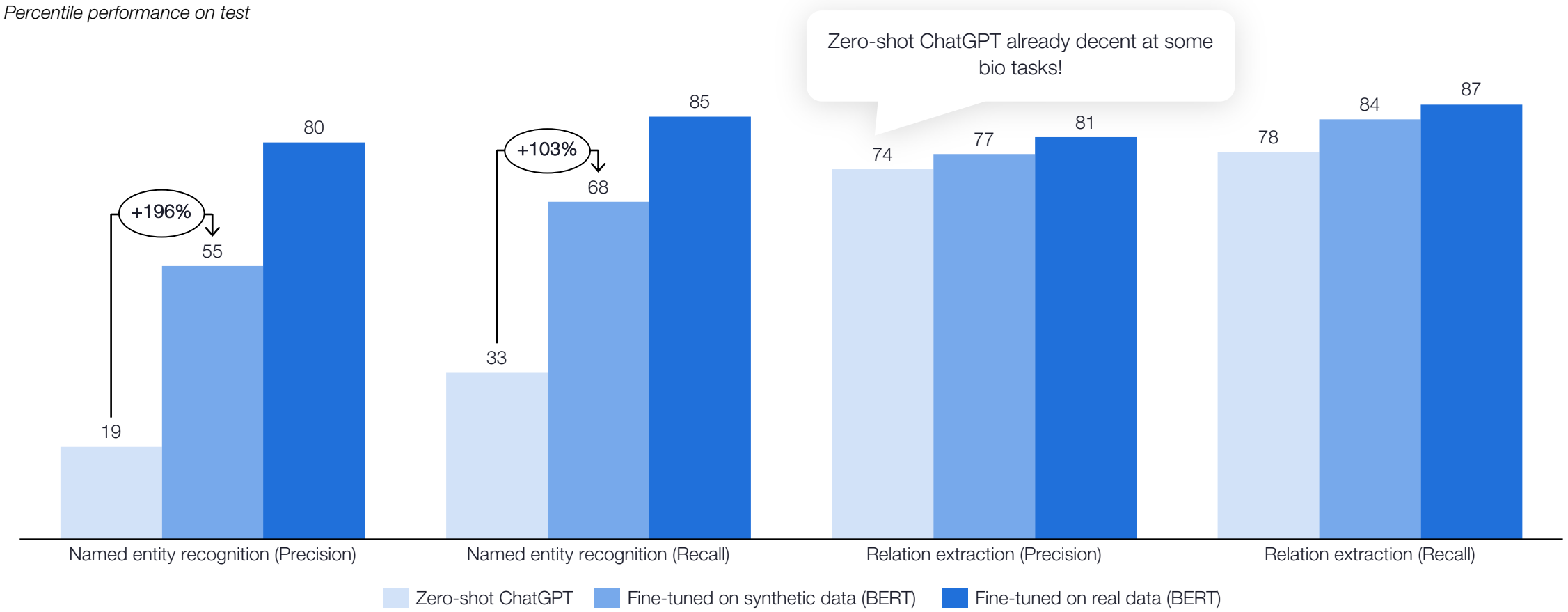


Source: Cohere as of September 2023, note that tested model sizes range from 124M to 1.5B. Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable statements or trends; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Synthetic data can augment fine-tuning

⟶ Synthetically generated data can help clean or distill datasets for fine-tuning

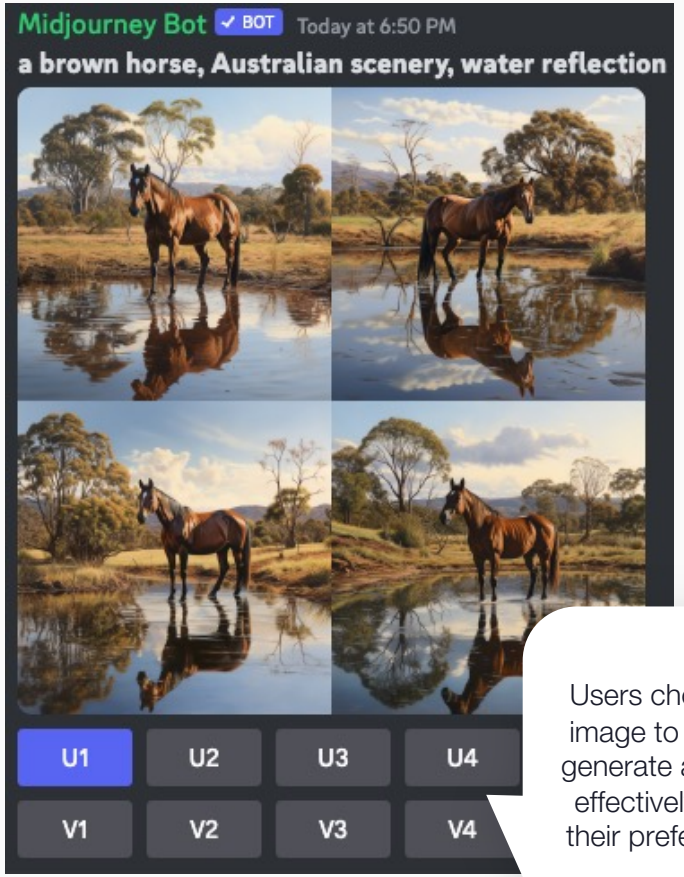
Results: Synthetic data fine-tuning yields significant improvement compared to zero-shot attempts, though is not yet comparable to real data



Source: Arxiv (Tang 2023), Coatue analysis and opinion, as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

User feedback data is another way to improve performance

Midjourney collects user feedback to continue refining models



Users choose which image to upscale (or generate a variant of), effectively choosing their preferred image

Prompt `/dungeons and dragons, female knight, of the rolling plains, full body, dark azure, victorian genre paintings, serene face, realistic depiction of light, golden light`

Midjourney V1 (Feb 2022) →

V2 (Apr 2022) →

V3 (Jul 2022)

V4 (Nov 2022) →

V5 (Mar 2023) →

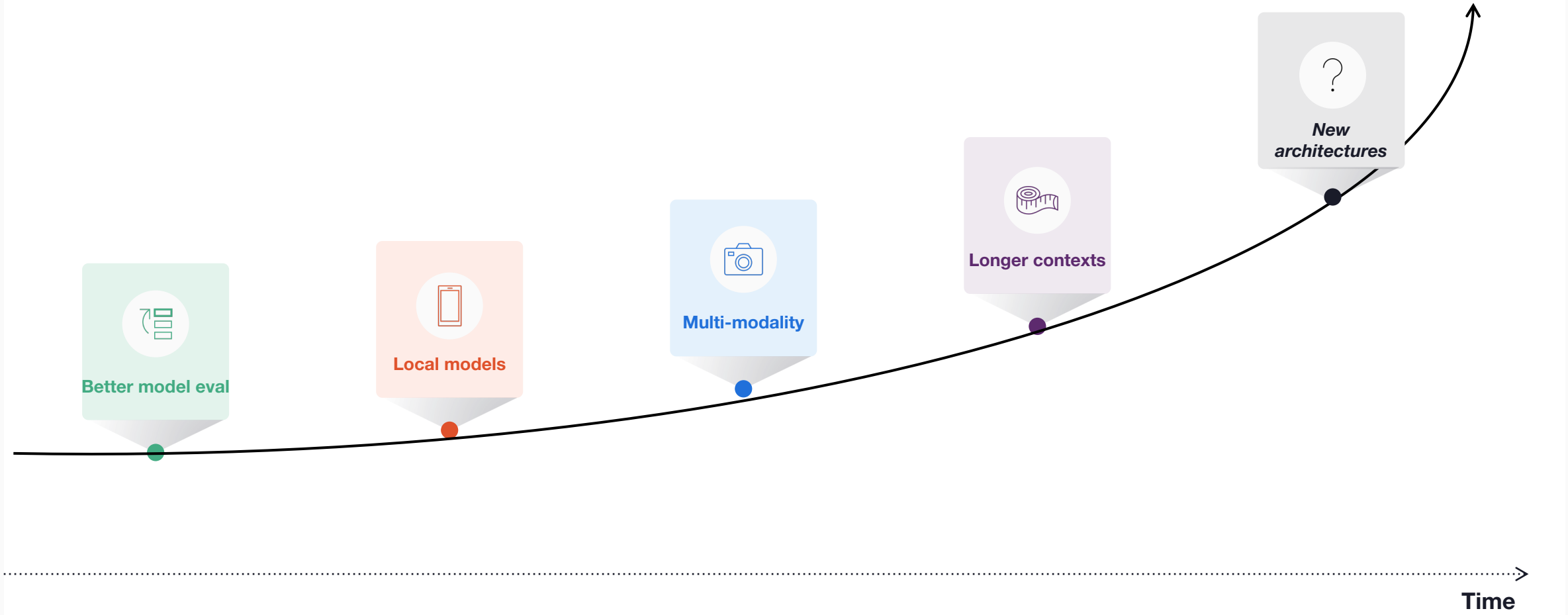
V5.2 (Jun 2023)

Note: Midjourney improvement is partially due to collecting user feedback but is only one part of the equation!

Source: AITuts, DIscord, Coatue analysis and opinion, as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

There are many other opportunities to improve models!

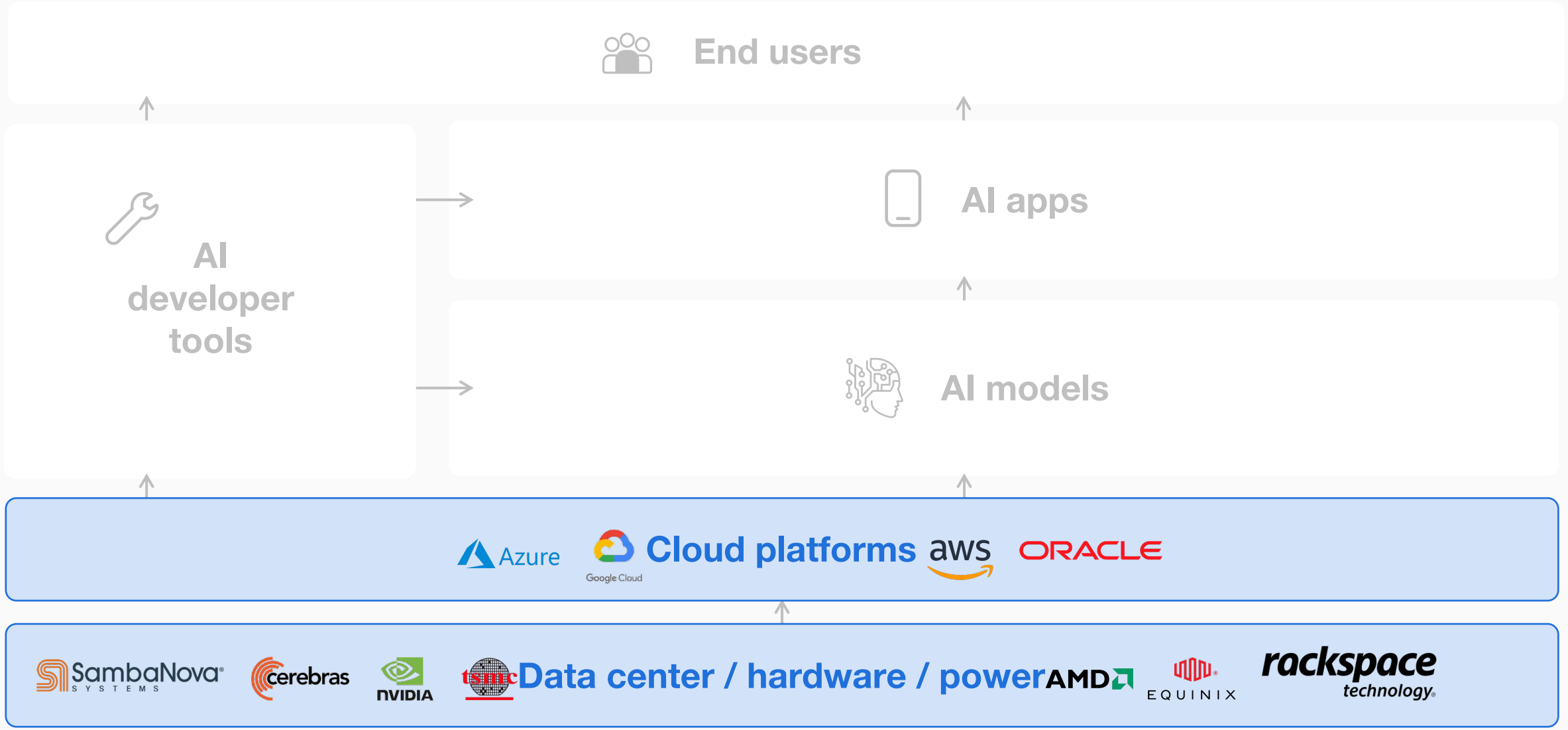
⟶ Beyond scaling parameters & data, there are many angles to push on



Non-exhaustive, illustrative opportunity set

Source: Coatue analysis and opinion, as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI has potential to re-accelerate underlying infrastructure

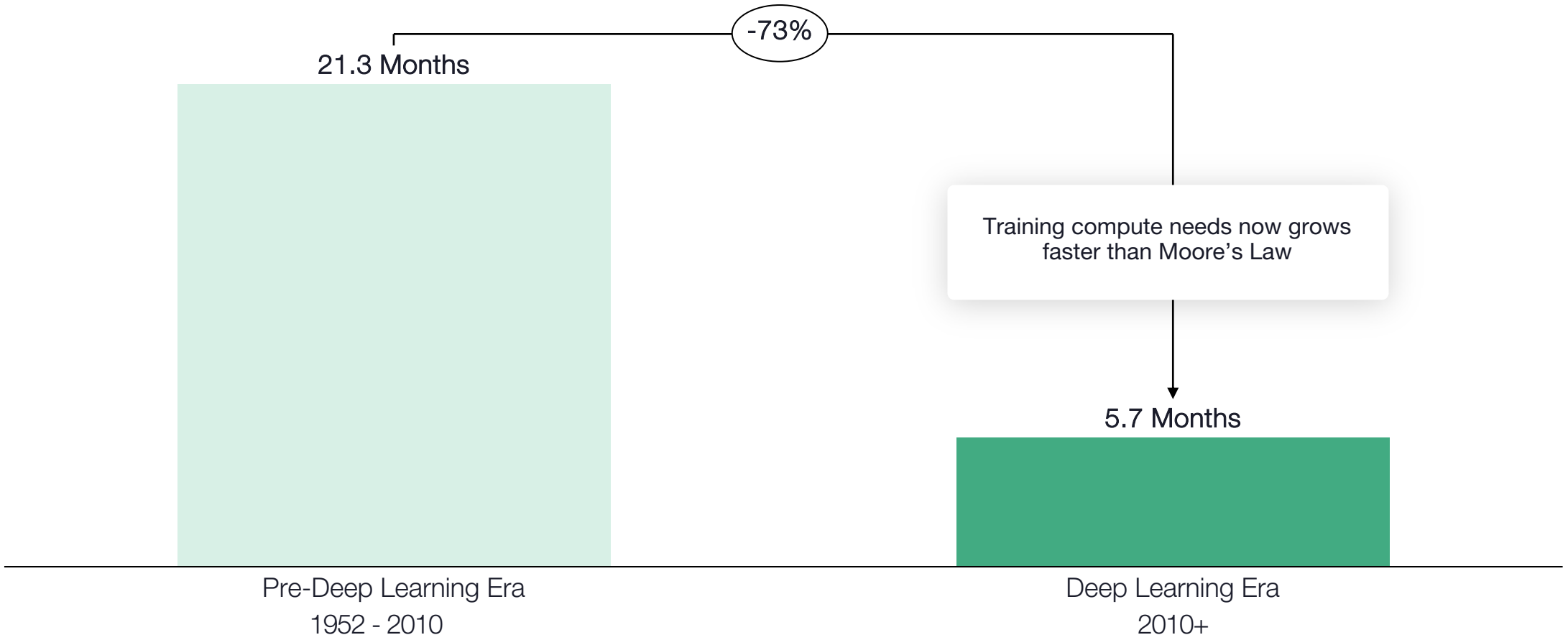


Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

This AI wave has been extremely compute hungry

→ ML models are doubling compute needs for training in months

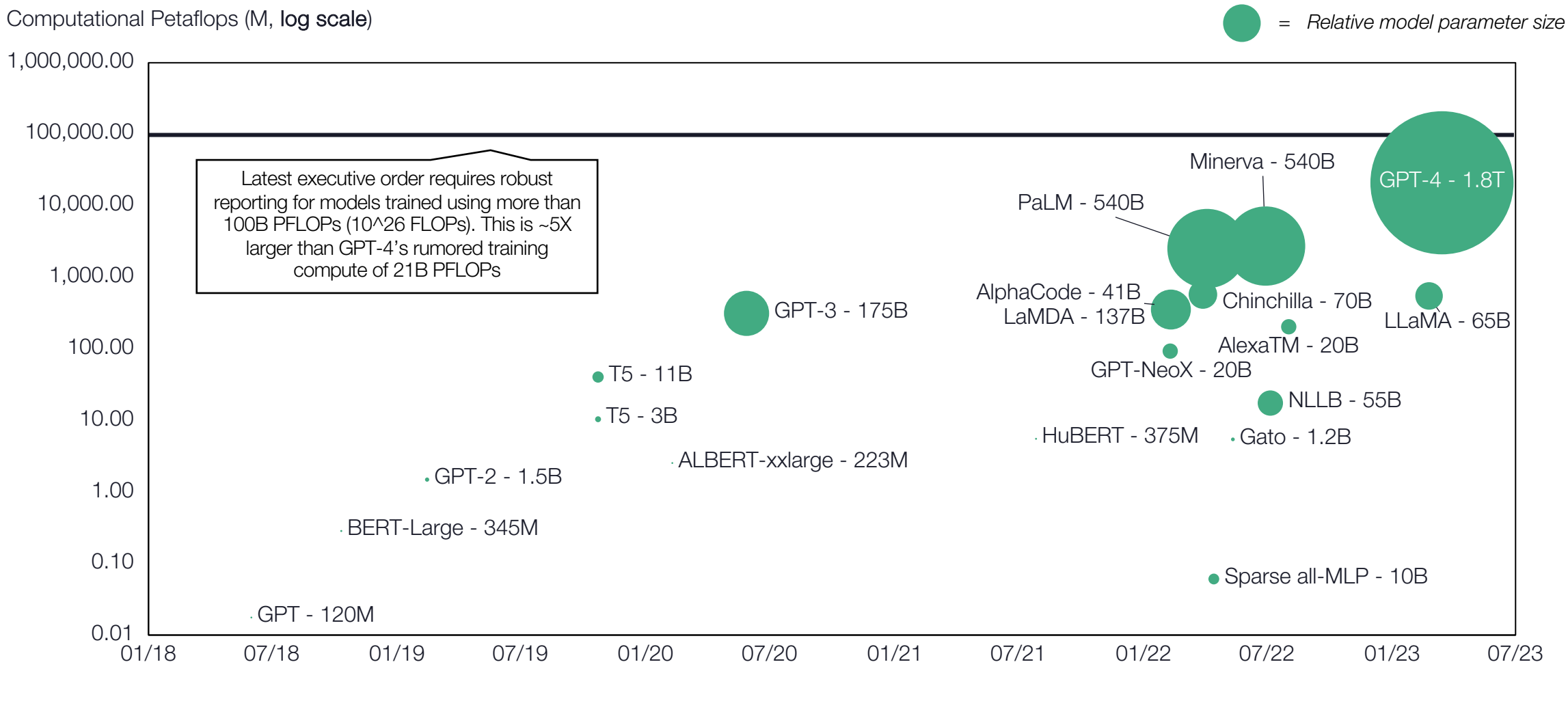
Months to double FLOPS used in model training



Source: Arxiv, Coatue analysis and opinion, as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Training compute has exponentially increased with model sizes

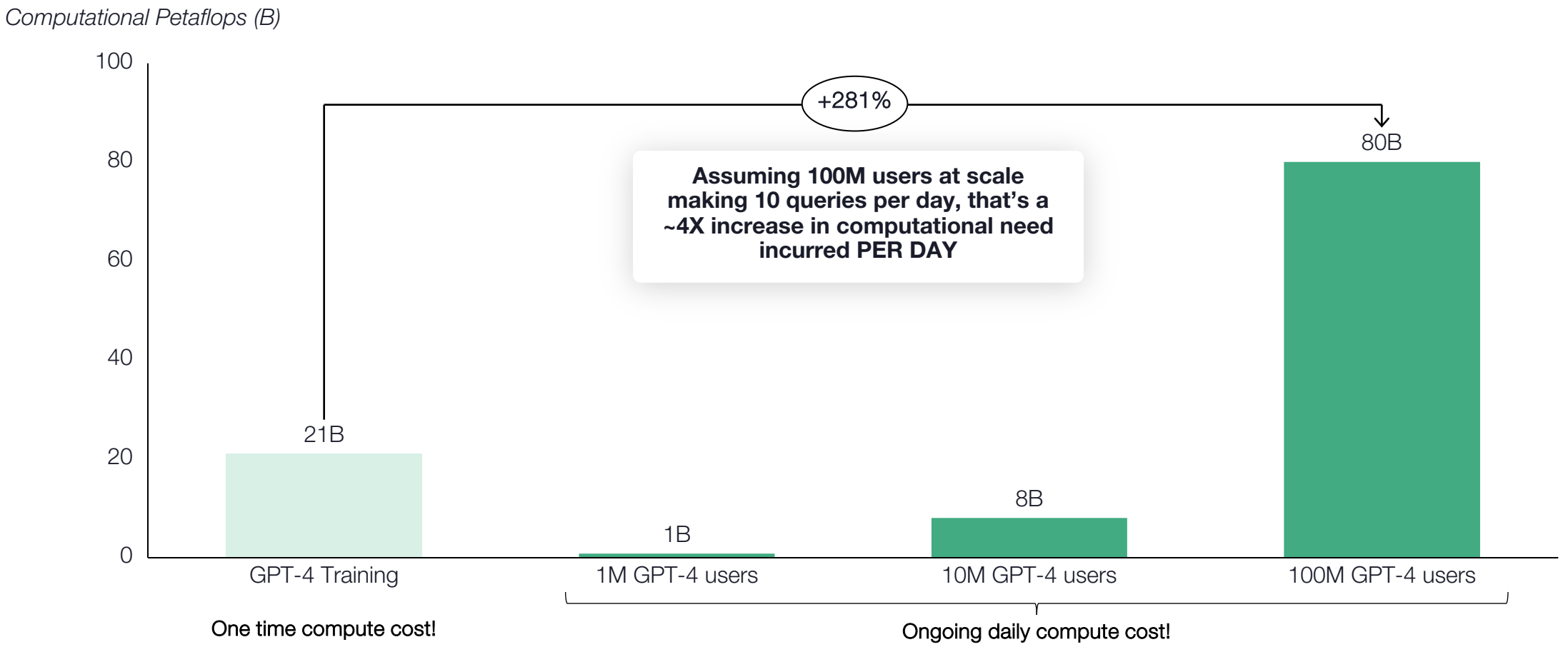
⟶ Massive inflection in compute needs for AI, ~70X increase from GPT-3 to GPT-4



Source: Epoch AI as of September 2023, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Model names listed above as examples of the applicable AI models; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Inference compute likely to dramatically outpace training

→ Ongoing inference likely to require much more compute than one-time training

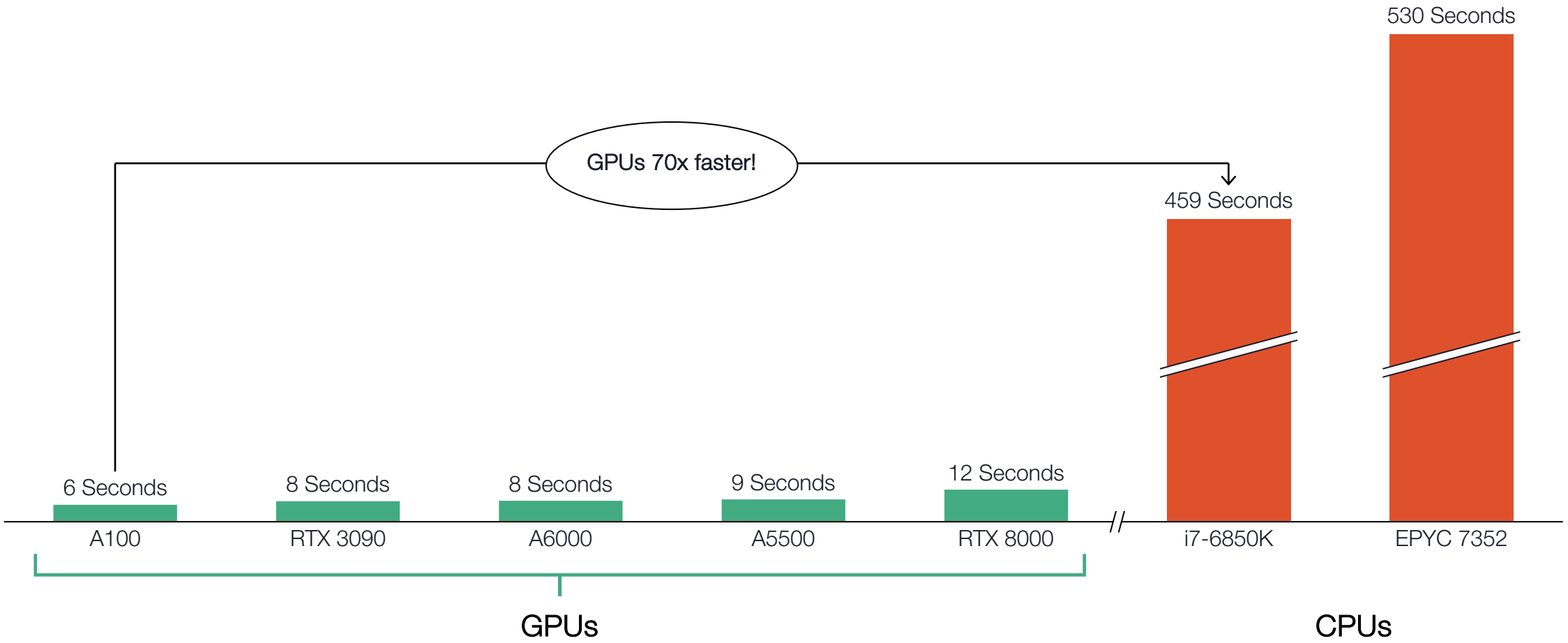


Source: Semianalysis, Coatue opinion and analysis as of November 2023. Assumes 560 TFLOPS/token, 150 tokens per query. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI compute has been primarily served by GPUs

⟶ GPUs are able to serve AI workloads much faster than CPUs

Time to produce an image with Stable Diffusion (lower is better)

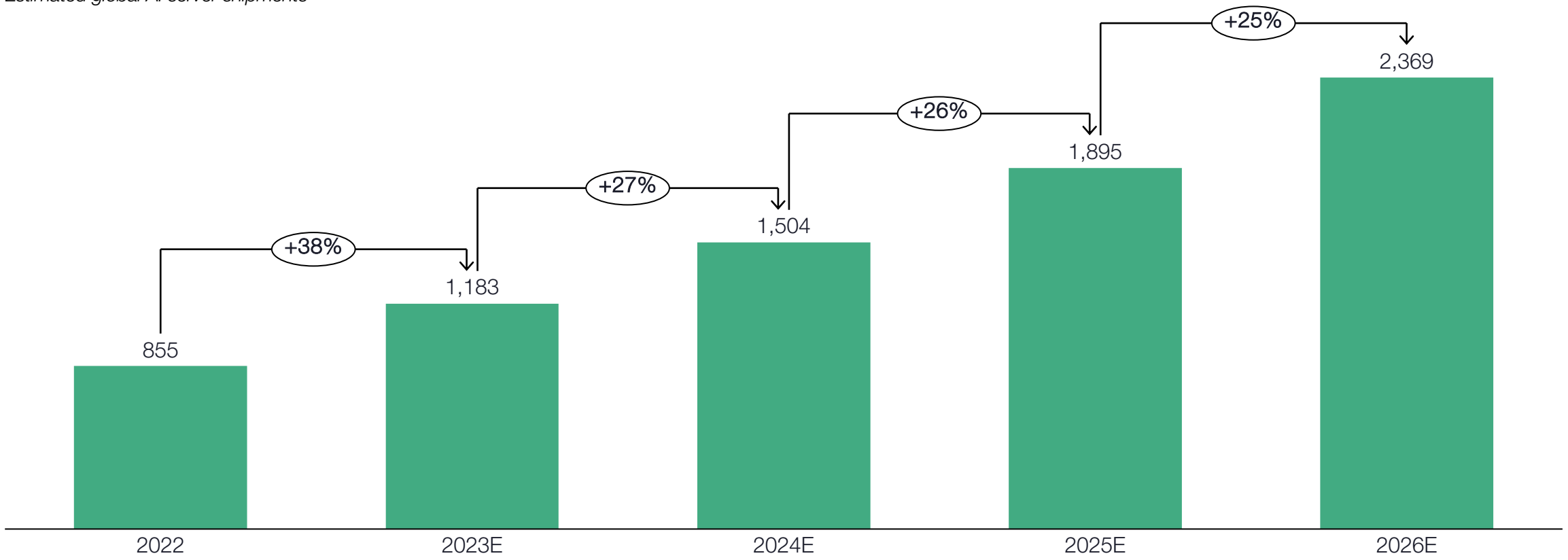


Source: Lambda Labs, Inference Benchmark for Stable Diffusion as of 2023. Assuming single precision. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

The demand for GPUs has only begun

⟶ Estimated ramp up for AI servers growing 25%+ Y/Y through 2026

Estimated global AI server shipments



What are the implications for this global shift in demand for GPUs?

Source: Trendforce as of May 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Follow the GPUs: AI poised to have impacts across our economy

$32B+

NVDA Revenue
last 12 months

NVIDIA

Power

Cloud

Data Centers

Semis

Source: NVIDIA public filings as of September 2023, Coatue analysis and opinion, as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclaimers for important disclosures, including regarding projections and forward-looking statements and companies and trends.

The AI wave may stress our power grid

$32B+

NVDA Revenue
last 12 months

NVIDIA

2-3x

Electrical transformer price increases

&

3-5 Years

Leadtime to connect to the grid

3-5 GW

More data center power required ’23-24E

=

50%

Potential increase in power demand by 2026

Source: NVIDIA public filings as of September 2023, PTR Inc, University of Wisconsin, IEA, Schroders, Coatue analysis and opinion, as of November 2023. For illustrative purposes only. Potential power and price increases are Coatue estimates based on external data sources and are subject to change based on several factors, including demand, supply constraints, competition, the pace of AI adoption. There is no guarantee that Coatue’s views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclaimers for important disclosures, including regarding projections and forward-looking statements and companies and trends.

More GPUs likely means more expensive servers

$32B+

NVDA Revenue
last 12 months

NVIDIA

Higher Server Bill of Materials Due to GPUs *'23-24E*

Note: all estimated numbers

	Non-AI Server		AI Server
CPU	~$2K	10x	~$20K
GPU			~$200K
Storage & RAM	~$5k	5x	~$20K
Power Supply	<$1K	10x	~$5K
Networking & Other	~$5K	3x	$15k
Server Cost	~$10K	26x	~$260K

Source: NVIDIA public filings as of September 2023, Semianalysis as of September 2023 showing server bill of materials. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclaimers for important disclosures, including regarding projections and forward-looking statements and companies and trends.

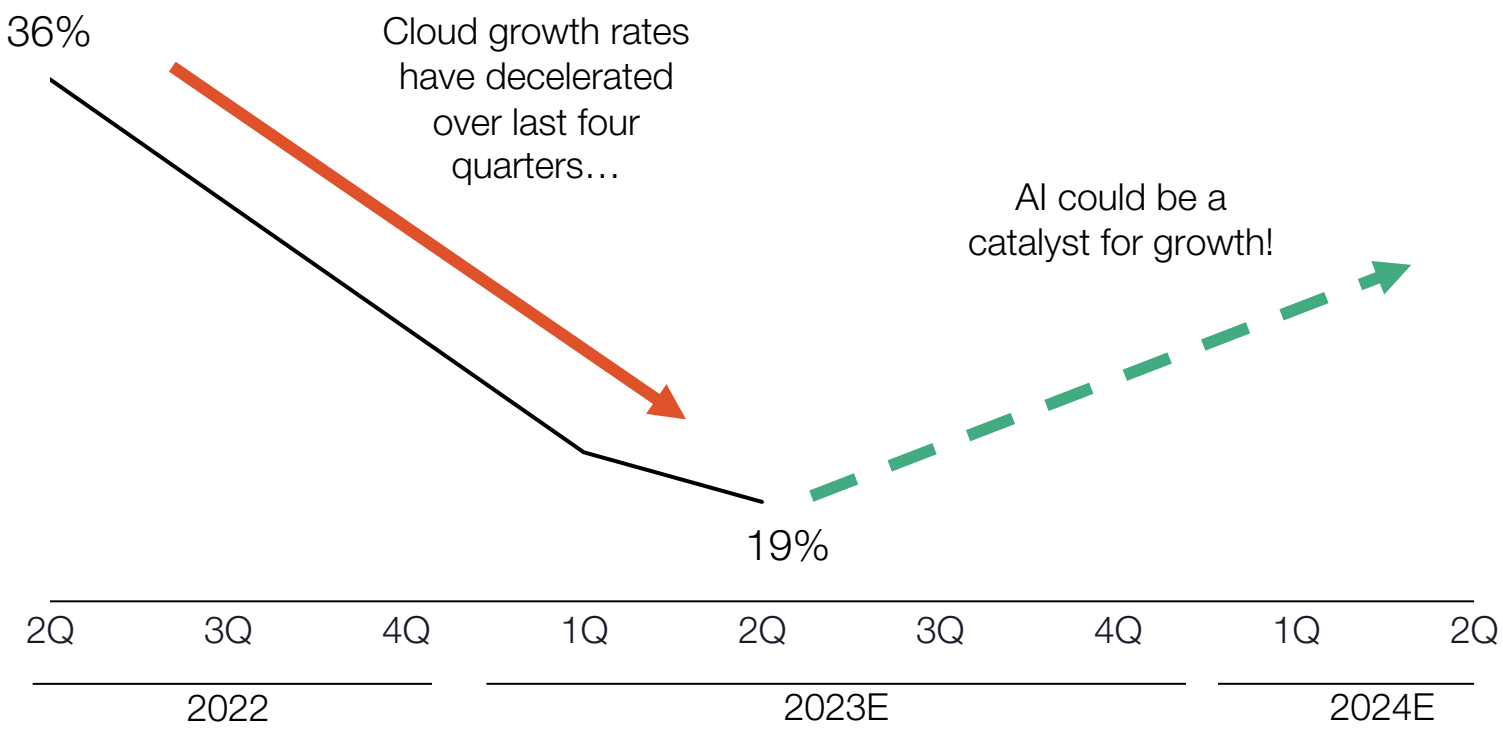
Could AI workloads drive a cloud reacceleration?

$32B+

NVDA Revenue
last 12 months

NVIDIA

Y/Y revenue growth rates for AWS, GCP, and Azure from Q2 2022 to Q2 2023



Source: NVIDIA public filings as of 2023, AWS & GCP public filings, Azure sell-side consensus from Bloomberg as of September 2023. Coatue analysis and opinion, as of November 2023. For illustrative purposes only. Illustrative future revenue growth rates for cloud providers are solely visuals and should not be interpreted as real figures. See Appendix-Disclaimers for important disclosures, including regarding projections and forward-looking statements.

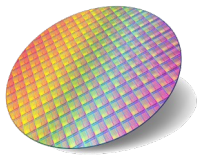
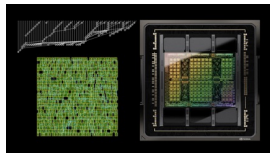
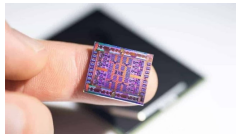
AI is the latest tech wave to inflect the semiconductor industry

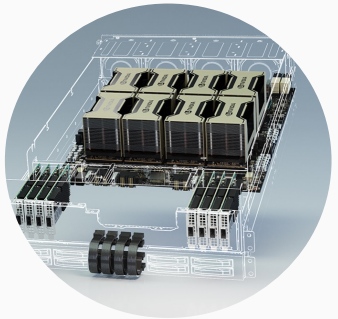
	Mainframe	PC + Internet	Smartphone	Public Cloud	AI
Time Period	Pre 1990	1990 - 2006	2007 - 2014	2014 - 2022	2022 onwards
Incremental Semi Spend	~$50B	~$100B	~$150B	~$250B	~$500B+ ?
Total Semi Spend	~$50B	~$200B	~$350B	~$600B	~$1.5tn+ ?
Key HW players	IBM	intel, DELL, Qualcomm, BROADCOM, Google, Microsoft, Microsoft, hp, arm, SKYWORKS, amazon			Lam RESEARCH, AMD, APPLIED MATERIALS, cerebras, NVIDIA, Micron, ASML, SAMSUNG

Source: SIA Industry data as of September 2023, Coatue AI semis market assumptions as of September 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

The entire semiconductor supply chain has potential to benefit

Semis value chain across manufacturing inputs to device assembly

Semi manufacturing inputs		Semi design and manufacturing		Device assembly
Materials	Capital equip.	IC design/embedded software	Fabrication, pkg. & testing	Assembly
GlobalWafers Co., Ltd. 環球晶圓股份有限公司 Unimicron 欣興電子 JSR	Lam Research ASML	intel AMD NVIDIA cerebras	tsmc	FOXCONN wistron
 *Ex: Silicon wafer*	 *Ex: EUV Lithography*	 *Ex: NVIDIA chip design*	 *Ex: 3nm chip*	 *End product: NVIDIA H100*



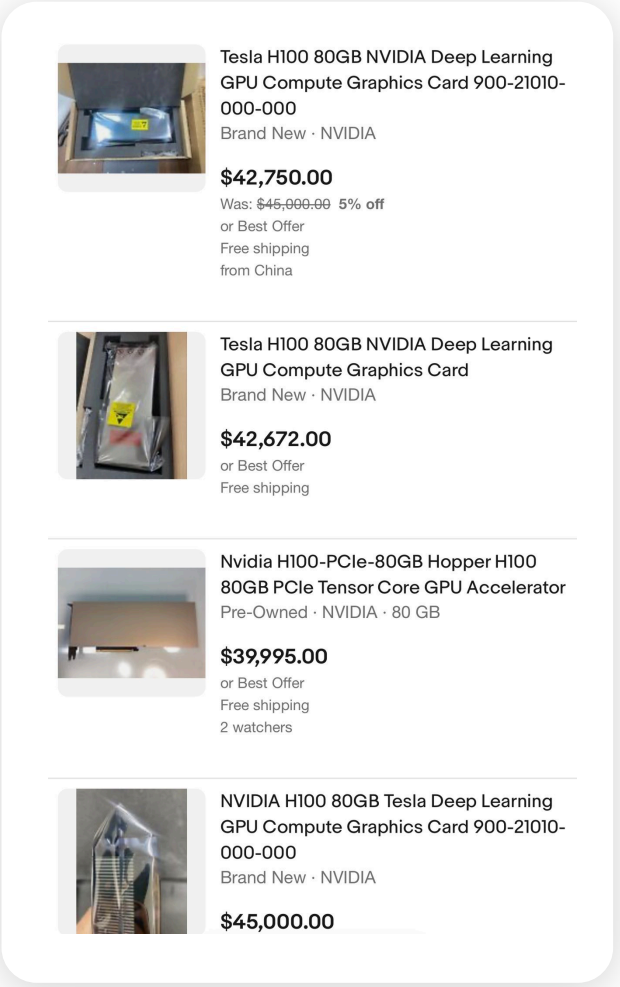
Data center servers powering AI!

Source: Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Demand for cutting edge GPUs has exceeded supply

⟶ H100 GPU prices on aftermarket are typically well above list price

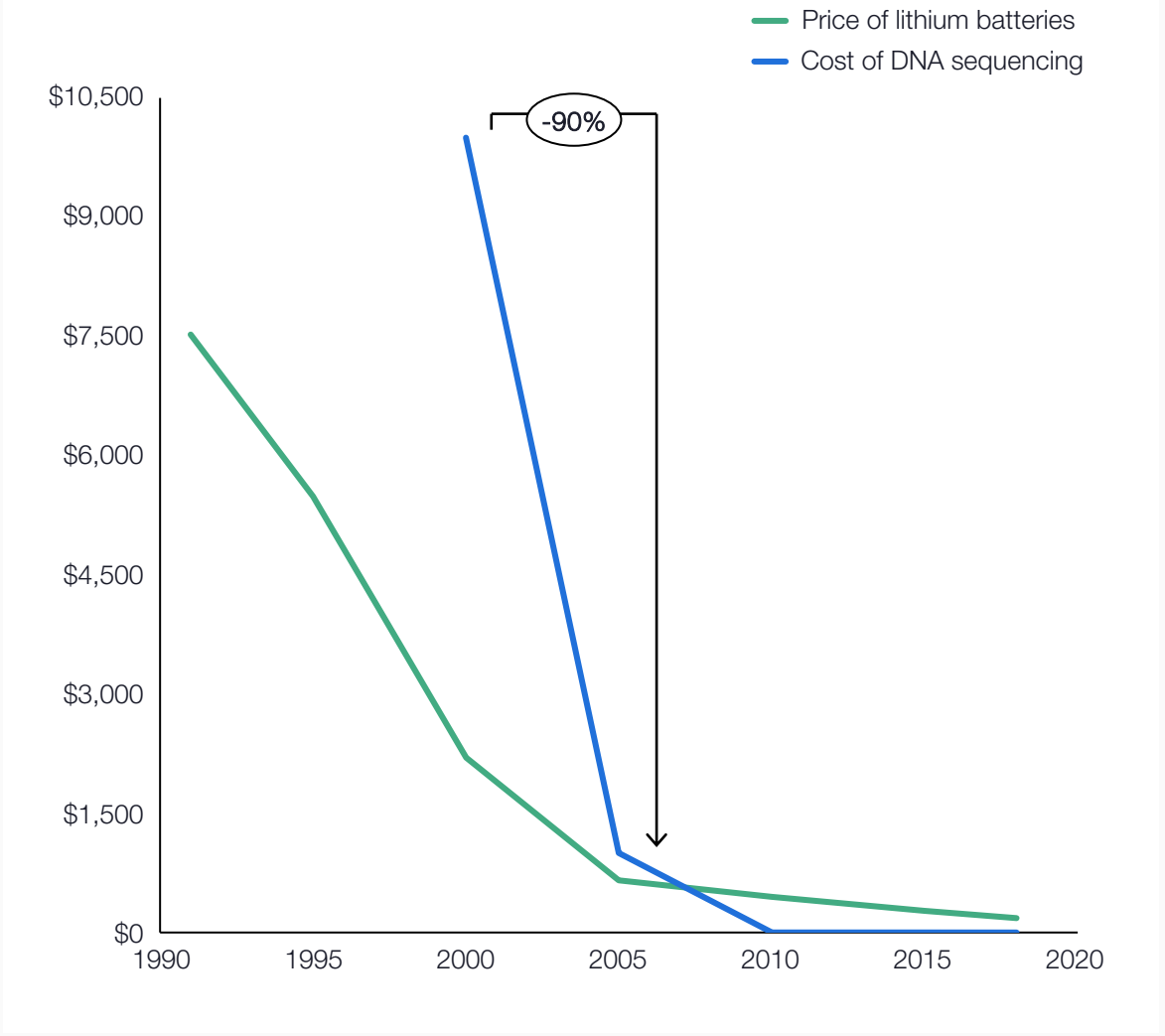
Pricing of individual H100 80GB GPU units on eBay & Amazon, not reflective of cluster availability



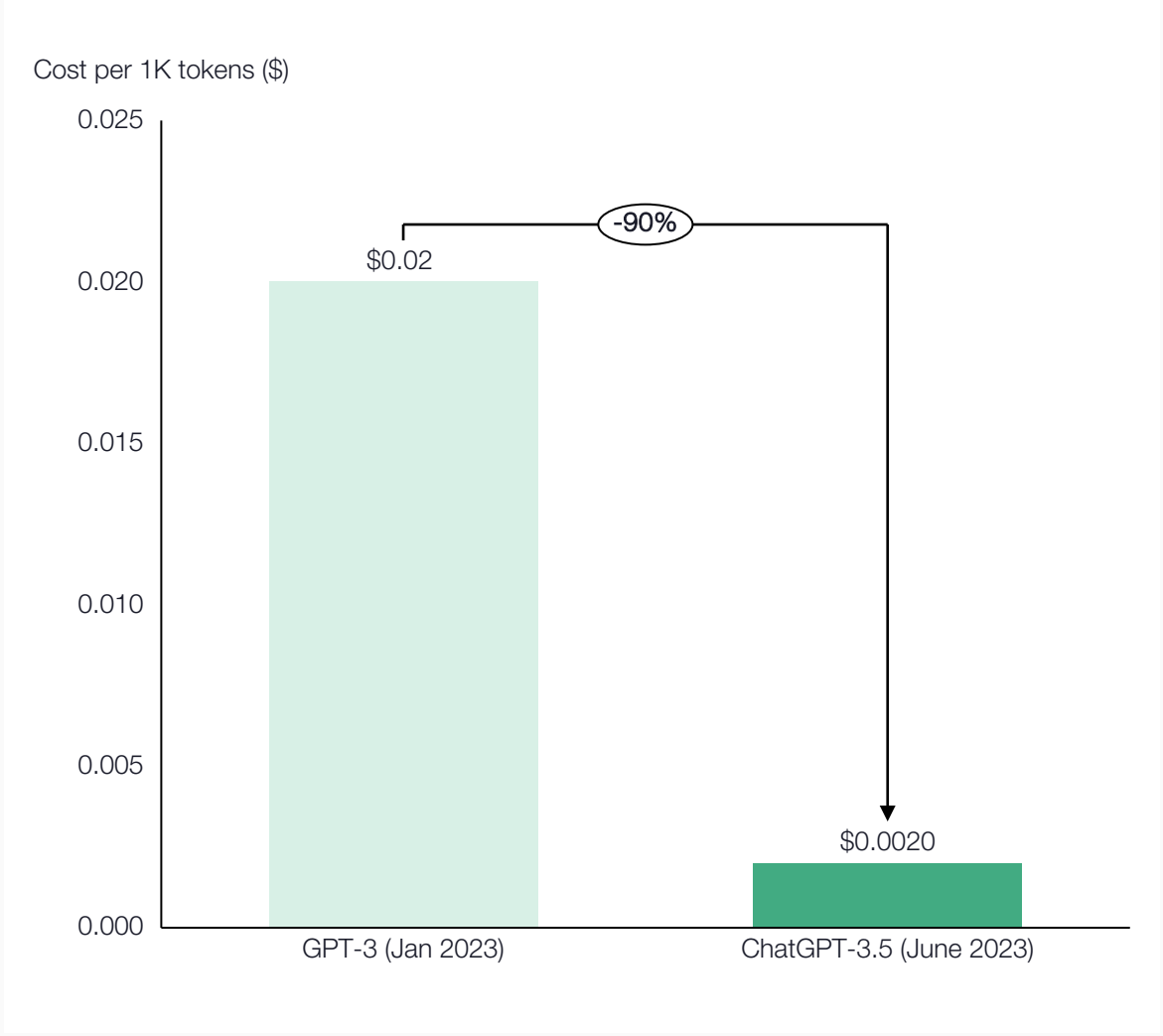
Source: Coatue analysis and opinion, as of November 2023. For illustrative purposes only; there is no guarantee that the demand for GPUs will continue to increase. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Despite intense demand, AI compute costs have decreased

⟶ Could AI compute resemble cost curves in other sectors?



⟶ Cost of running GPT-3/3.5 down 90% in 5 months!

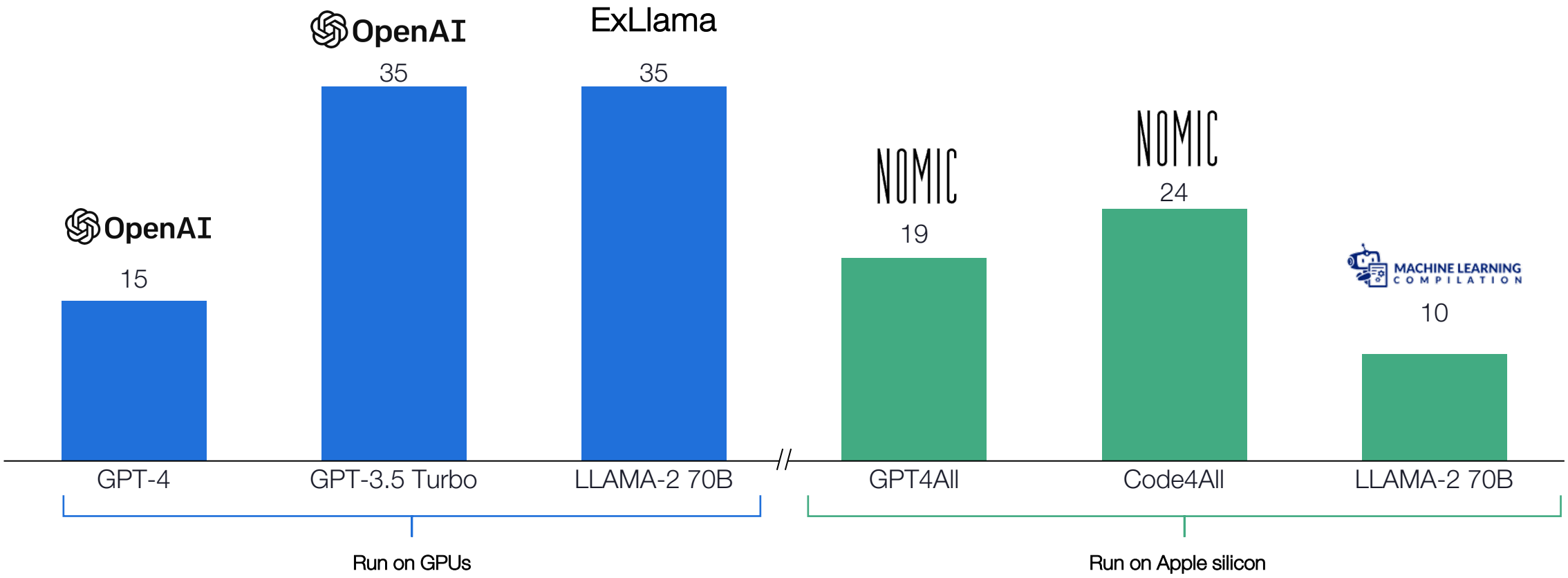


Source: OurWorldInData, Genome.gov, OpenAI pricing, Coatue analysis and opinion, as of November 2023. Price of Lithium batteries is per kWh, and cost of DNA sequencing is per megabase. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Models on edge could alleviate GPU shortage as well

⟶ Local models on Apple silicon becoming as fast as models running on GPUs

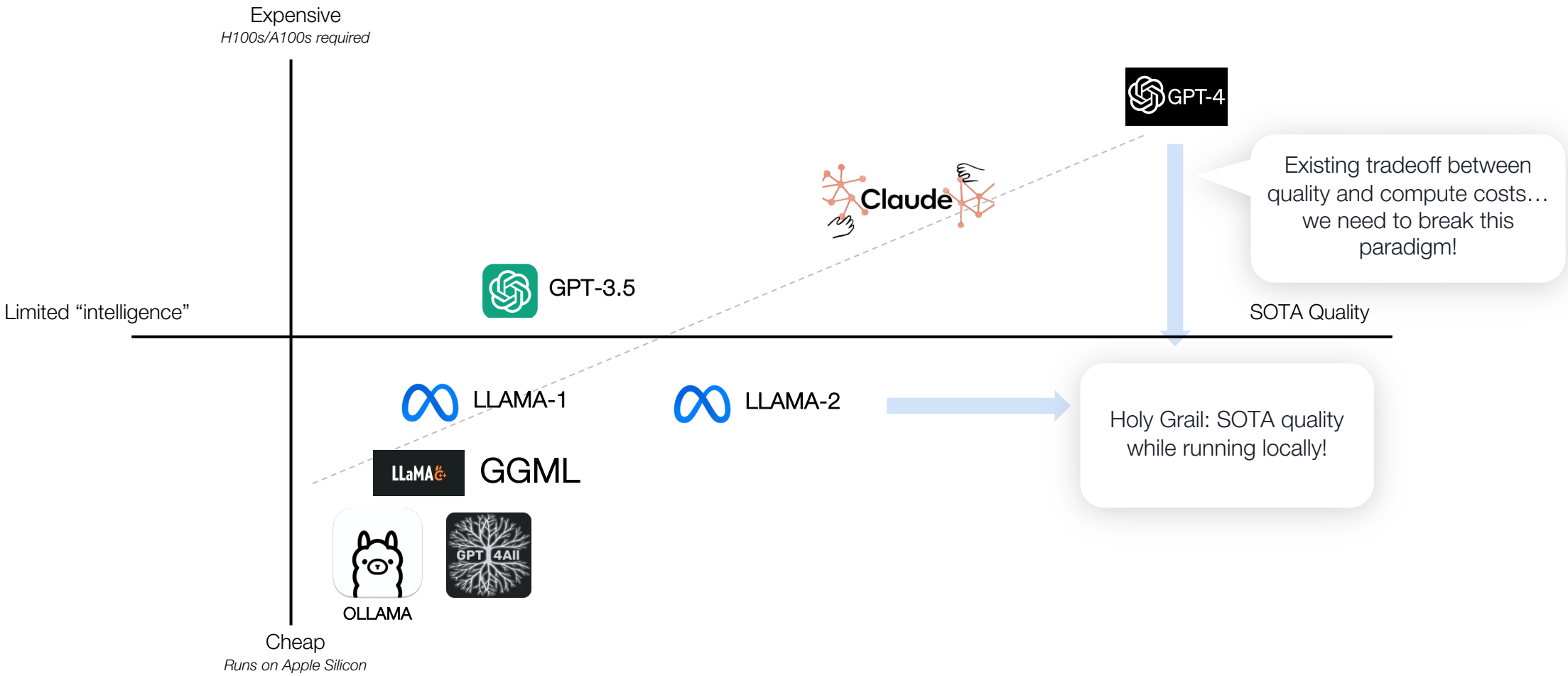
Tokens per second (higher the better) of LLMs



Source: ExLlama, MLC, OpenAI token generation tracking from GitHub, Nomic, Coatue analysis and opinion, as of November 2023. Performance tracking is from third parties and may not be representative of performance normally. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

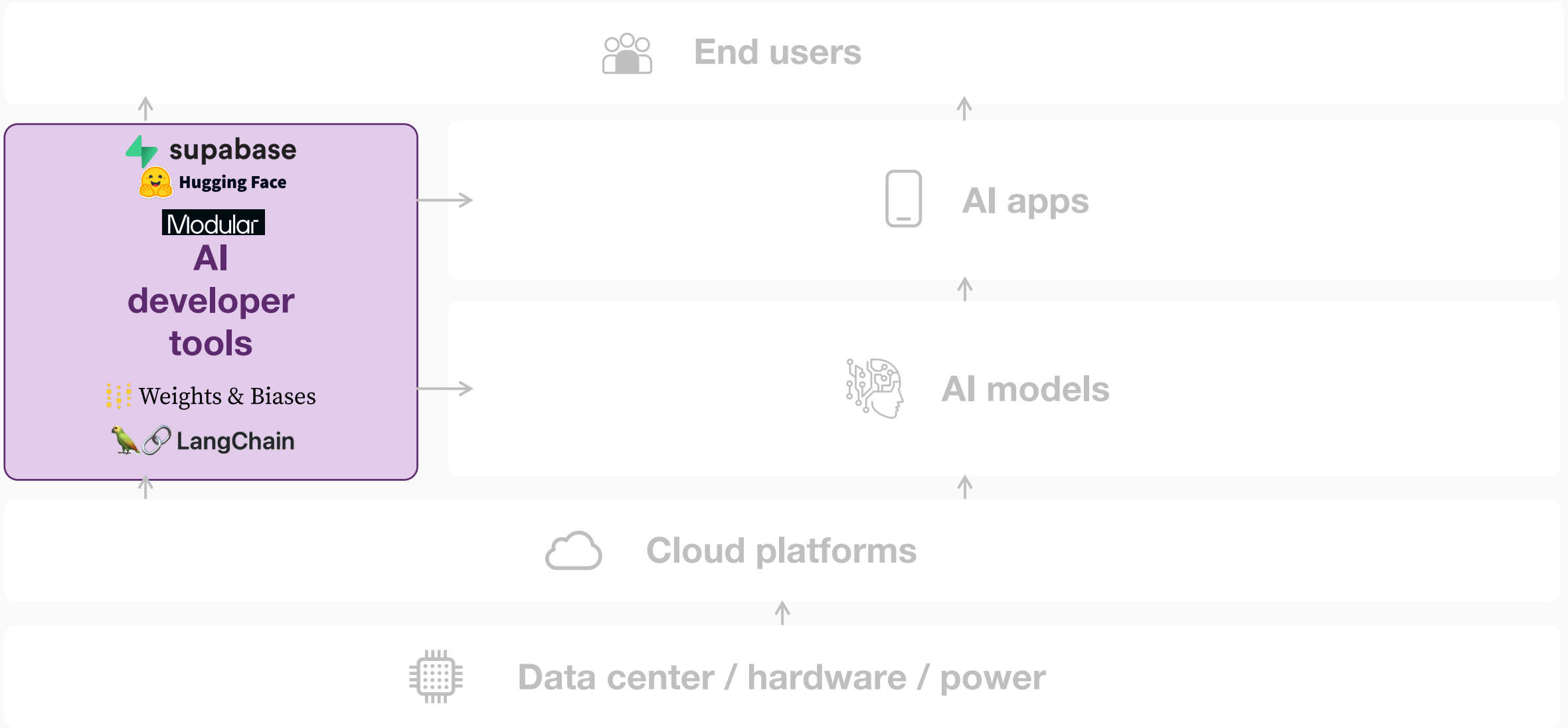
Will we reach AI's Holy Grail?

⟶ Largest, most expensive models are still most performant….for now



Source: Coatue analysis and opinion, as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI has started to create a new ecosystem of tools



Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI Ops is a new category of tools for AI engineers

Illustrative; non-exhaustive

ML Ops: Focused on creating ML models

Data labeling
Snorkel, DataRobot, scale

Model hub
Hugging Face, mlflow, GitHub

Model training & development
Lightning AI, Weights & Biases, PyTorch, DataRobot, databricks, mlflow, TensorFlow, ABACUS.AI

Model inference
databricks, anyscale, Amazon SageMaker, SELDON

Monitoring
Arthur, GANTRY, fiddler, Weights & Biases, DataRobot

AI Ops: Focused on operationalizing Generative AI

Data labeling & curation
Snorkel, Argilla, Cleanlab, NOMIC ATLAS, scale

Model hub
Hugging Face, LatchBio, roboflow, Replicate

Fine tuning
Hugging Face, databricks, scale, Humanloop, surge AI, Snorkel

Model inference
Hugging Face, Replicate, databricks, Modal, Lepton AI

LLM Ops
llamaindex, Weights & Biases, Lightning AI, LangChain, ABACUS.AI

Vector DBs
supabase, Pinecone, Weaviate, NOMIC ATLAS

Monitoring & evaluation
Arthur, Weights & Biases, GANTRY, Zeno, Humanloop

Output Guardrails
Arthur, Nomos AI

1. Beyond labeling, data curation is becoming more important as engineers try to enhance model performance and alignment.

2. New tools enabling fine tuning and inference have become easier for the AI developer to use

3. Emerging category of tools enabling developers to use LLMs more effectively; Vector DBs have exploded in popularity due to embeddings.

4. Securing the last mile deployment of LLMs through model evaluation, guardrails, and ongoing RLHF is supporting a new set of companies

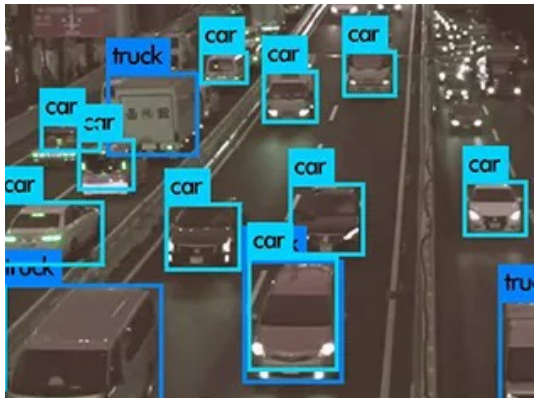
Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. Not exhaustive of all companies in these categories. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Data curation tools will be critical for improving models

⟶ Data curation an emerging new category between data collection & labeling, and model training

Data collecting & labeling → **Dataset curation** *(New category)* → *Model training*

scale | scale Nucleus | Argilla | NOMIC ATLAS | LIGHTLY | Cleanlab (Open-Source) | anyscale | PyTorch | Keras | TensorFlow



Labeled data feeds ML models

Preparation

Automatically clean and scrub data for errors

Analyze

Profile the dataset across various metrics (e.g. token length distribution, entity label distribution)

Curate

Filter data to include best examples for training; discard low-quality samples & identify human errors in labeling

Pre-training

Fine-tuning

RLHF

Curating datasets can reduce costs & improve quality. Training on ~30% of dataset can be sufficient! (from Cohere study)

Source: Cohere as of November 2023, Coatue opinion and analysis as of September 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

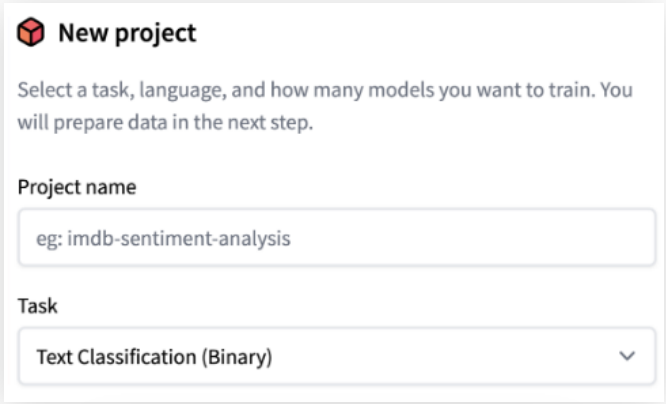
Hugging Face

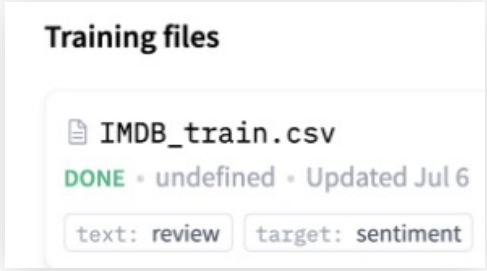
Fine tuning models has become much more accessible

Hugging Face Autotrain lets you fine tune open-source models on your own data in just a few clicks

1

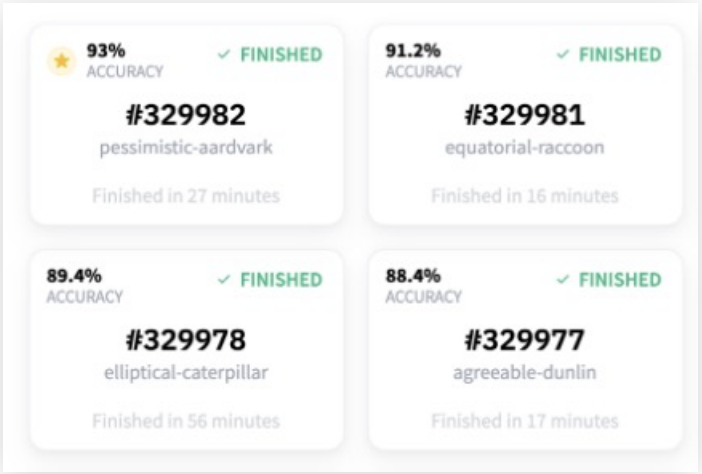
Select type of task & upload training dataset





2

Hugging Face suggests suitable models



3

Select model(s) and evaluate model training progress

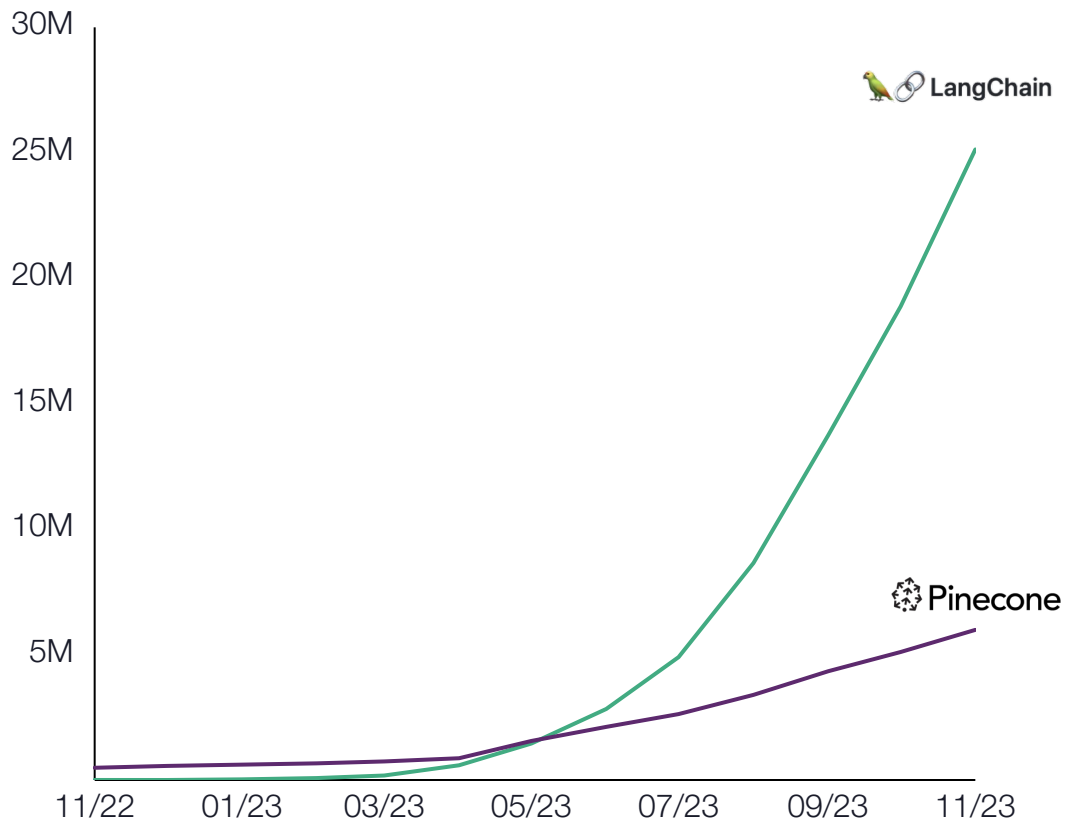
Model ID	Loss	Accuracy
#329982 pessimistic-aardvark	0.2462	0.9300
#329971 baggy-woodpecker	0.2109	0.9216
#329970 this-leopard	0.2453	0.9189
#329981 equatorial-raccoon	0.2212	0.9117
#329974 regal-termite	0.2606	0.9091
#329968 fearful-lobster	0.2440	0.9089
#329975 unlucky-cobra	0.2813	0.9022
#329972 far-badger	0.2555	0.8981

Source: Hugging Face, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

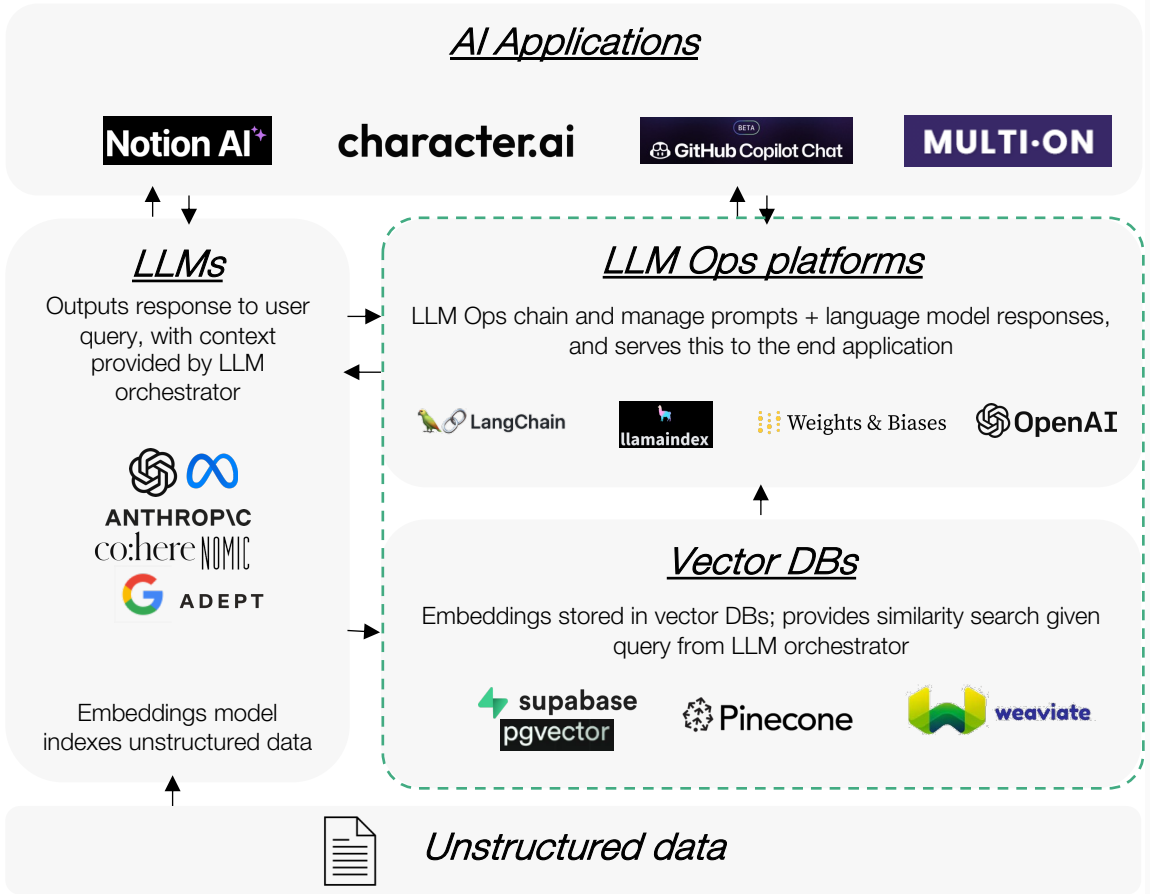
LLM Ops & Vector DBs are a new enabling layer for AI apps

Tools are already being put into production

Cumulative installs (incl. machine)



LLM Ops & Vector DBs enable retrieval augmentation



Source: PyPI downloads, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Can VectorDBs be standalone winners?

→ Only three DB types have significant public outcomes

OLAP

Google BigQuery · amazon REDSHIFT · ClickHouse · databricks

snowflake ~$50B *mkt cap*

OLTP

CockroachDB · PostgreSQL · redis · Amazon Aurora · MySQL

mongoDB. ~$25B *mkt cap*

Observability

splunk> · Grafana · elastic · new relic.

DATADOG ~$25B *mkt cap*

→ Startups have tried to create new categories of DBs

Real-time streaming DBs

Materialize · ROCKSET · imply

Graph DBs

RelationalAI · Amazon Neptune · EDGE|DB · neo4j

Vector DBs

Milvus · weaviate · Pinecone

No large standalone outcomes yet…

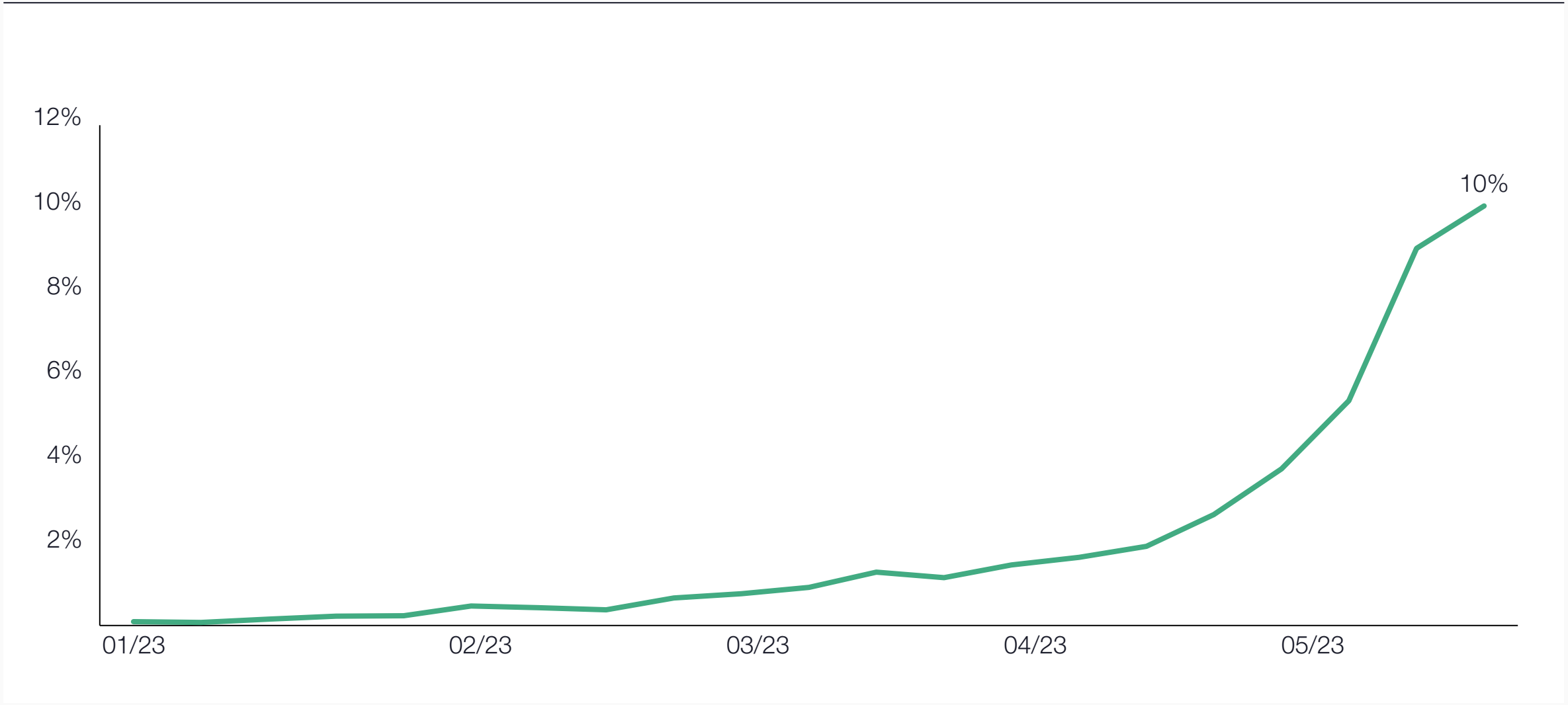
… Will vector DBs be different?

Source: CapitalIQ, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

General purpose databases are being used as VectorDBs too

% of Supabase projects using pgvector

supabase



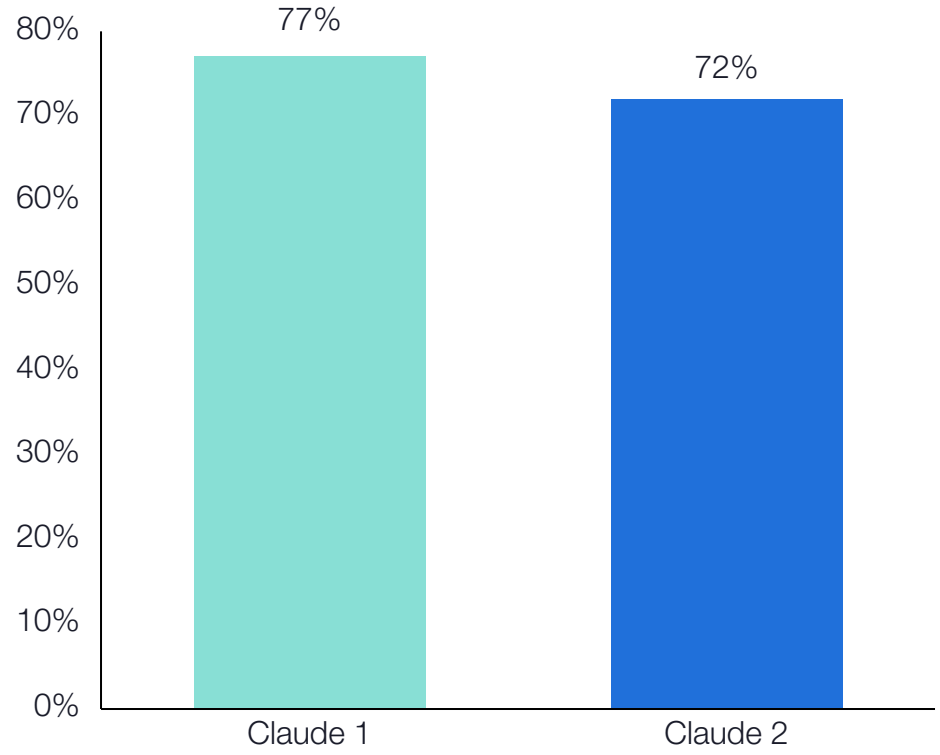
Source: Supabase data as of June 2023, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Problem: Model evaluation is broken today

⟶ Humans prefer Claude 1 to Claude 2...

Overall win rates (human preference) against other models

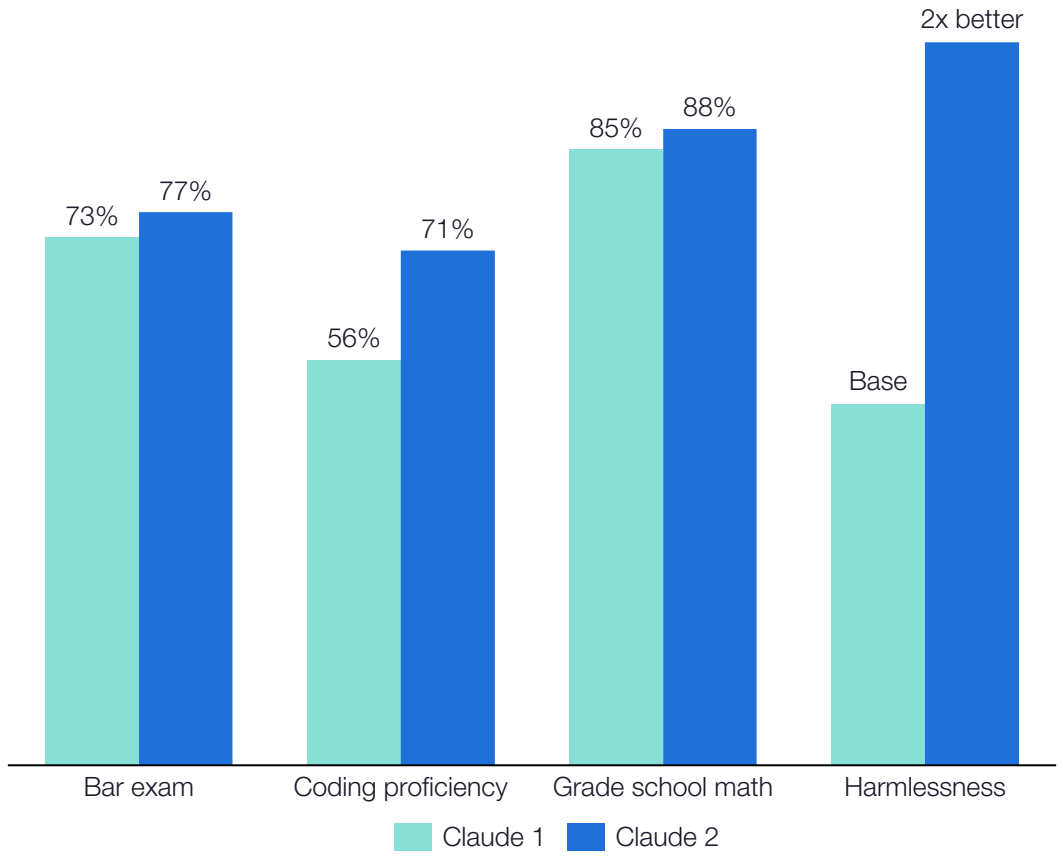
LMSYS



⟶ ...But Claude 2 performs better on benchmarks

Performance on different benchmarks

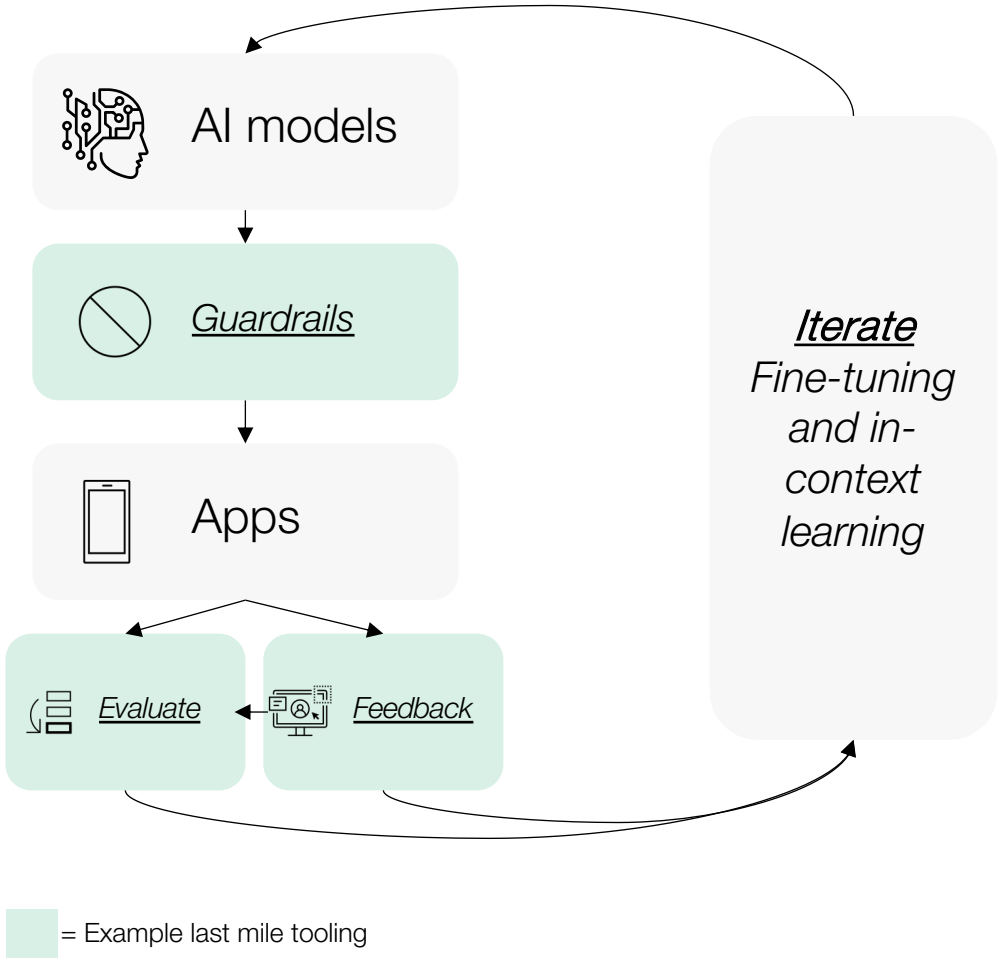
ANTHROP\C



Source: LMSYS, Anthropic, Coatue analysis and opinion, as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Evaluation is one of many 'last mile' tools needed for AI in production

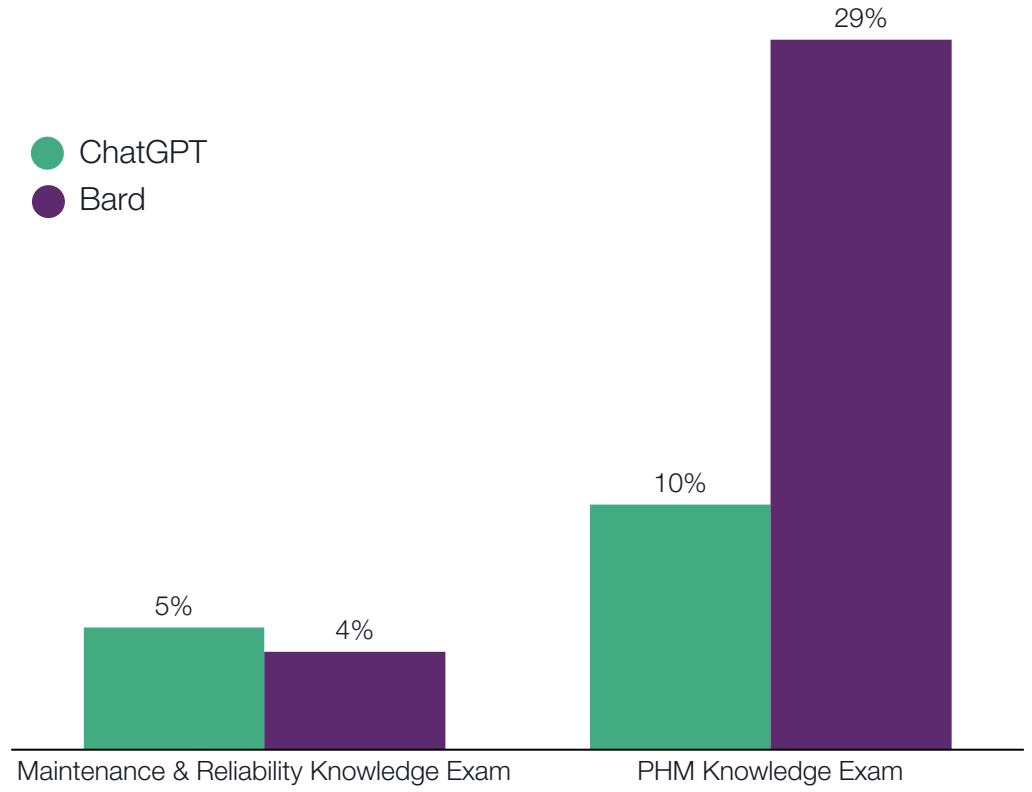
⟶ Last-mile tooling can improve AI accuracy and alignment



⟶ This may help prevent hallucinations in critical sectors!

Industrials case study: AI applied to prognostics & health mgmt. (PHM)

% of questions with hallucinated answers



Source: LinkedIn Post (Sarah Lukens 2023), Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

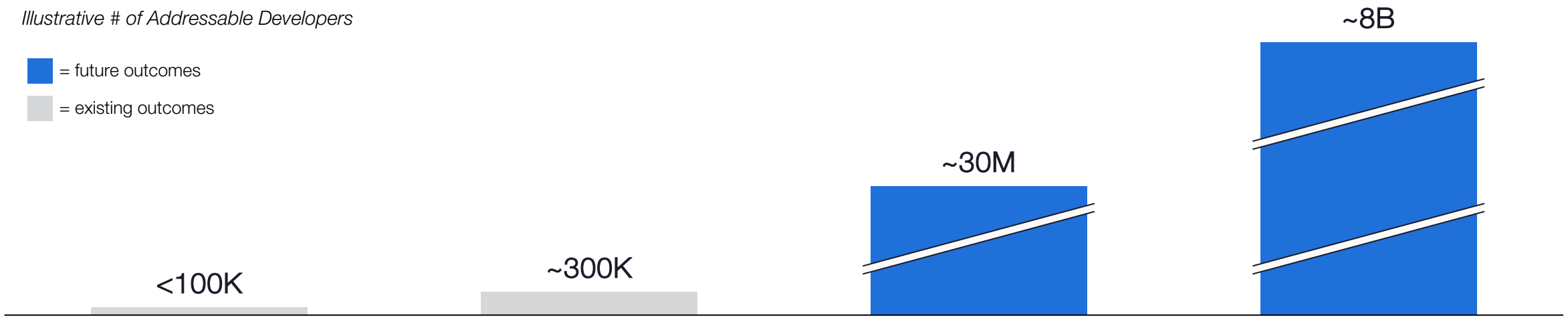
We're excited that AI Ops enables more developers to build apps

→ New AI Ops tooling is accessible to all developers

Illustrative # of Addressable Developers

= future outcomes

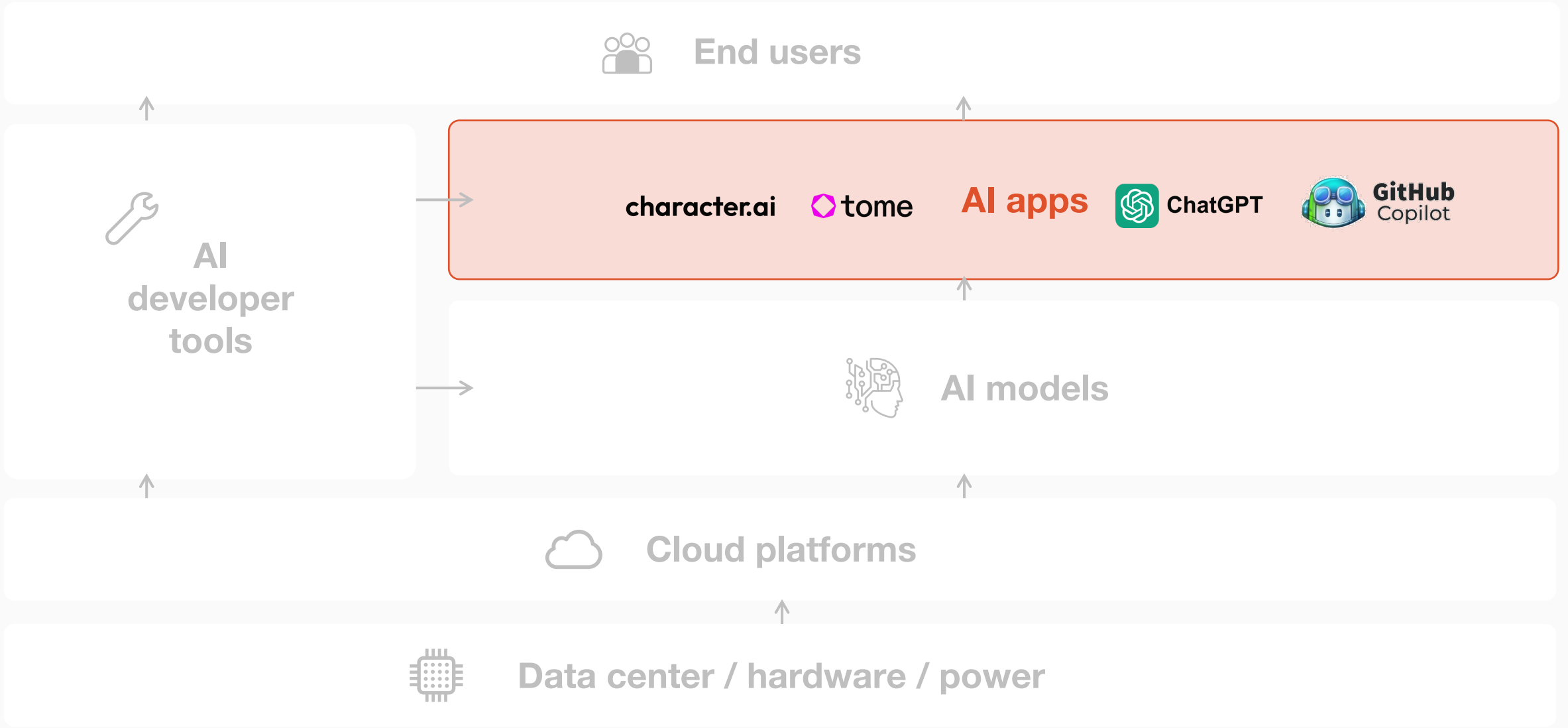
= existing outcomes



Deep Learning Era	Rise of ML Engineers	Era of AI Ops	Natural language programming
Pre-2015	*2015-2022*	*2023+*	*As soon as 2024?*
Example companies PyTorch	*Example companies* mlflow W&B	*Example companies* LangChain HUGGING FACE	*Example companies* OpenAI GPTs
Deep Learning Frameworks primarily usable only by ML researchers	*Transformers and ML Ops making building with models easier for more ML engineers*	*AI Ops tools enables all developers to be AI engineers*	***Could OpenAI's GPTs become the first way billions of people build AI apps with no code?***

Source: IADSS as of September 2023, Tencent/TheVerge as of 2017, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

The application layer is where humans will interact with AI



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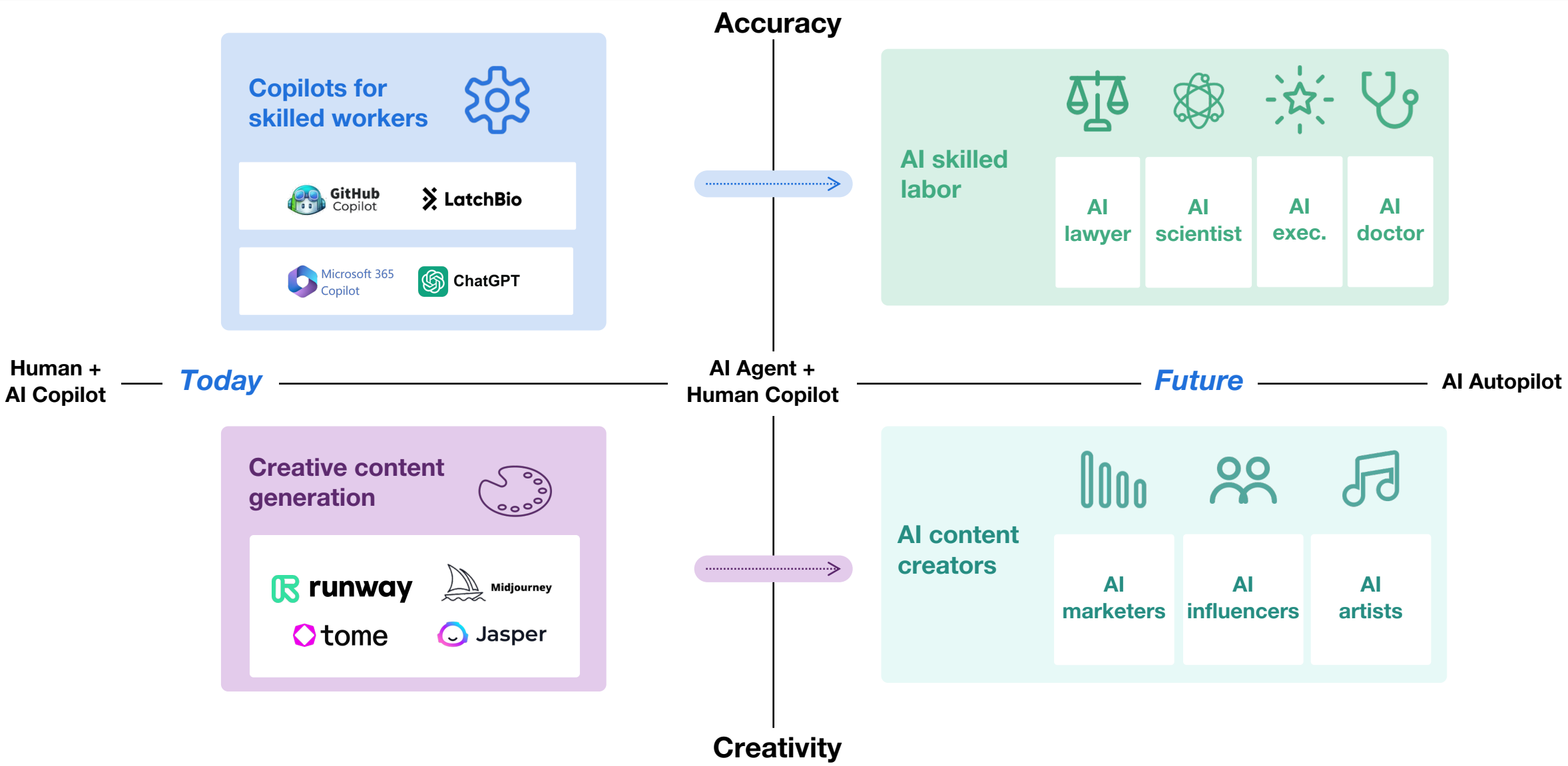
We expect AI to become even more impactful and autonomous



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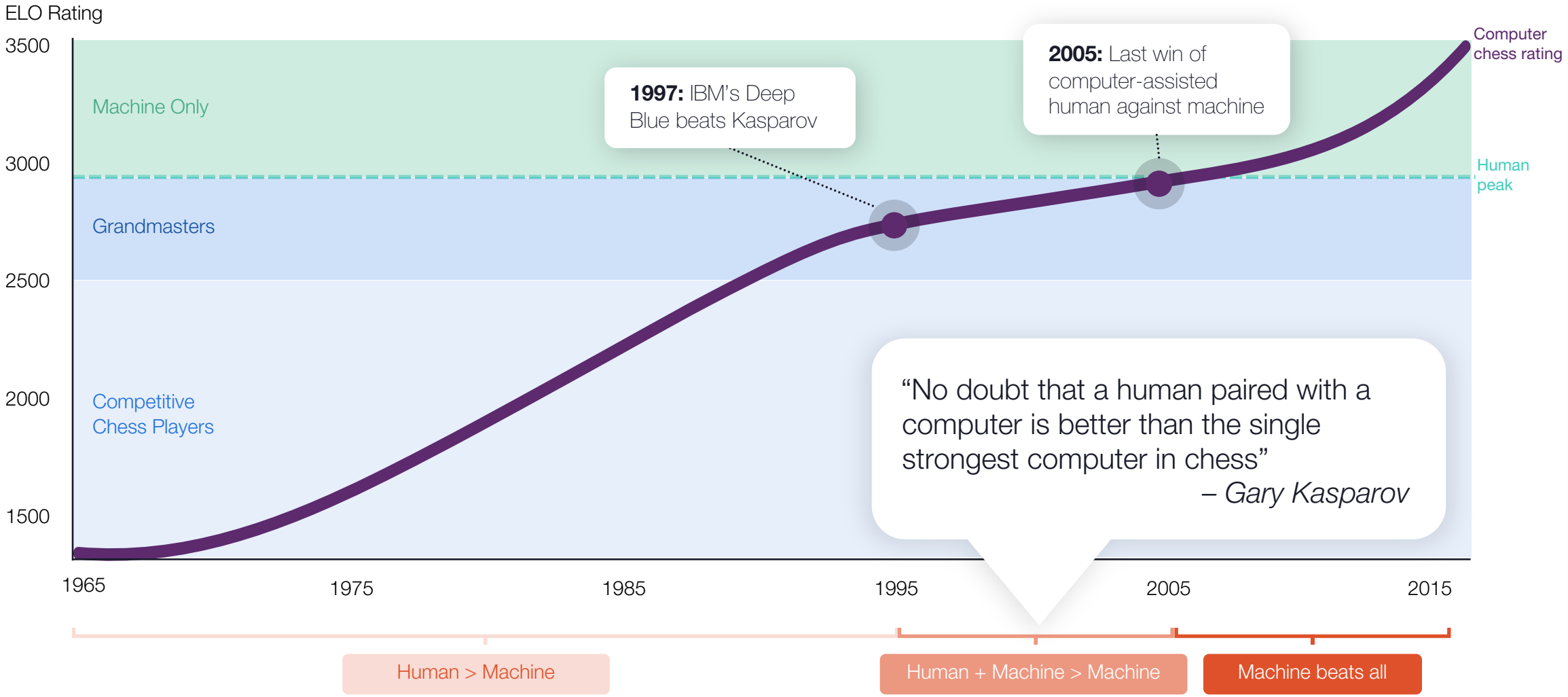
We have seen this before: Copilot phase was short-lived in chess

⟶ Computer chess rating

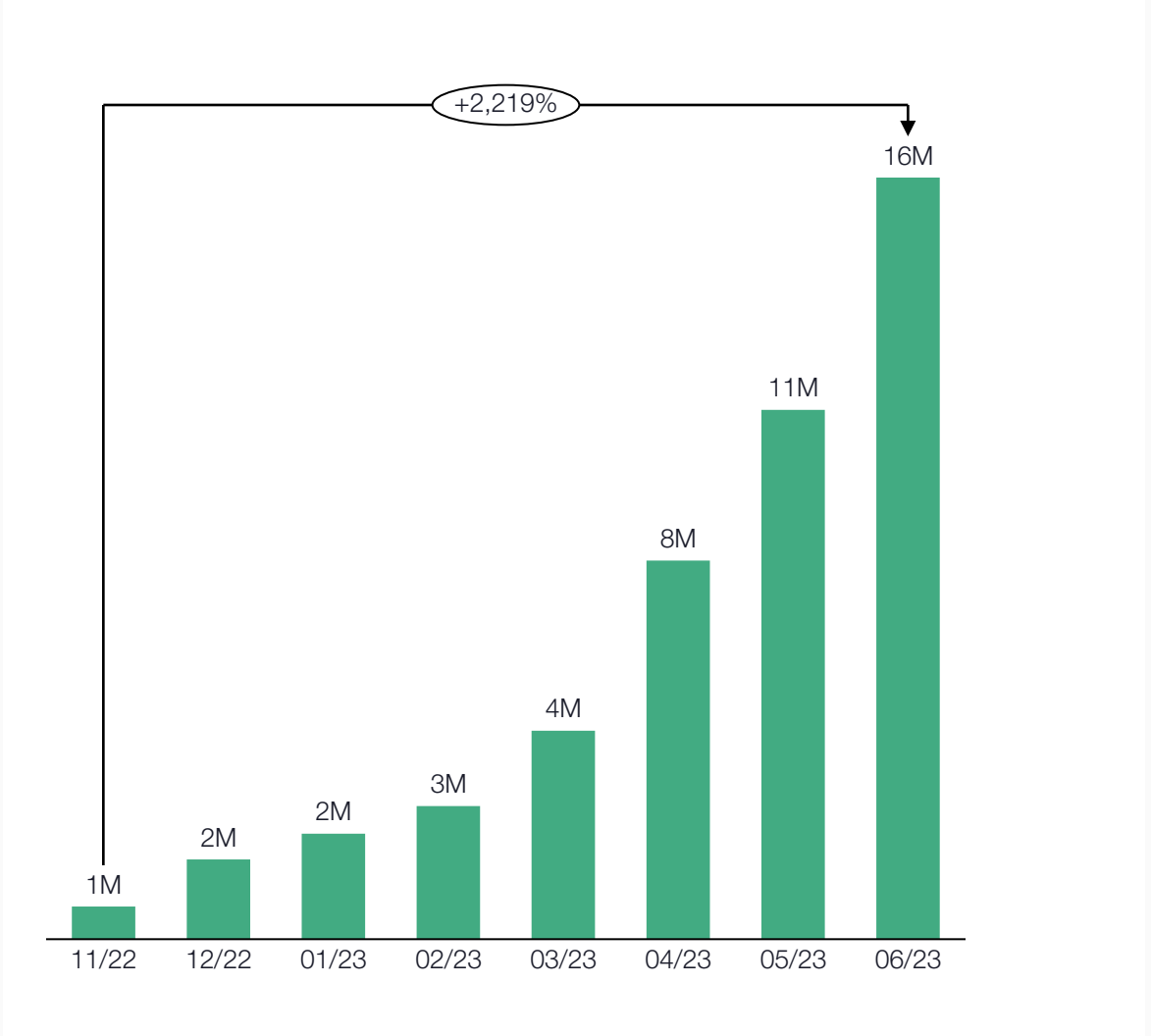


Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

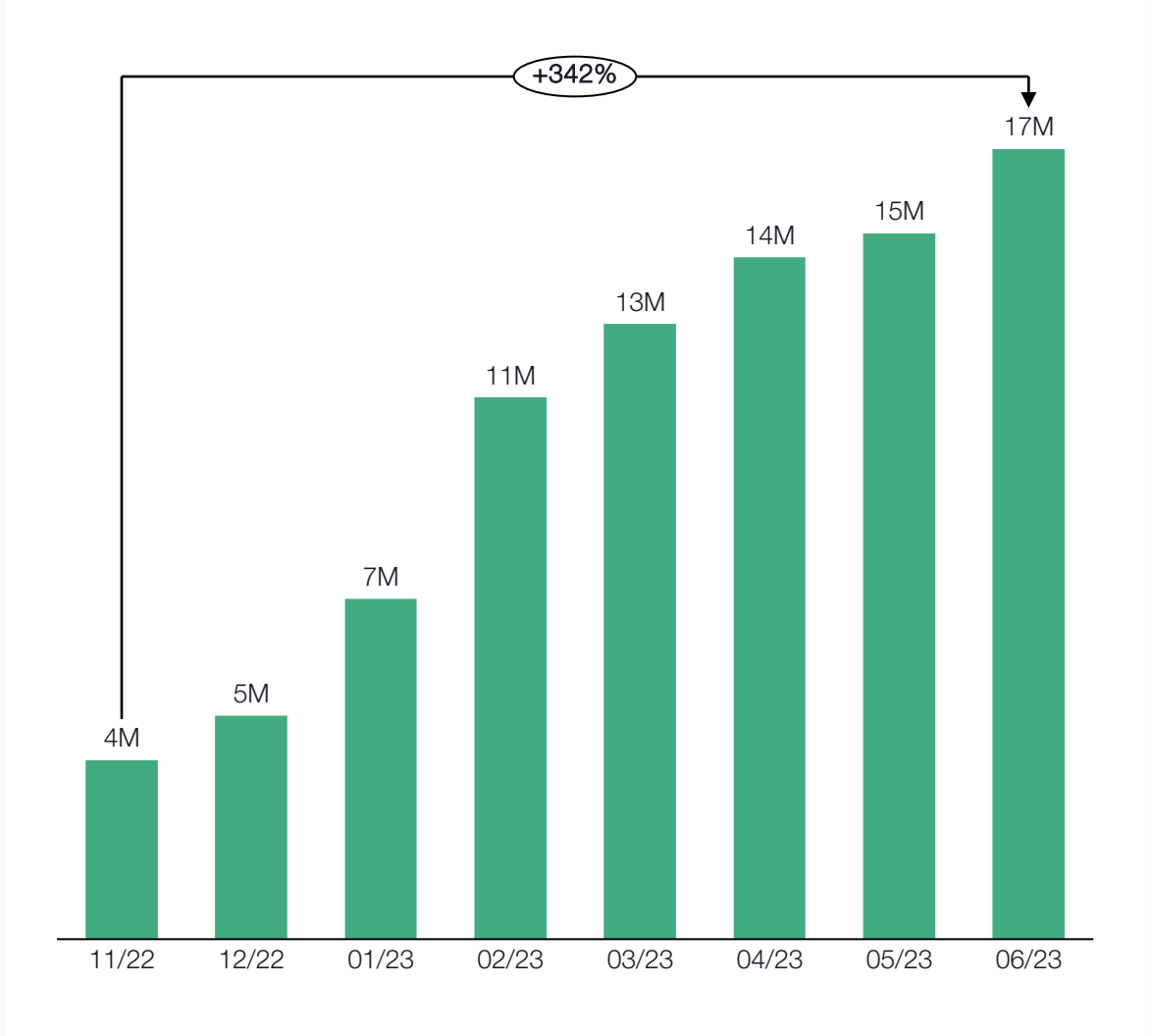
AI adoption accelerating across creative modalities

Usage of Runway's AI video tools over time

runway



Midjourney Discord members over time

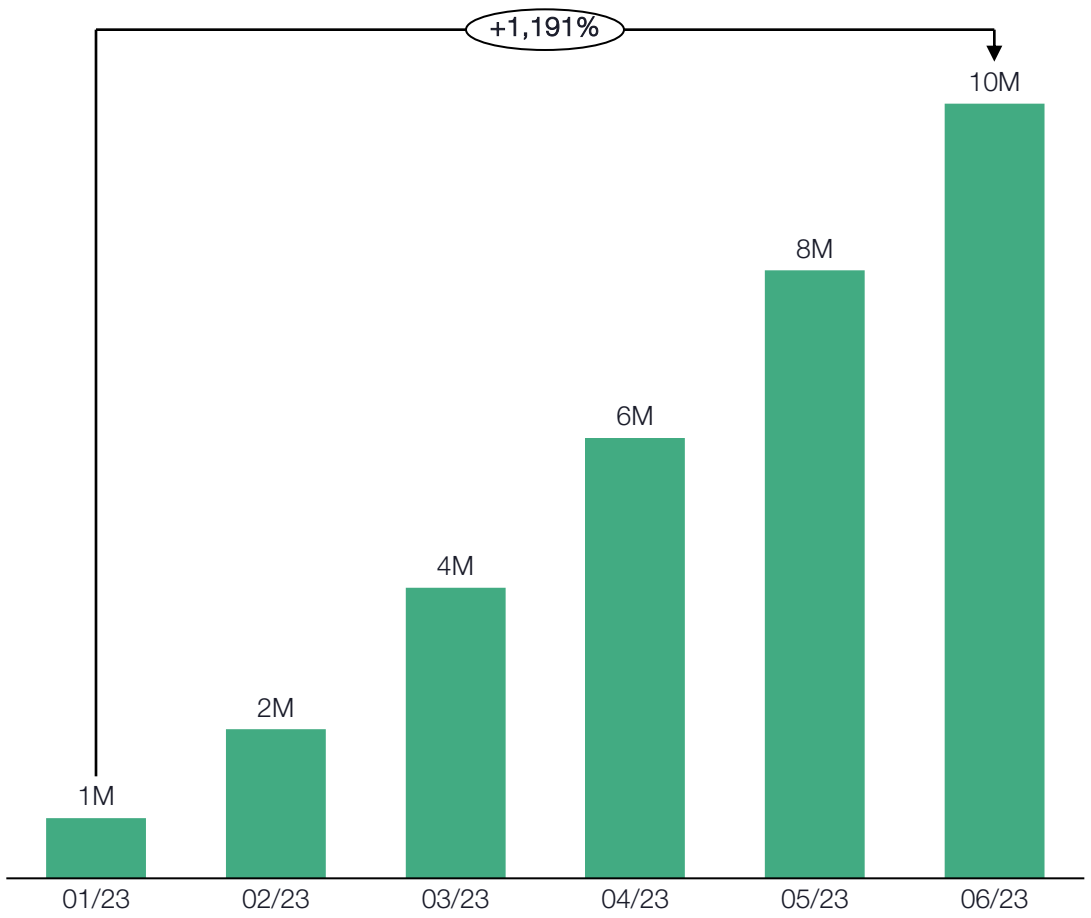


Source: Runway usage as of June 2023 showing cumulative usage including video generation, AI rotoscoping, etc. Midjourney Discord members as of June 2023. Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI ramping up for design use cases in professional settings

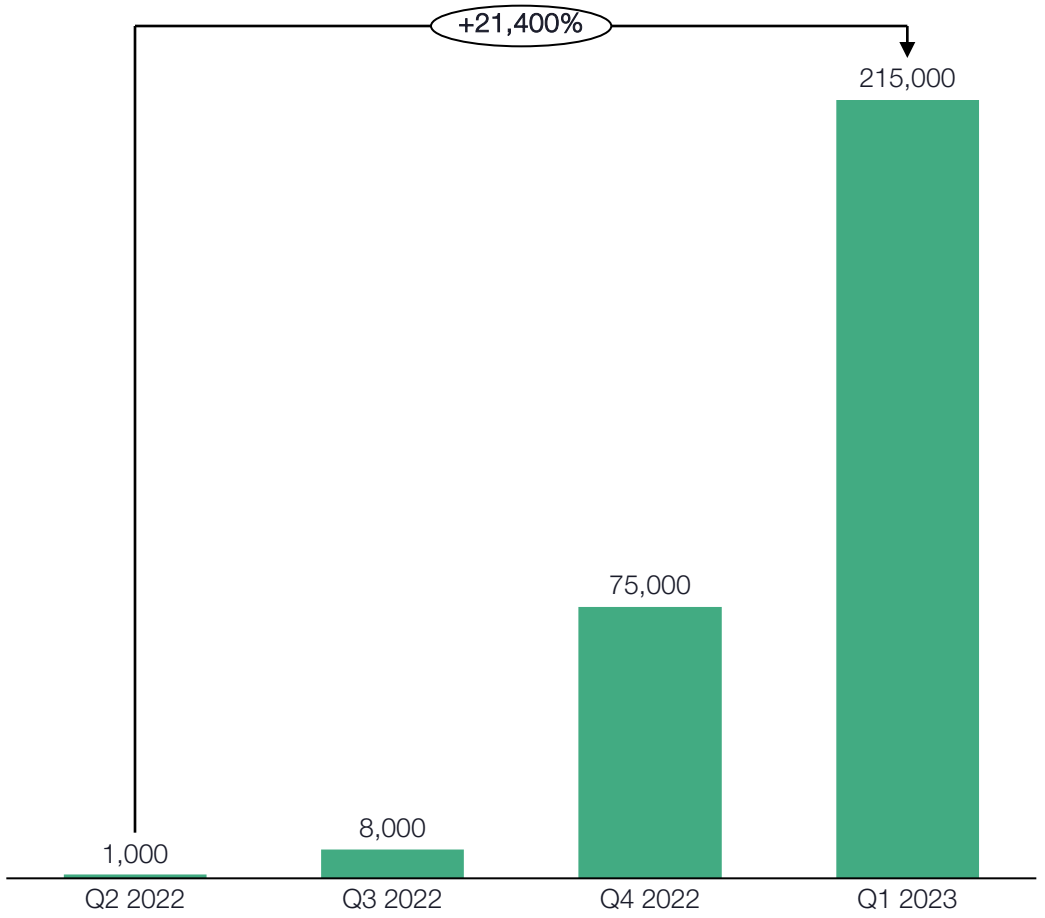
Cumulative Tome signups

tome



AI solar designs generated

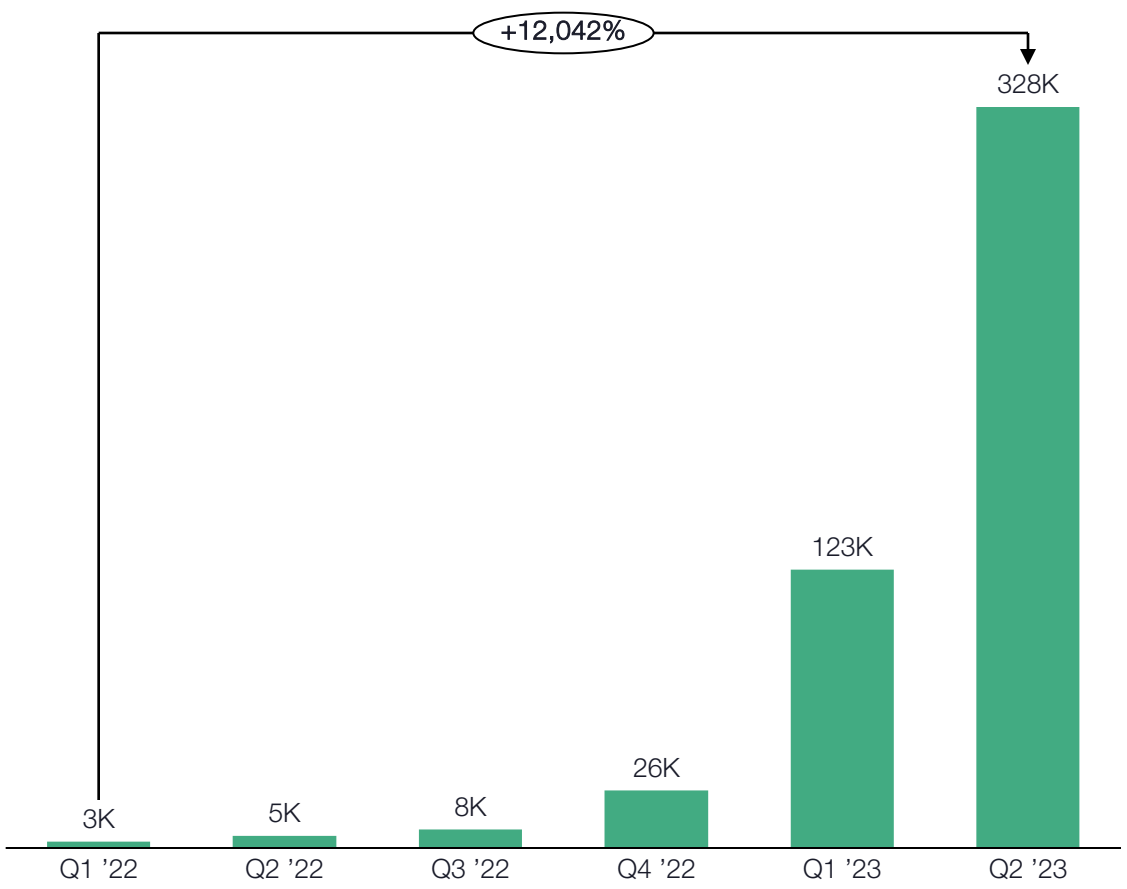
aurora



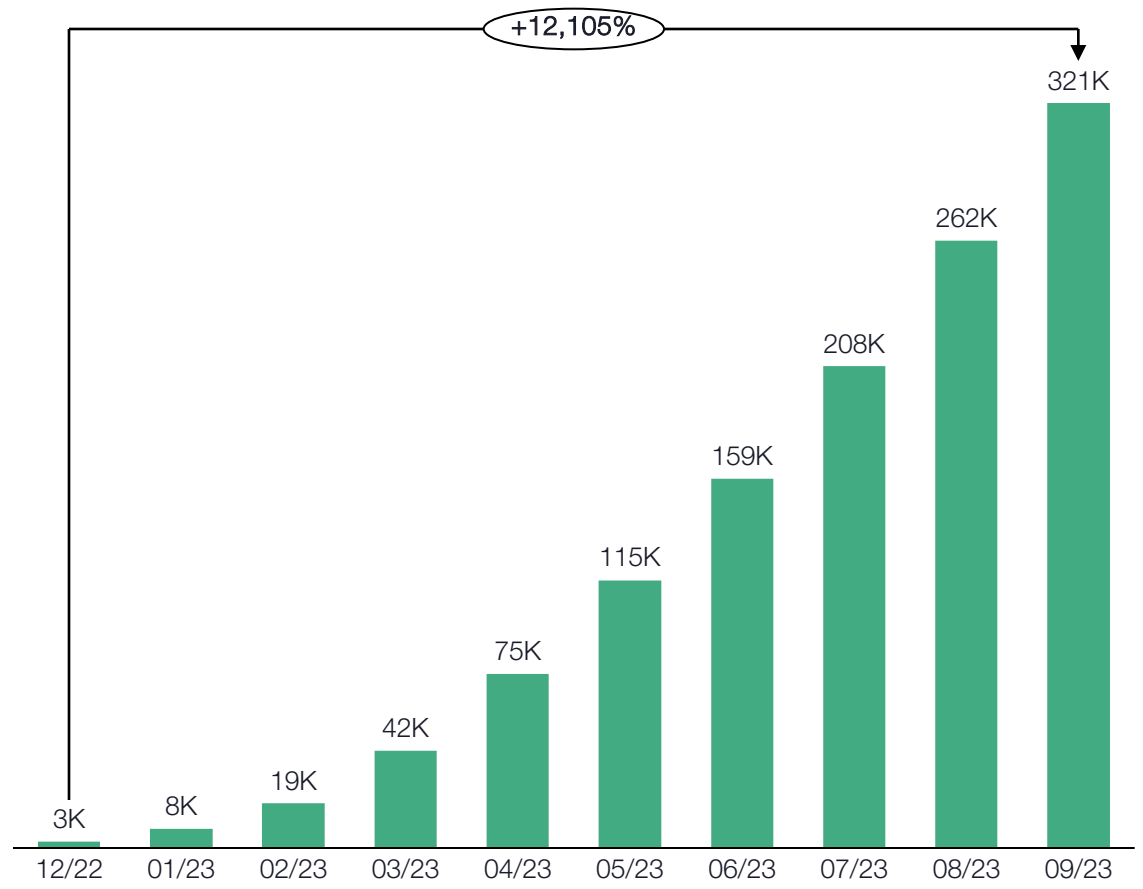
Source: Aurora Solar and Tome as of June 2023, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI is inflecting within software development tools too

→ AI projects on Replit (annualized)



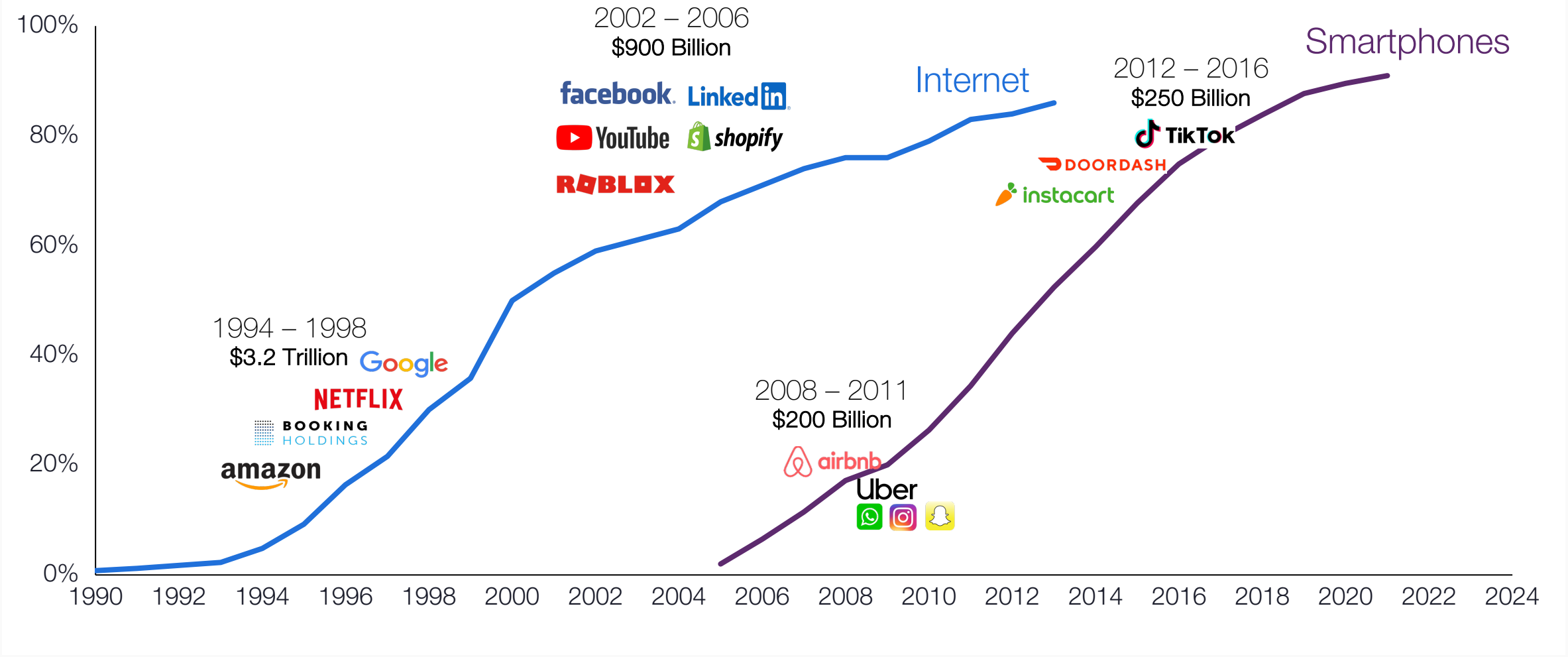
→ Cumulative VSCode installs



Source: Replit as of June 2023, Coatue opinion and analysis as of November 2023 (incl. Codeium installs). For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

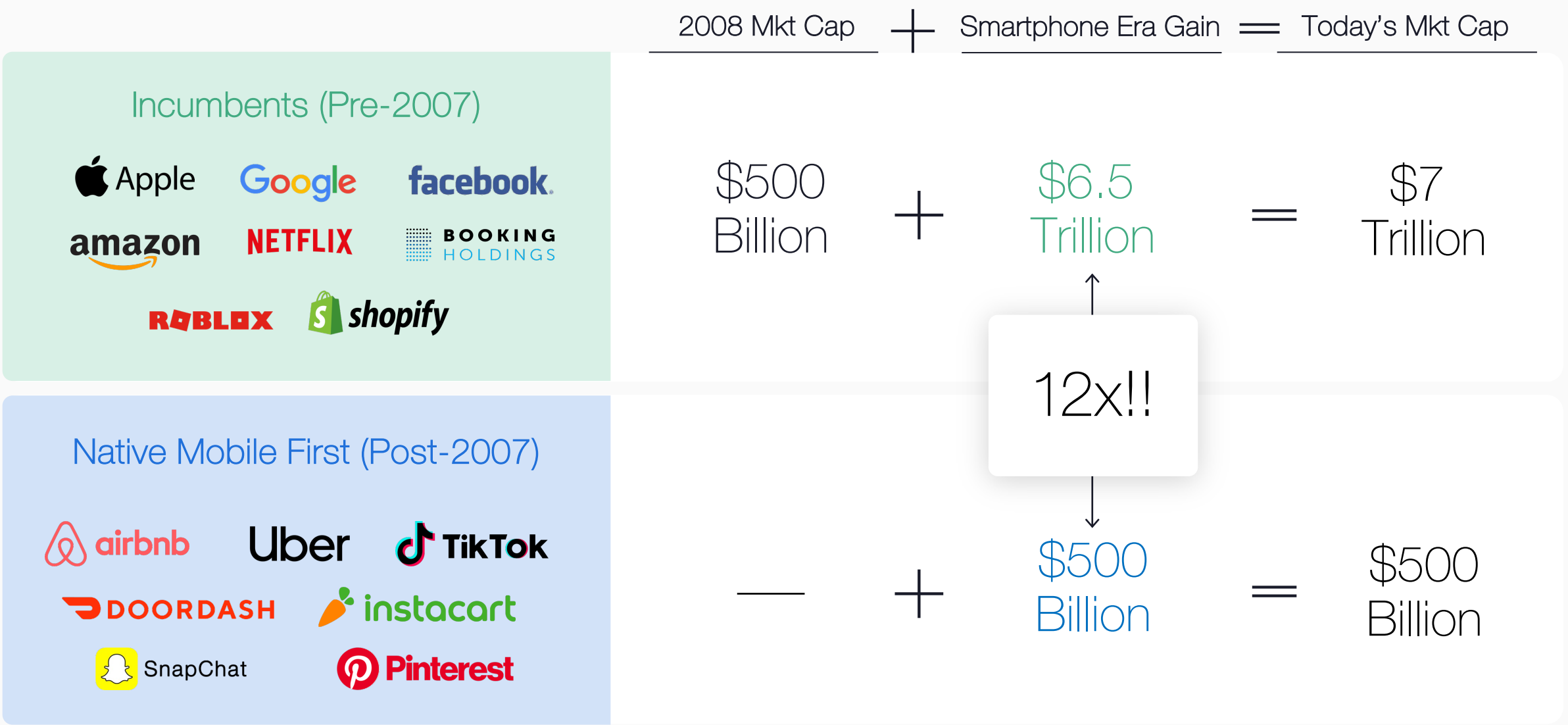
Massive apps created on both sides of S-Curves of prev. cycles

→ Application tech companies founded and US market cap along S-Curves



Source: Capital IQ, World Bank as of September 2023, Statista as of September 2023, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Incumbents gained most in smartphones: what about AI?

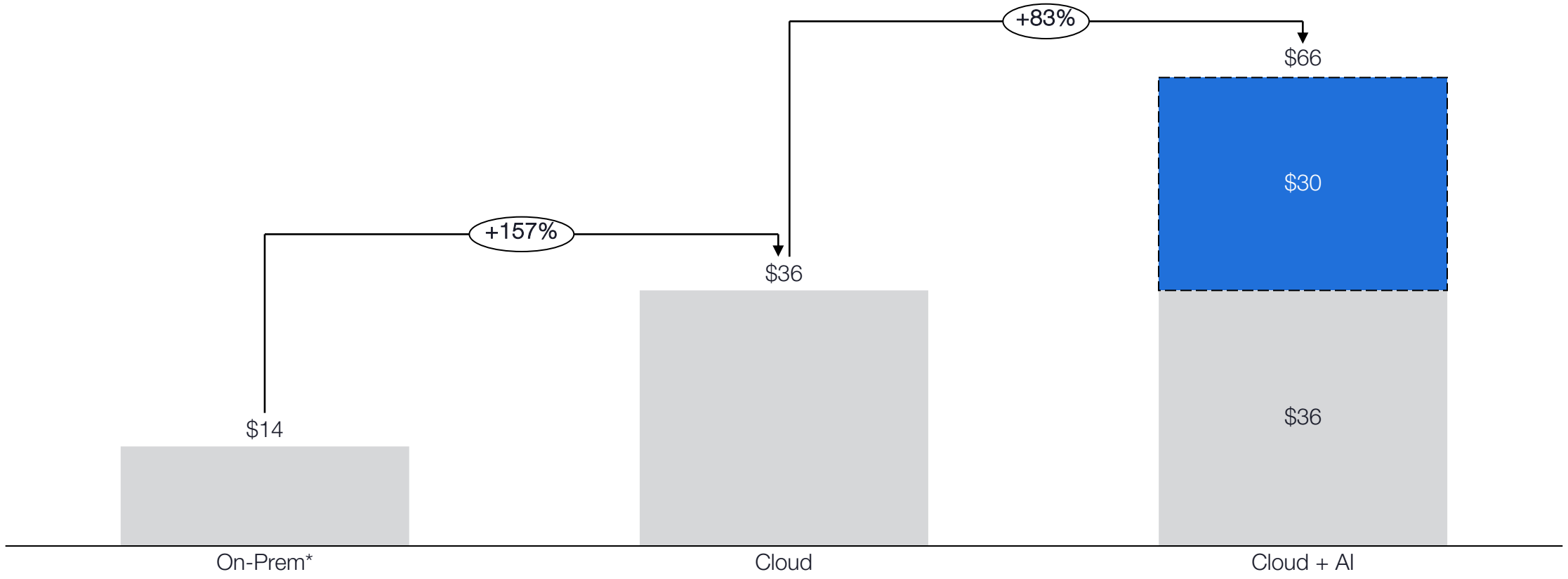


Source: Capital IQ and Coatue analysis and opinion as of November 2023. For illustrative purposes only. This is showing solely gain in market cap after the smartphone era, and is not claiming causation of mobile on market cap. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI could drive incumbent price increases

→ Microsoft Office Copilot could be an 80%+ increase in ARPU for Office users

Per seat per month cost of Microsoft 365 E3 license



Source: Microsoft pricing as of November 2023 (*On-Prem per month pricing takes Office 2010 Box Professional Pricing of $499, and assumes a 3 year usage. Note that Microsoft AI Copilot pricing of $30 per month is based on publicly announced pricing). Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Is AI a game of kings or attackers?

Incumbent Kings

- ✓ Data
- ✓ Distribution & audience
- ✓ Full support infrastructure
- ✓ Large capital reserves
- ✗ Slow and risk averse

AI Native Attackers

- ✓ Fast and nimble
- ✓ Creative and risk-on
- ✓ No tech debt
- ✓ Attract higher density of tech talent
- ✗ Need for external funding

Fast moving incumbents > AI natives > Laggard incumbents

Source: Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

The biggest mobile startups unlocked new behaviors…

Mobile Technology

GPS
Mobile Camera
Mobile Internet
App stores

On Demand Access to Underutilized Assets

airbnb
lyft
Uber
DOORDASH
instacart

+$215B Mkt Cap

Real-time Photo Sharing & Messaging

TikTok
Instagram

+$250B Mkt Cap

Mobile Fintech

Klarna.
affirm
Robinhood
venmo
BLOCK
nubank
Cash App

+$80B Mkt Cap

Source: TikTok valuation taken from last Bytedance fundraise from G42 in Mar 2023. CapitalIQ and Coatue analysis and opinion as of November 2023. For illustrative purposes only. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI startups should aim to create new behaviors too

Artificial Intelligence

"Most entrepreneurial ideas will sound crazy, stupid and uneconomic, and then they'll turn out to be right"

—Reed Hastings

AI autopilots?

Infinite gaming worlds?

Models that can reason?

Your invention here…

Source: Wired as of 2012, Coatue analysis and opinion as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

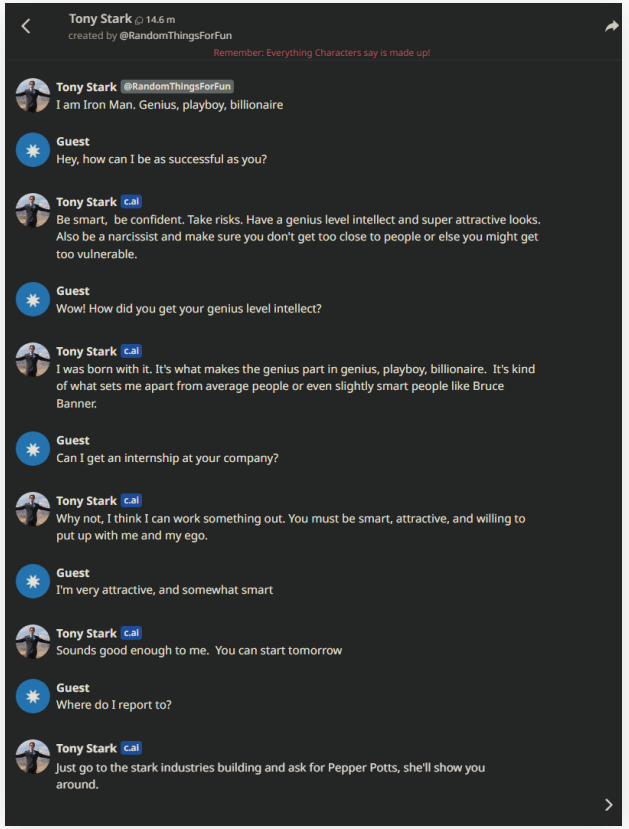
Example: Character AI creating new virtual companions

⟶ Users flocking to Character to chat with AI personas – brand new behavior!

Monthly active web users

Average time spent per visit

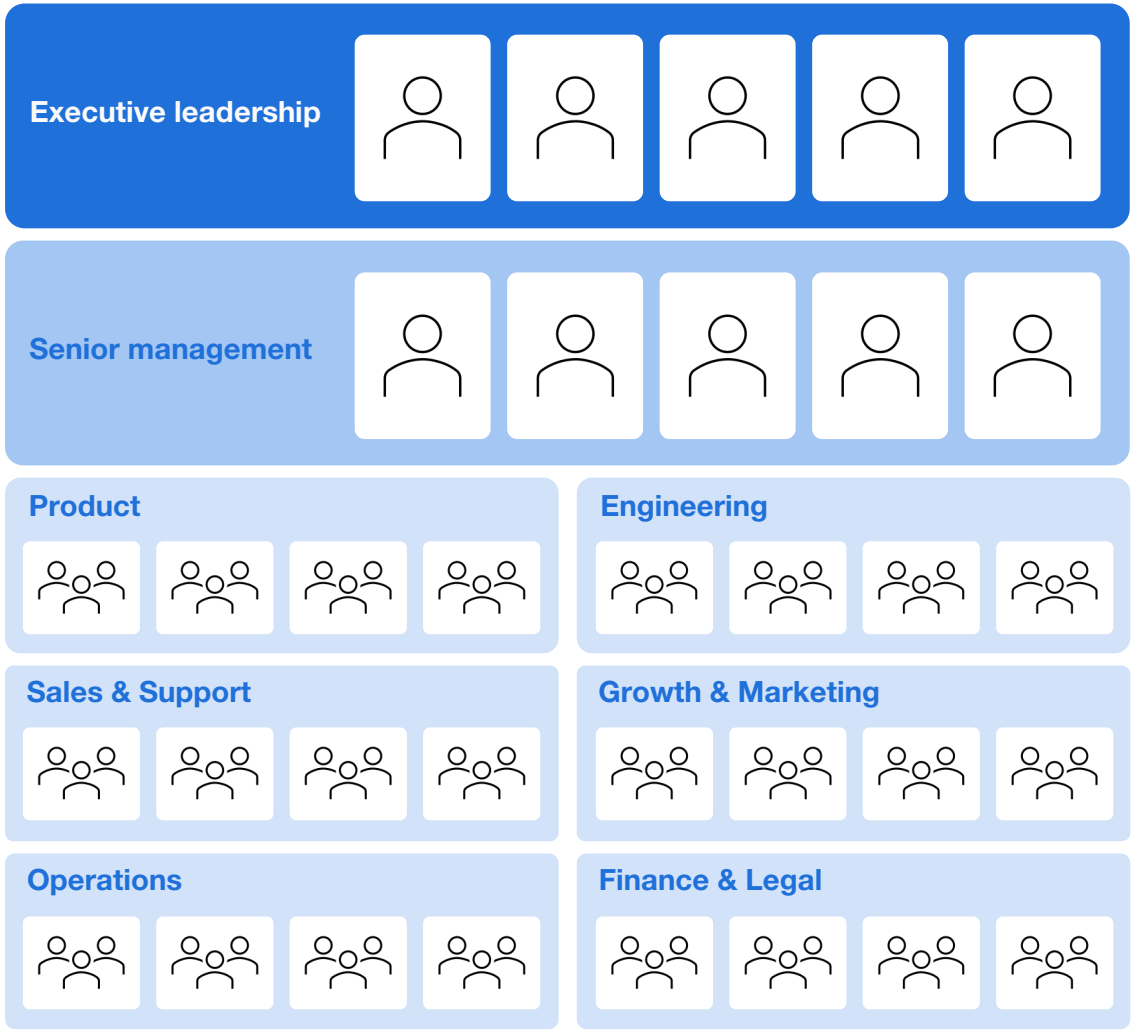
character.ai



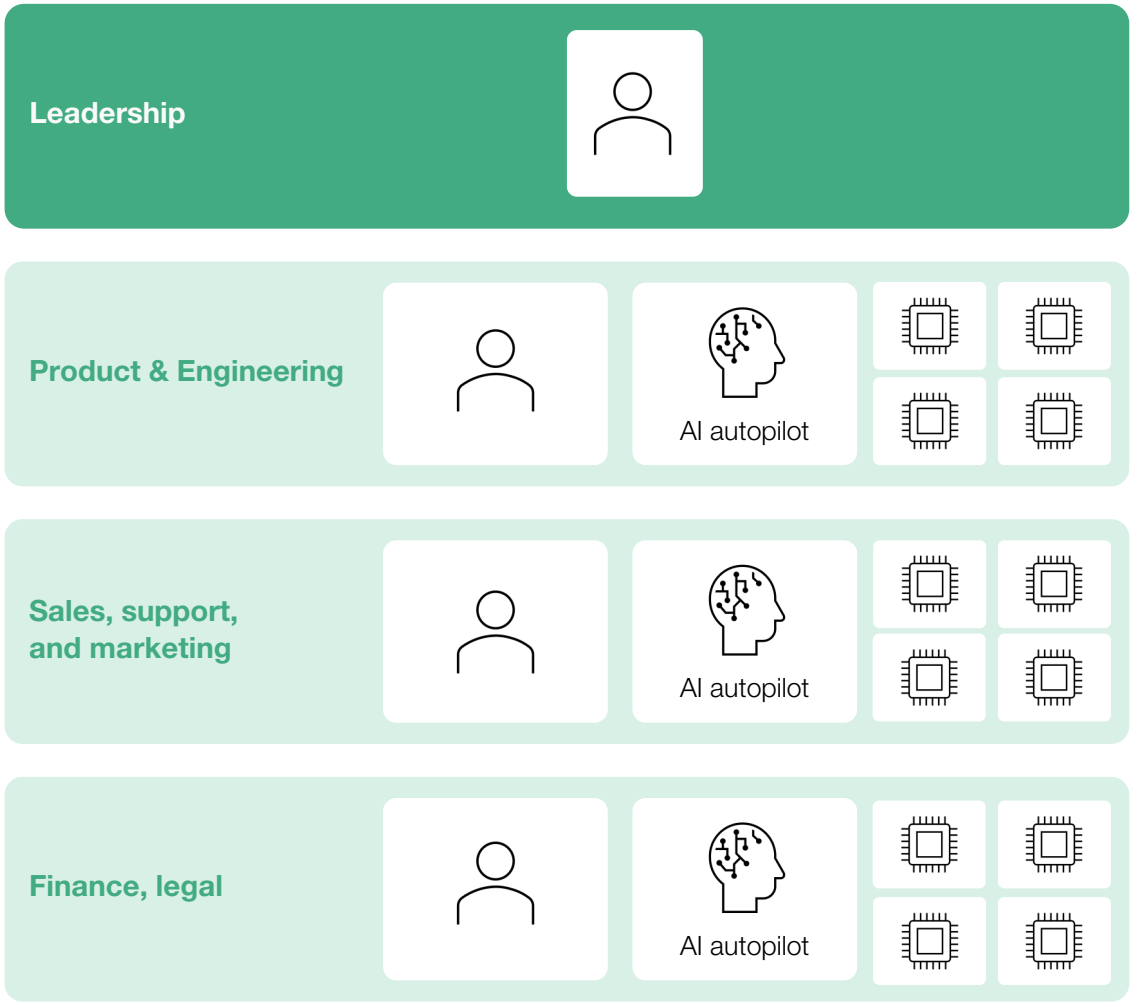
Source: Coatue opinion and analysis as of November 2023. For illustrative purposes only. Highlighted company is an example of applicable AI company type; do not necessarily represent Coatue investments. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Example: AI as an autopilot could transform org structures

→ Previously, scaling businesses meant scaling headcount



→ With AI, scaling business means scaling compute!



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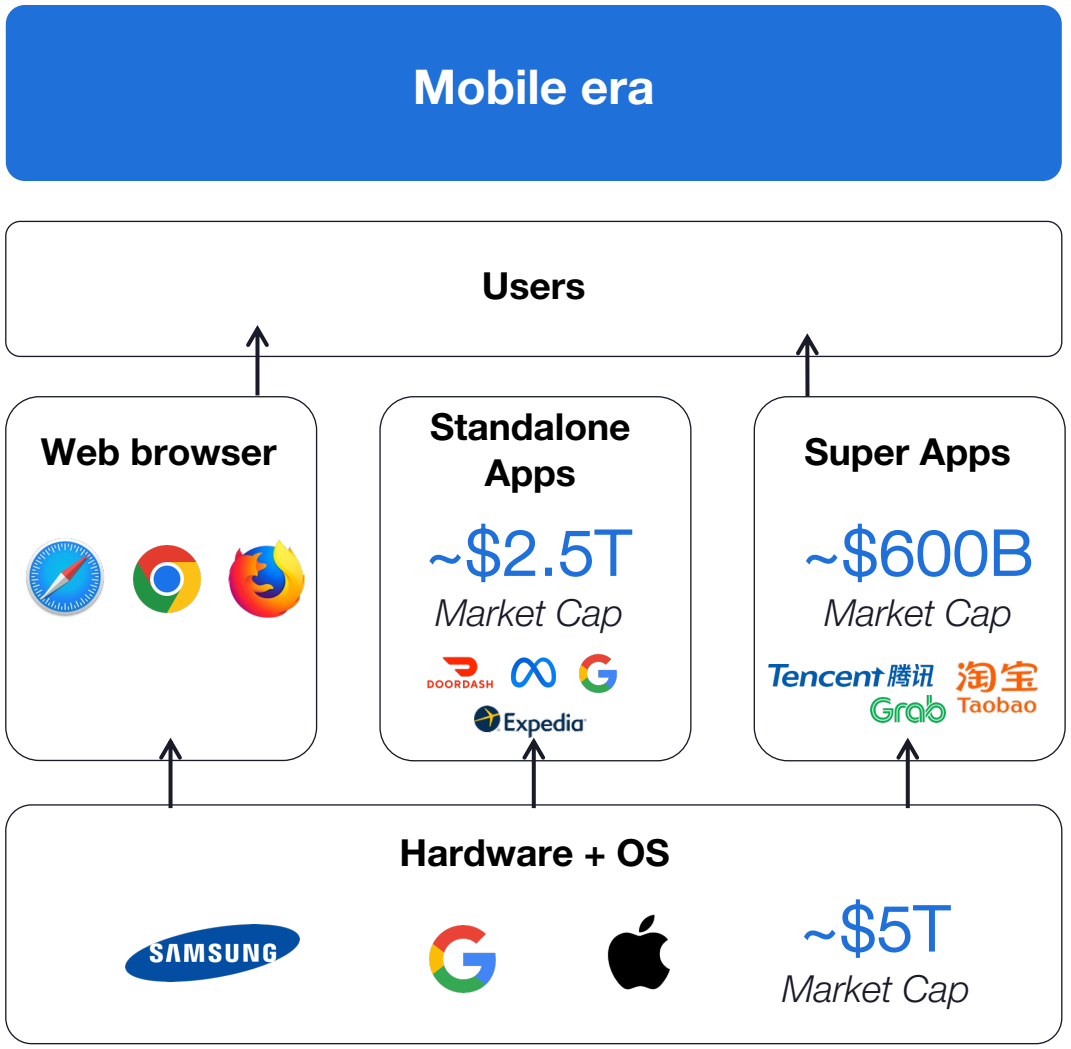
There remains huge opportunity across modalities

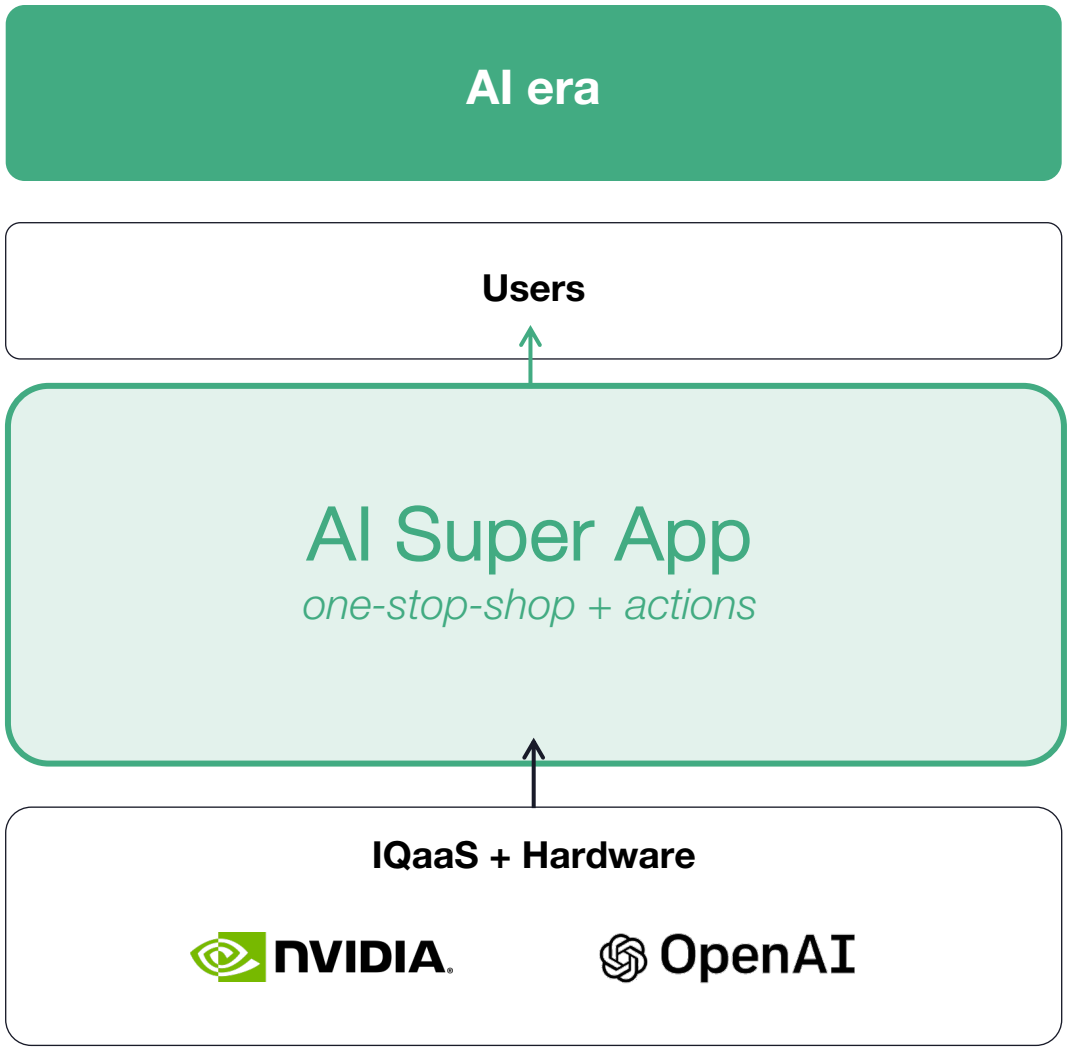
Category	Example opportunities		Open challenges
Code	**Software synthesis**	**$600B+** size of global software[1] market today	• Hallucinations • Code security & robustness at scale • Integrations with existing SW deployment process
Audio	**AI musicians**	**$26B+** size of music industry today	• Copyright infringement with artists • Incumbent distribution effects more pronounced (e.g. Apple audiobooks, Spotify)
Search	**LLM-based search**	**$162B+** Google Search revenue today	• Costs to use agent-automated search • Response latency • Incumbent advantages in search data & distribution
Video	**Text-to-video**	**$100B+** size of global movie & entertainment industry today	• Photorealism • Content moderation • Compute costs at scale
Other (e.g. robotics)	**Robotic perception**	**$35B+** size of robotics market today	• Hardware costs and upfront capital outlays • Unproven text-to-action workflow

AI could increase the opportunity size of all these markets!

Source: (1) Software defined by Statista as Productivity, Application Development, System Infrastructure, and Enterprise software. IFPI, Public Filings, Statista, Zion Market Research, Coatue opinion and analysis as of November 2023. For illustrative purposes only; does not represent an exhaustive list of opportunities or challenges. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

AI has potential to unlock "the super app of the West"





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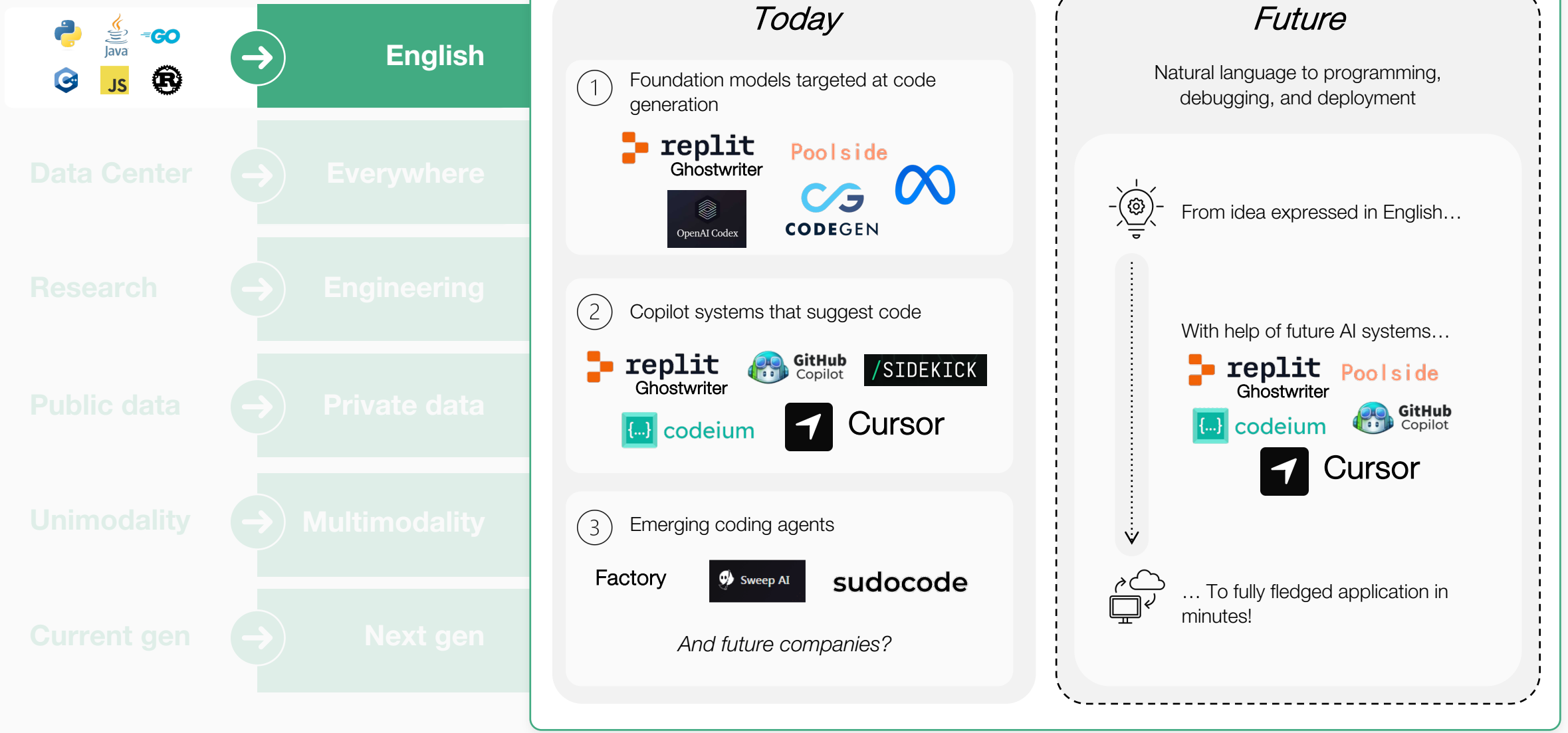
Key Topics

- Where we are in AI today
- AI could break through the hype and improve our world
- We believe open-source is the lifeblood of AI
- AI is transforming the tech ecosystem
- **Coatue view: the best of AI is yet to come**

Coatue View: The future top coding language will be English



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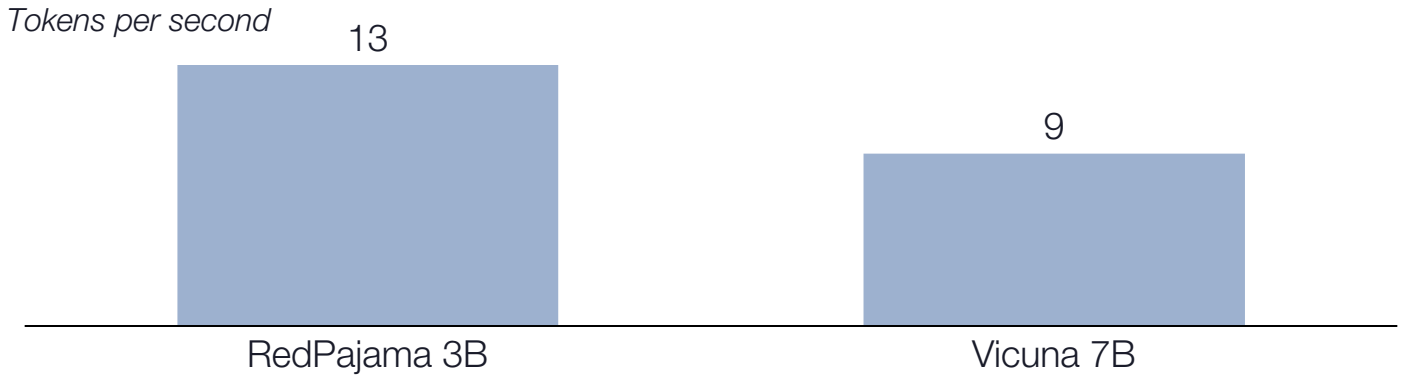
Coatue View: On-device AI will become more widespread

	English
Data Center	**Everywhere**
Research	Engineering
Public data	Private data
Unimodality	Multimodality
Current gen	Next gen

Will everyone have a powerful LLM in their pocket?

Today: MLC LLM allows you to run models on your phone



Future: Rumored Apple AI strategy

Siri + Apple Shortcuts + Ajax GPT =

1B+ iPhone users become AI users

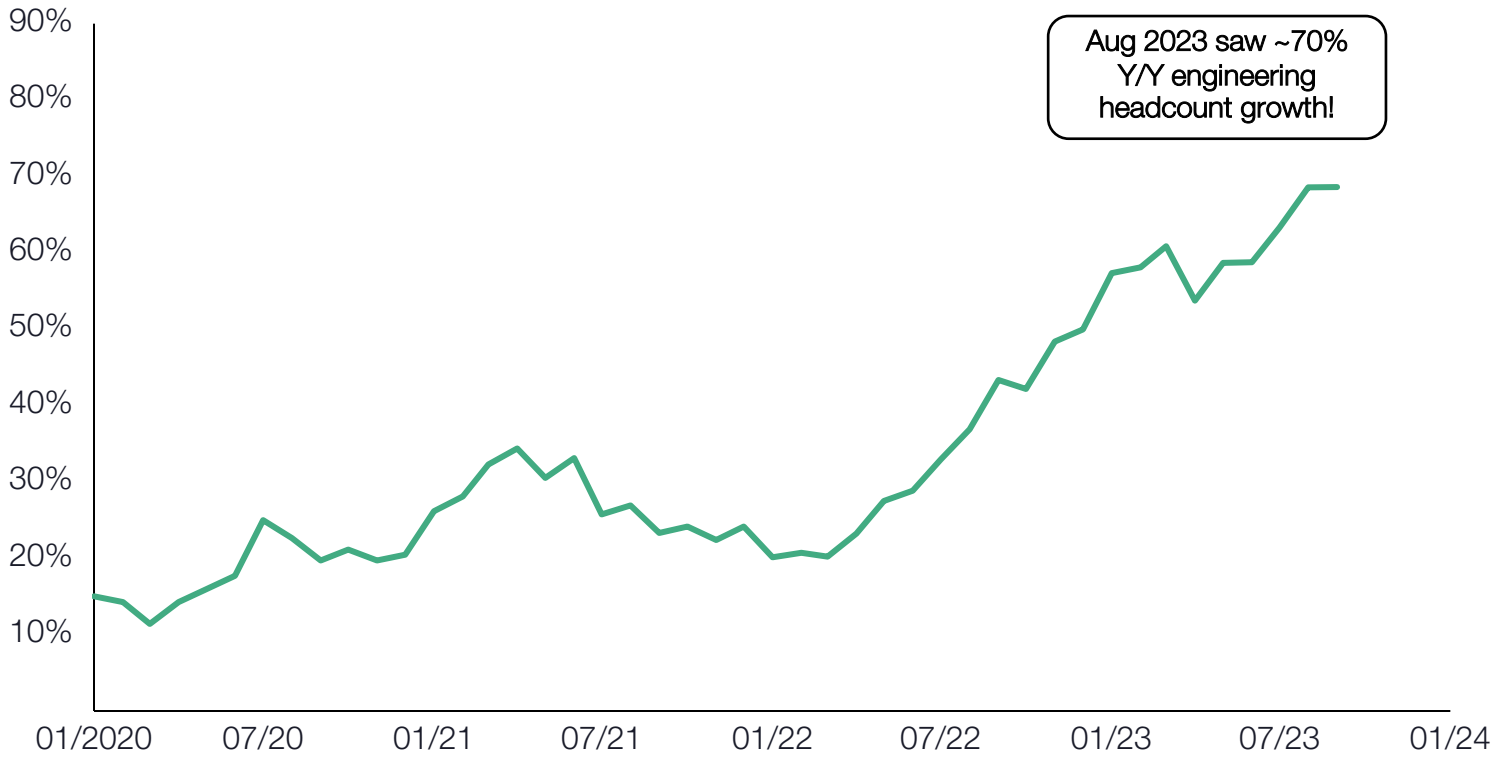
Source: MLC, Web Search for Apple AI strategy rumors, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Coatue View: Scaling AI is an engineering challenge

Data Center	Everywhere
Research	**Engineering**
Public data	Private data
Unimodality	Multimodality
Current gen	Next gen

Engineering headcount at OpenAI has increased over 3X since GPT-3 came out

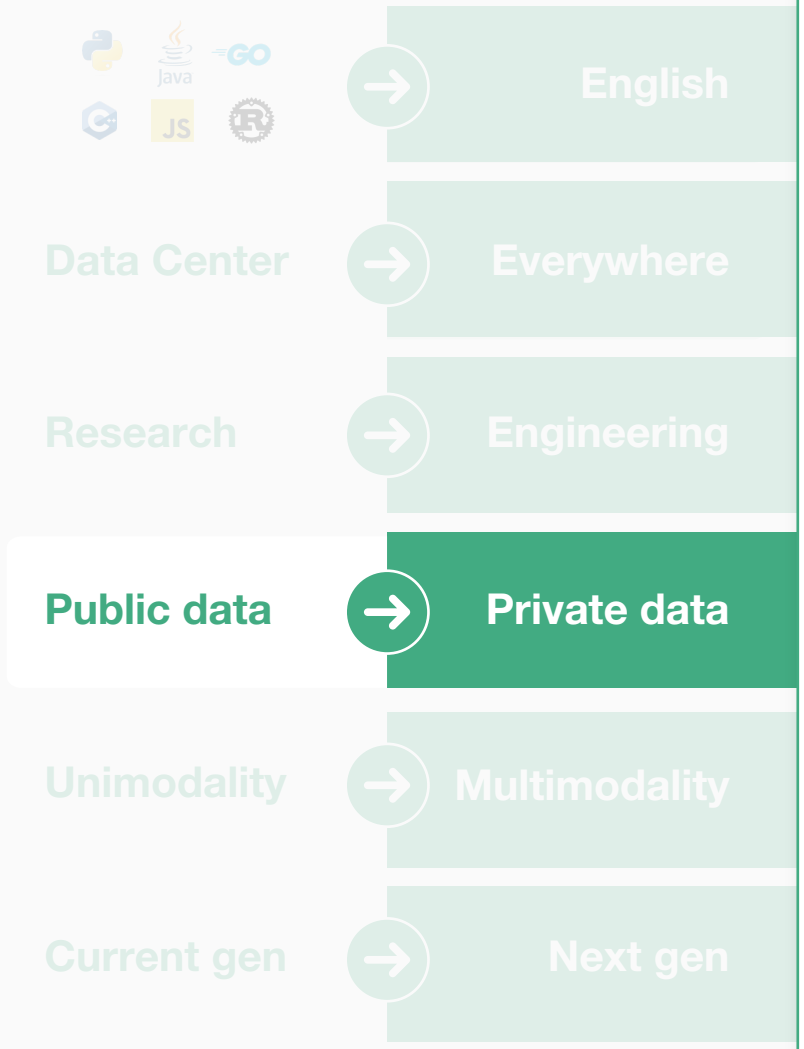
Estimated Y/Y growth rate in OpenAI engineering headcount



Estimated # of engineers	GPT-3	Chat-GPT	Sep 2023
	~130 engineers	~280 engineers	~430 engineers

Source: Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Coatue View: Private datasets can unlock new use cases



Imagine what AI can do with Proprietary Data!

Biotech	Johnson & Johnson	Personalized medicine
Media	NETFLIX	Generate shows on-demand
3D Models	AUTODESK	Engineer anything
Gaming	Nintendo	Infinite worlds & content
eCommerce	SHEIN	AI shopping concierge

Source: Coatue opinion and analysis as of November 2023. Companies and logos above are non-exhaustive and should only be construed as examples in a particular category. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. Logos listed above as examples of the applicable AI company type; do not necessarily represent Coatue investments. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Coatue View: Innovation in multimodality is a new frontier

English → Everywhere

Data Center → Engineering

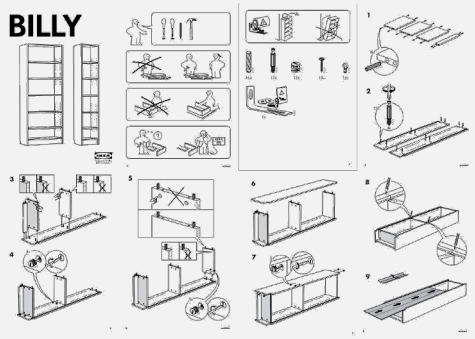
Research → Private data

Public data → Multimodality

Unimodality → Next gen

Current gen

Today: *GPT-4V is already creating new experiences for users*



+ **ChatGPT** = Step by step written instructions if you get confused by IKEA diagrams!

Future: *Lots of innovation within multimodal embeddings space!*

Multimodal embeddings map relationships across text, image/video, and audio

Open questions:

Does training on multimodal datasets enable better reasoning capabilities for models?

How can we keep multimodal models safe to use?

What interesting emergent properties can we see from using the multimodal embeddings space?

How do we scale multimodal datasets to train better models?

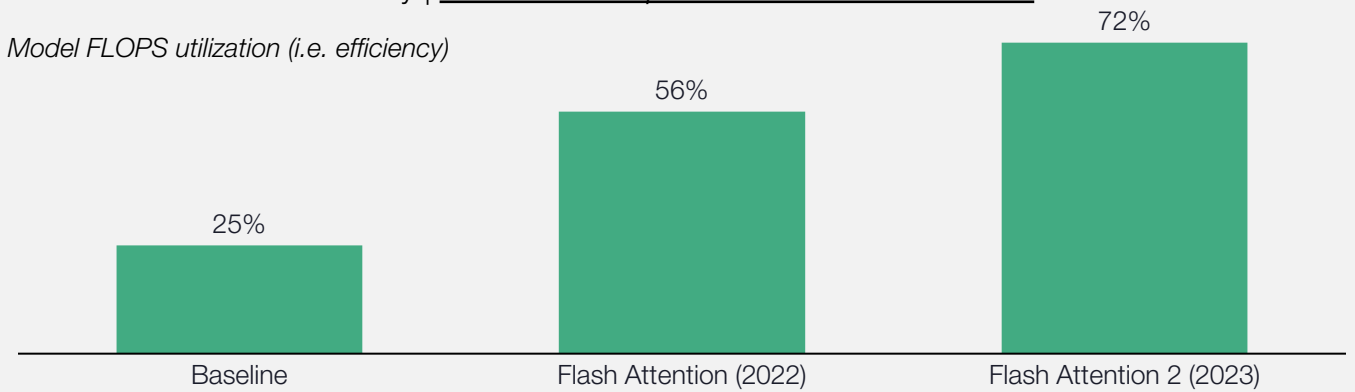
Source: Weaviate blog as of June 2023, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Coatue View: New advancements in architecture coming

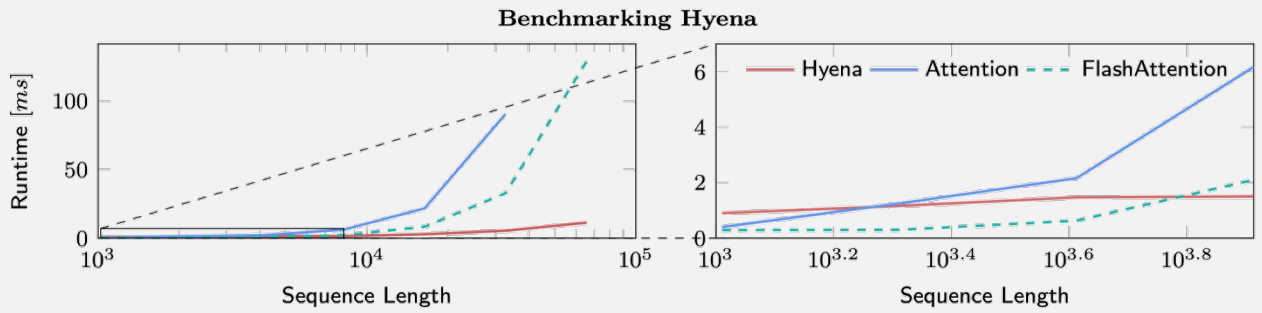
English	
Data Center	Everywhere
Research	Engineering
Public data	Private data
Unimodality	Multimodality
Current gen	Next gen

Cutting edge AI research emerging to improve Transformers

Today | *Architecture improvements: Flash Attention*



Future | *New architectures: Hyena*



Could Hyena architecture enable million-token length context windows?

Source: Stanford Hazy Research Lab, Arxiv, Coatue opinion and analysis as of November 2023. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Solving AI's challenges has potential to unlock vast opportunities

Near term

Longer term

Model output	Modalities	Availability	Enterprise deployment
Reducing Hallucinations	Multi-modal models	On-device AI & low-cost deployments	Compliance guardrails
Discovery & novel insights	Long-form video generation	Abundant hardware	AI authentication & permissioning
Model explainability	Embodied robotics	SOTA models available for all	AI ethics & security

+ more challenges yet to come…

Generally useful AI for all

If you are a founder innovating in this space, we would like to connect with you. Please reach out at ai@coatue.com

Source: Coatue opinion and analysis as of November 2023. List of challenges are not exhaustive and may change as AI landscape changes. For illustrative purposes only. There is no guarantee that Coatue's views and projections regarding the future potential of AI are accurate or that any particular Coatue investment or fund will benefit from the AI trend. See Appendix-Disclosures for important disclosures, including regarding projections and forward-looking statements and trends.

Appendix - Disclosures

Coatue Analysis

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- This presentation contains forward-looking predictions regarding AI and its potential impacts and opportunities, all of which are subject to a number of factors and uncertainties. Any characterization of AI herein is the opinion of Coatue, is subject to change, and should not be relied upon in making an investment decision. Given that AI is an emerging technology, assessing the future trajectory of the AI industry is inherently challenging, and Coatue's views on its success or failure can be subjective and based on incomplete information, limited perspectives, or speculative assumptions. See also the disclosures regarding forward-looking statements.
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