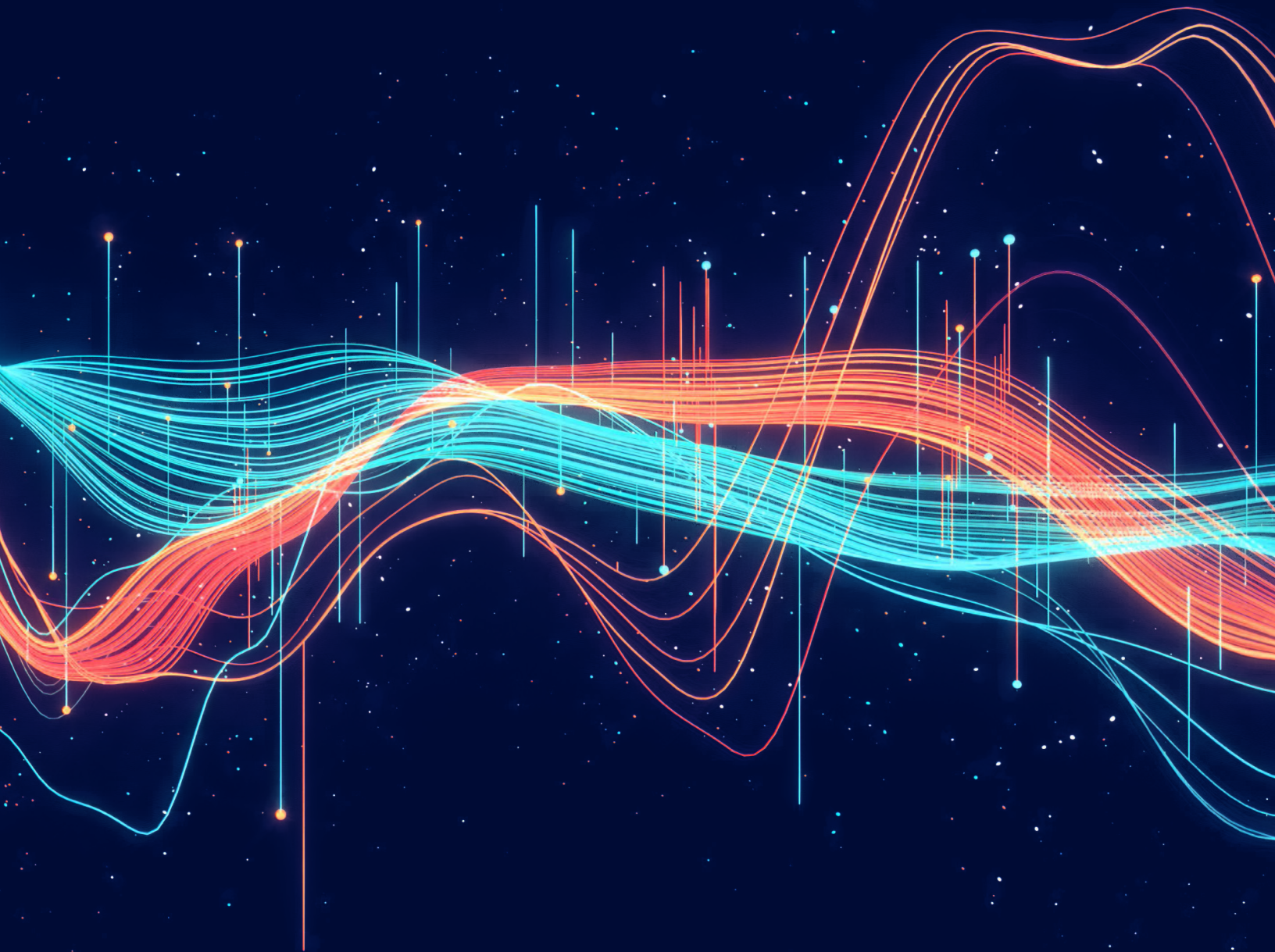


# Artificial Intelligence Index Report 2025



Stanford University  
Human-Centered  
Artificial Intelligence

# Introduction to the AI Index Report 2025

Welcome to the eighth edition of the AI Index report. The 2025 Index is our most comprehensive to date and arrives at an important moment, as AI's influence across society, the economy, and global governance continues to intensify. New in this year's report are in-depth analyses of the evolving landscape of AI hardware, novel estimates of inference costs, and new analyses of AI publication and patenting trends. We also introduce fresh data on corporate adoption of responsible AI practices, along with expanded coverage of AI's growing role in science and medicine.

Since its founding in 2017 as an offshoot of the [One Hundred Year Study of Artificial Intelligence](#), the AI Index has been committed to equipping policymakers, journalists, executives, researchers, and the public with accurate, rigorously validated, and globally sourced data. Our mission has always been to help these stakeholders make better-informed decisions about the development and deployment of AI. In a world where AI is discussed everywhere—from boardrooms to kitchen tables—this mission has never been more essential.

The AI Index continues to lead in tracking and interpreting the most critical trends shaping the field—from the shifting geopolitical landscape and the rapid evolution of underlying technologies, to AI's expanding role in business, policymaking, and public life. Longitudinal tracking remains at the heart of our mission. In a domain advancing at breakneck speed, the Index provides essential context—helping us understand where AI stands today, how it got here, and where it may be headed next.

Recognized globally as one of the most authoritative resources on artificial intelligence, the AI Index has been cited in major media outlets such as The New York Times, Bloomberg, and The Guardian; referenced in hundreds of academic papers; and used by policymakers and government agencies around the world. We have briefed companies like Accenture, IBM, Wells Fargo, and Fidelity on the state of AI, and we continue to serve as an independent source of insights for the global AI ecosystem.

# Message From the Co-directors

As AI continues to reshape our lives, the corporate world, and public discourse, the AI Index continues to track its progress—offering an independent, data-driven perspective on AI’s development, adoption, and impact, across time and geography.

What a year 2024 has been for AI. The recognition of AI’s role in advancing humanity’s knowledge is reflected in Nobel prizes in physics and chemistry, and the Turing award for foundational work in reinforcement learning. The once-formidable Turing Test is no longer considered an ambitious goal, having been surpassed by today’s sophisticated systems. Meanwhile, AI adoption has accelerated at an unprecedented rate, as millions of people are now using AI on a regular basis both for their professional work and leisure activities. As high-performing, low-cost, and openly available models proliferate, AI’s accessibility and impact are set to expand even further.

After a brief slowdown, corporate investment in AI rebounded. The number of newly funded generative AI startups nearly tripled, and after years of sluggish uptake, business adoption accelerated significantly in 2024. AI has moved from the margins to become a central driver of business value.

Governments, too, are ramping up their involvement. Policymakers are no longer just debating AI—they’re investing in it. Several countries launched billion-dollar national AI infrastructure initiatives, including major efforts to expand energy capacity to support AI development. Global coordination is increasing, even as local initiatives take shape.

Yet trust remains a major challenge. Fewer people believe AI companies will safeguard their data, and concerns about fairness and bias persist. Misinformation continues to pose risks, particularly in elections and the proliferation of deepfakes. In response, governments are advancing new regulatory frameworks aimed at promoting transparency, accountability, and fairness. Public attitudes are also shifting. While skepticism remains, a global survey in 2024 showed a notable rise in optimism about AI’s potential to deliver broad societal benefits.

AI is no longer just a story of what’s possible—it’s a story of what’s happening now and how we are collectively shaping the future of humanity. Explore this year’s AI Index report and see for yourself.

**Yolanda Gil and Raymond Perrault**  
Co-directors, AI Index Report

# Top Takeaways

**1. AI performance on demanding benchmarks continues to improve.** In 2023, researchers introduced new benchmarks—MMMU, GPQA, and SWE-bench—to test the limits of advanced AI systems. Just a year later, performance sharply increased: scores rose by 18.8, 48.9, and 67.3 percentage points on MMMU, GPQA, and SWE-bench, respectively. Beyond benchmarks, AI systems made major strides in generating high-quality video, and in some settings, language model agents even outperformed humans in programming tasks with limited time budgets.

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**2. AI is increasingly embedded in everyday life.** From healthcare to transportation, AI is rapidly moving from the lab to daily life. In 2023, the FDA approved 223 AI-enabled medical devices, up from just six in 2015. On the roads, self-driving cars are no longer experimental: Waymo, one of the largest U.S. operators, provides over 150,000 autonomous rides each week, while Baidu's affordable Apollo Go robotaxi fleet now serves numerous cities across China.

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**3. Business is all in on AI, fueling record investment and usage, as research continues to show strong productivity impacts.** In 2024, U.S. private AI investment grew to \$109.1 billion—nearly 12 times China's \$9.3 billion and 24 times the U.K.'s \$4.5 billion. Generative AI saw particularly strong momentum, attracting \$33.9 billion globally in private investment—an 18.7% increase from 2023. AI business usage is also accelerating: 78% of organizations reported using AI in 2024, up from 55% the year before. Meanwhile, a growing body of research confirms that AI boosts productivity and, in most cases, helps narrow skill gaps across the workforce.

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**4. The U.S. still leads in producing top AI models—but China is closing the performance gap.** In 2024, U.S.-based institutions produced 40 notable AI models, compared to China's 15 and Europe's three. While the U.S. maintains its lead in quantity, Chinese models have rapidly closed the quality gap: performance differences on major benchmarks such as MMLU and HumanEval shrank from double digits in 2023 to near parity in 2024. China continues to lead in AI publications and patents. Model development is increasingly global, with notable launches from the Middle East, Latin America, and Southeast Asia.

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**5. The responsible AI ecosystem evolves—unevenly.** AI-related incidents are rising sharply, yet standardized RAI evaluations remain rare among major industrial model developers. However, new benchmarks like HELM Safety, AIR-Bench, and FACTS offer promising tools for assessing factuality and safety. Among companies, a gap persists between recognizing RAI risks and taking meaningful action. In contrast, governments are showing increased urgency: In 2024, global cooperation on AI governance intensified, with organizations including the OECD, EU, U.N., and African Union releasing frameworks focused on transparency, trustworthiness, and other core responsible AI principles.

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## Top Takeaways (cont'd)

**6. Global AI optimism is rising—but deep regional divides remain.** In countries like China (83%), Indonesia (80%), and Thailand (77%), strong majorities see AI products and services as more beneficial than harmful. In contrast, optimism remains far lower in places like Canada (40%), the United States (39%), and the Netherlands (36%). Still, sentiment is shifting: Since 2022, optimism has grown significantly in several previously skeptical countries, including Germany (+10%), France (+10%), Canada (+8%), Great Britain (+8%), and the United States (+4%).

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**7. AI becomes more efficient, affordable, and accessible.** Driven by increasingly capable small models, the inference cost for a system performing at the level of GPT-3.5 dropped over 280-fold between November 2022 and October 2024. At the hardware level, costs have declined by 30% annually, while energy efficiency has improved by 40% each year. Open-weight models are closing the gap with closed models, reducing the performance difference from 8% to just 1.7% on some benchmarks in a single year. Together, these trends are rapidly lowering the barriers to advanced AI.

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**8. Governments are stepping up on AI—with regulation and investment.** In 2024, U.S. federal agencies introduced 59 AI-related regulations—more than double the number in 2023—and issued by twice as many agencies. Globally, legislative mentions of AI rose 21.3% across 75 countries since 2023, marking a ninefold increase since 2016. Alongside growing attention, governments are investing at scale: Canada pledged \$2.4 billion, China launched a \$47.5 billion semiconductor fund, France committed €109 billion, India pledged \$1.25 billion, and Saudi Arabia's Project Transcendence represents a \$100 billion initiative.

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**9. AI and computer science education is expanding—but gaps in access and readiness persist.** Two-thirds of countries now offer or plan to offer K–12 CS education—twice as many as in 2019—with Africa and Latin America making the most progress. In the U.S., the number of graduates with bachelor's degrees in computing has increased 22% over the last 10 years. Yet access remains limited in many African countries due to basic infrastructure gaps like electricity. In the U.S., 81% of K–12 CS teachers say AI should be part of foundational CS education, but less than half feel equipped to teach it.

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**10. Industry is racing ahead in AI—but the frontier is tightening.** Nearly 90% of notable AI models in 2024 came from industry, up from 60% in 2023, while academia remains the top source of highly cited research. Model scale continues to grow rapidly—training compute doubles every five months, datasets every eight, and power use annually. Yet performance gaps are shrinking: the Elo skill score difference between the top and 10th-ranked models fell from 11.9% to 5.4% in a year, and the top two are now separated by just 0.7%. The frontier is increasingly competitive—and increasingly crowded.

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## Top Takeaways (cont'd)

**11. AI earns top honors for its impact on science.** AI's growing importance is reflected in major scientific awards: Two Nobel Prizes recognized work that led to deep learning (physics) and to its application to protein folding (chemistry), while the Turing Award honored groundbreaking contributions to reinforcement learning.

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**12. Complex reasoning remains a challenge.** AI models excel at tasks like International Mathematical Olympiad problems but still struggle with complex reasoning benchmarks like PlanBench. They often fail to reliably solve logic tasks even when provably correct solutions exist, limiting their effectiveness in high-stakes settings where precision is critical.

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## Public Data and Tools

The AI Index 2025 Report is supplemented by raw data and an interactive tool. We invite each reader to use the data and the tool in a way most relevant to their work and interests.

- **Raw data and charts:** The public data and high-resolution images of all the charts in the report are available on [Google Drive](#).
  - **Global AI Vibrancy Tool:** Compare the AI ecosystems of over 30 countries. The Global AI Vibrancy tool will be updated in the summer of 2025.
- 

## AI Index and Stanford HAI

The AI Index is an independent initiative at the [Stanford Institute for Human-Centered Artificial Intelligence \(HAI\)](#).



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Stanford University  
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The AI Index was conceived within the [One Hundred Year Study on Artificial Intelligence \(AI100\)](#).

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The AI Index welcomes feedback and new ideas for next year. Contact us at [nmaslej@stanford.edu](mailto:nmaslej@stanford.edu).

The AI Index acknowledges that while authored by a team of human researchers, its writing process was aided by AI tools. Specifically, the authors used ChatGPT and Claude to help tighten and copy edit initial drafts. The workflow involved authors writing the original copy and utilizing AI tools as part of the editing process.



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# Report Highlights

## CHAPTER 1:

### Research and Development

**1. Industry continues to make significant investments in AI and leads in notable AI model development, while academia leads in highly cited research.** Industry's lead in notable model development, highlighted in the two previous AI Index reports, has only grown more pronounced, with nearly 90% of notable models in 2024 (compared to 60% in 2023) originating from industry. Academia has remained the single leading institutional producer of highly cited (top 100) publications over the past three years.

---

**2. China leads in AI research publication totals, while the United States leads in highly influential research.** In 2023, China produced more AI publications (23.2%) and citations (22.6%) than any other country. Over the past three years, U.S. institutions have contributed the most top-100-cited AI publications.

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**3. AI publication totals continue to grow and increasingly dominate computer science.** Between 2013 and 2023, the total number of AI publications in venues related to computer science and other scientific disciplines nearly tripled, increasing from approximately 102,000 to over 242,000. Proportionally, AI's share of computer science publications has risen from 21.6% in 2013 to 41.8% in 2023.

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**4. The United States continues to be the leading source of notable AI models.** In 2024, U.S.-based institutions produced 40 notable AI models, significantly surpassing China's 15 and Europe's combined total of three. In the past decade, more notable machine learning models have originated from the United States than any other country.

---

**5. AI models get increasingly bigger, more computationally demanding, and more energy intensive.** New research finds that the training compute for notable AI models doubles approximately every five months, dataset sizes for training LLMs every eight months, and the power required for training annually. Large-scale industry investment continues to drive model scaling and performance gains.

---

**6. AI models become increasingly cheaper to use.** The cost of querying an AI model that scores the equivalent of GPT-3.5 (64.8) on MMLU, a popular benchmark for assessing language model performance, dropped from \$20.00 per million tokens in November 2022 to just \$0.07 per million tokens by October 2024 (Gemini-1.5-Flash-8B)—a more than 280-fold reduction in approximately 18 months. Depending on the task, LLM inference prices have fallen anywhere from 9 to 900 times per year.

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# Report Highlights

## CHAPTER 1:

### Research and Development (cont'd)

**7. AI patenting is on the rise.** Between 2010 and 2023, the number of AI patents has grown steadily and significantly, ballooning from 3,833 to 122,511. In just the last year, the number of AI patents has risen 29.6%. As of 2023, China leads in total AI patents, accounting for 69.7% of all grants, while South Korea and Luxembourg stand out as top AI patent producers on a per capita basis.

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**8. AI hardware gets faster, cheaper, and more energy efficient.** New research suggests that machine learning hardware performance, measured in 16-bit floating-point operations, has grown 43% annually, doubling every 1.9 years. Price performance has improved, with costs dropping 30% per year, while energy efficiency has increased by 40% annually.

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**9. Carbon emissions from AI training are steadily increasing.** Training early AI models, such as AlexNet (2012), had modest amounts of carbon emissions at 0.01 tons. More recent models have significantly higher emissions for training: GPT-3 (2020) at 588 tons, GPT-4 (2023) at 5,184 tons, and Llama 3.1 405B (2024) at 8,930 tons. For perspective, the average American emits 18 tons of carbon per year.

## CHAPTER 2:

### Technical Performance

**1. AI masters new benchmarks faster than ever.** In 2023, AI researchers introduced several challenging new benchmarks, including MMMU, GPQA, and SWE-bench, aimed at testing the limits of increasingly capable AI systems. By 2024, AI performance on these benchmarks saw remarkable improvements, with gains of 18.8 and 48.9 percentage points on MMMU and GPQA, respectively. On SWE-bench, AI systems could solve just 4.4% of coding problems in 2023—a figure that jumped to 71.7% in 2024.

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**2. Open-weight models catch up.** Last year's AI Index revealed that leading open-weight models lagged significantly behind their closed-weight counterparts. By 2024, this gap had nearly disappeared. In early January 2024, the leading closed-weight model outperformed the top open-weight model by 8.0% on the Chatbot Arena Leaderboard. By February 2025, this gap had narrowed to 1.7%.

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# Report Highlights

## CHAPTER 2:

### Technical Performance (cont'd)

**3. The gap closes between Chinese and U.S. models.** In 2023, leading American models significantly outperformed their Chinese counterparts—a trend that no longer holds. At the end of 2023, performance gaps on benchmarks such as MMLU, MMMU, MATH, and HumanEval were 17.5, 13.5, 24.3, and 31.6 percentage points, respectively. By the end of 2024, these margins had narrowed substantially to 0.3, 8.1, 1.6, and 3.7 percentage points.

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**4. AI model performance converges at the frontier.** According to last year's AI Index, the Elo score difference between the top and 10th-ranked model on the Chatbot Arena Leaderboard was 11.9%. By early 2025, this gap had narrowed to 5.4%. Likewise, the difference between the top two models shrank from 4.9% in 2023 to just 0.7% in 2024. The AI landscape is becoming increasingly competitive, with high-quality models now available from a growing number of developers.

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**5. New reasoning paradigms like test-time compute improve model performance.** In 2024, OpenAI introduced models like o1 and o3 that are designed to iteratively reason through their outputs. This test-time compute approach dramatically improved performance, with o1 scoring 74.4% on an International Mathematical Olympiad qualifying exam, compared to GPT-4o's 9.3%. However, this enhanced reasoning comes at a cost: o1 is nearly six times more expensive and 30 times slower than GPT-4o.

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**6. More challenging benchmarks are continually being proposed.** The saturation of traditional AI benchmarks like MMLU, GSM8K, and HumanEval, coupled with improved performance on newer, more challenging benchmarks such as MMMU and GPQA, has pushed researchers to explore additional evaluation methods for leading AI systems. Notable among these are Humanity's Last Exam, a rigorous academic test where the top system scores just 8.80%; FrontierMath, a complex mathematics benchmark where AI systems solve only 2% of problems; and BigCodeBench, a coding benchmark where AI systems achieve a 35.5% success rate—well below the human standard of 97%.

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**7. High-quality AI video generators demonstrate significant improvement.** In 2024, several advanced AI models capable of generating high-quality videos from text inputs were launched. Notable releases include OpenAI's SORA, Stable Video Diffusion 3D and 4D, Meta's Movie Gen, and Google DeepMind's Veo 2. These models produce videos of significantly higher quality compared to those from 2023.

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# Report Highlights

## CHAPTER 2:

### Technical Performance (cont'd)

**8. Smaller models drive stronger performance.** In 2022, the smallest model registering a score higher than 60% on MMLU was PaLM, with 540 billion parameters. By 2024, Microsoft's Phi-3-mini, with just 3.8 billion parameters, achieved the same threshold—the equivalent of a 142-fold reduction in two years.

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**9. Complex reasoning remains a problem.** Even though the addition of mechanisms such as chain-of-thought reasoning has significantly improved the performance of LLMs, these systems still cannot reliably solve problems for which provably correct solutions can be found using logical reasoning, such as arithmetic and planning, especially on instances larger than those they were trained on. This has a significant impact on the trustworthiness of these systems and their suitability in high-risk applications.

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**10. AI agents show early promise.** The launch of RE-Bench in 2024 introduced a rigorous benchmark for evaluating complex tasks for AI agents. In short time-horizon settings (two-hour budget), top AI systems score four times higher than human experts, but as the time budget increases, human performance surpasses AI—outscored it two to one at 32 hours. AI agents already match human expertise in select tasks, such as writing Triton kernels, while delivering results faster and at lower costs.

## CHAPTER 3:

### Responsible AI

**1. Evaluating AI systems with responsible AI (RAI) criteria is still uncommon, but new benchmarks are beginning to emerge.** Last year's AI Index highlighted the lack of standardized RAI benchmarks for LLMs. While this issue persists, new benchmarks such as HELM Safety and AIR-Bench help to fill this gap.

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**2. The number of AI incident reports continues to increase.** According to the AI Incidents Database, the number of reported AI-related incidents rose to 233 in 2024—a record high and a 56.4% increase over 2023.

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# Report Highlights

## CHAPTER 3:

### Responsible AI (cont'd)

**3. Organizations acknowledge RAI risks, but mitigation efforts lag.** A McKinsey survey on organizations' RAI engagement shows that while many identify key RAI risks, not all are taking active steps to address them. Risks including inaccuracy, regulatory compliance, and cybersecurity were top of mind for leaders with only 64%, 63%, and 60% of respondents, respectively, citing them as concerns.

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**4. Across the globe, policymakers demonstrate a significant interest in RAI.** In 2024, global cooperation on AI governance intensified, with a focus on articulating agreed-upon principles for responsible AI. Several major organizations—including the OECD, European Union, United Nations, and African Union—published frameworks to articulate key RAI concerns such as transparency and explainability, and trustworthiness.

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**5. The data commons is rapidly shrinking.** AI models rely on massive amounts of publicly available web data for training. A recent study found that data use restrictions increased significantly from 2023 to 2024, as many websites implemented new protocols to curb data scraping for AI training. In actively maintained domains in the C4 common crawl dataset, the proportion of restricted tokens jumped from 5–7% to 20–33%. This decline has consequences for data diversity, model alignment, and scalability, and may also lead to new approaches to learning with data constraints.

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**6. Foundation model research transparency improves, yet more work remains.** The updated Foundation Model Transparency Index—a project tracking transparency in the foundation model ecosystem—revealed that the average transparency score among major model developers increased from 37% in October 2023 to 58% in May 2024. While these gains are promising, there is still considerable room for improvement.

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**7. Better benchmarks for factuality and truthfulness.** Earlier benchmarks like HaluEval and TruthfulQA, aimed at evaluating the factuality and truthfulness of AI models, have failed to gain widespread adoption within the AI community. In response, newer and more comprehensive evaluations have emerged, such as the updated Hughes Hallucination Evaluation Model leaderboard, FACTS, and SimpleQA.

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**8. AI-related election misinformation spread globally, but its impact remains unclear.** In 2024, numerous examples of AI-related election misinformation emerged in more than a dozen countries and across over 10 social media platforms, including during the U.S. presidential election. However, questions remain about the measurable impacts of this problem, with many expecting misinformation campaigns to have affected elections more profoundly than they did.

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# Report Highlights

## CHAPTER 3:

### Responsible AI (cont'd)

**9. LLMs trained to be explicitly unbiased continue to demonstrate implicit bias.** Many advanced LLMs—including GPT-4 and Claude 3 Sonnet—were designed with measures to curb explicit biases, but they continue to exhibit implicit ones. The models disproportionately associate negative terms with Black individuals, more often associate women with humanities instead of STEM fields, and favor men for leadership roles, reinforcing racial and gender biases in decision making. Although bias metrics have improved on standard benchmarks, AI model bias remains a pervasive issue.

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**10. RAI gains attention from academic researchers.** The number of RAI papers accepted at leading AI conferences increased by 28.8%, from 992 in 2023 to 1,278 in 2024, continuing a steady annual rise since 2019. This upward trend highlights the growing importance of RAI within the AI research community.

## CHAPTER 4:

### Economy

**1. Global private AI investment hits record high with 26% growth.** Corporate AI investment reached \$252.3 billion in 2024, with private investment climbing 44.5% and mergers and acquisitions up 12.1% from the previous year. The sector has experienced dramatic expansion over the past decade, with total investment growing more than thirteenfold since 2014.

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**2. Generative AI funding soars.** Private investment in generative AI reached \$33.9 billion in 2024, up 18.7% from 2023 and over 8.5 times higher than 2022 levels. The sector now represents more than 20% of all AI-related private investment.

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**3. The U.S. widens its lead in global AI private investment.** U.S. private AI investment hit \$109.1 billion in 2024, nearly 12 times higher than China's \$9.3 billion and 24 times the U.K.'s \$4.5 billion. The gap is even more pronounced in generative AI, where U.S. investment exceeded the combined total of China and the European Union plus the U.K. by \$25.4 billion, expanding on its \$21.8 billion gap in 2023.

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**4. Use of AI climbs to unprecedented levels.** In 2024, the proportion of survey respondents reporting AI use by their organizations jumped to 78% from 55% in 2023. Similarly, the number of respondents who reported using generative AI in at least one business function more than doubled—from 33% in 2023 to 71% last year.

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# Report Highlights

## CHAPTER 4: Economy (cont'd)

**5. AI is beginning to deliver financial impact across business functions, but most companies are early in their journeys.** Most companies that report financial impacts from using AI within a business function estimate the benefits as being at low levels. 49% of respondents whose organizations use AI in service operations report cost savings, followed by supply chain management (43%) and software engineering (41%), but most of them report cost savings of less than 10%. With regard to revenue, 71% of respondents using AI in marketing and sales report revenue gains, 63% in supply chain management, and 57% in service operations, but the most common level of revenue increases is less than 5%.

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**6. Use of AI shows dramatic shifts by region, with Greater China gaining ground.** While North America maintains its leadership in organizations' use of AI, Greater China demonstrated one of the most significant year-over-year growth rates, with a 27 percentage point increase in organizational AI use. Europe followed with a 23 percentage point increase, suggesting a rapidly evolving global AI landscape and intensifying international competition in AI implementation.

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**7. China's dominance in industrial robotics continues despite slight moderation.** In 2023, China installed 276,300 industrial robots, six times more than Japan and 7.3 times more than the United States. Since surpassing Japan in 2013, when China accounted for 20.8% of global installations, its share has risen to 51.1%. While China continues to install more robots than the rest of the world combined, this margin narrowed slightly in 2023, marking a modest moderation in its dramatic expansion.

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**8. Collaborative and interactive robot installations become more common.** In 2017, collaborative robots represented a mere 2.8% of all new industrial robot installations, a figure that climbed to 10.5% by 2023. Similarly, 2023 saw a rise in service robot installations across all application categories except medical robotics. This trend indicates not just an overall increase in robot installations but also a growing emphasis on deploying robots for human-facing roles.

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**9. AI is driving significant shifts in energy sources, attracting interest in nuclear energy.** Microsoft announced a \$1.6 billion deal to revive the Three Mile Island nuclear reactor to power AI, while Google and Amazon have also secured nuclear energy agreements to support AI operations.

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**10. AI boosts productivity and bridges skill gaps.** Last year's AI Index was among the first reports to highlight research showing AI's positive impact on productivity. This year, additional studies reinforced those findings, confirming that AI boosts productivity and, in most cases, helps narrow the gap between low- and high-skilled workers.

# Report Highlights

## CHAPTER 5: Science and Medicine

**1. Bigger and better protein sequencing models emerge.** In 2024, several large-scale, high-performance protein sequencing models, including ESM3 and AlphaFold 3, were launched. Over time, these models have grown significantly in size, leading to continuous improvements in protein prediction accuracy.

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**2. AI continues to drive rapid advances in scientific discovery.** AI's role in scientific progress continues to expand. While 2022 and 2023 marked the early stages of AI-driven breakthroughs, 2024 brought even greater advancements, including Aviair, which trains LLM agents for biological tasks, and FireSat, which significantly enhances wildfire prediction.

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**3. The clinical knowledge of leading LLMs continues to improve.** OpenAI's recently released o1 set a new state-of-the-art 96.0% on the MedQA benchmark—a 5.8 percentage point gain over the best score posted in 2023. Since late 2022, performance has improved 28.4 percentage points. MedQA, a key benchmark for assessing clinical knowledge, may be approaching saturation, signaling the need for more challenging evaluations.

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**4. AI outperforms doctors on key clinical tasks.** A new study found that GPT-4 alone outperformed doctors—both with and without AI—in diagnosing complex clinical cases. Other recent studies show AI surpassing doctors in cancer detection and identifying high-mortality-risk patients. However, some early research suggests that AI-doctor collaboration yields the best results, making it a fruitful area of further research.

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**5. The number of FDA-approved, AI-enabled medical devices skyrockets.** The FDA authorized its first AI-enabled medical device in 1995. By 2015, only six such devices had been approved, but the number spiked to 223 by 2023.

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**6. Synthetic data shows significant promise in medicine.** Studies released in 2024 suggest that AI-generated synthetic data can help models better identify social determinants of health, enhance privacy-preserving clinical risk prediction, and facilitate the discovery of new drug compounds.

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**7. Medical AI ethics publications are increasing year over year.** The number of publications on ethics in medical AI nearly quadrupled from 2020 to 2024, rising from 288 in 2020 to 1,031 in 2024.

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# Report Highlights

## CHAPTER 5:

### Science and Medicine (cont'd)

**8. Foundation models come to medicine.** In 2024, a wave of large-scale medical foundation models were released, ranging from general-purpose multimodal models like Med-Gemini to specialized models such as EchoCLIP for echocardiology, VisionFM for ophthalmology, and ChexAgent for radiology.

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**9. Publicly available protein databases grow in size.** Since 2021, the number of entries in major public protein science databases has grown significantly, including UniProt (31%), PDB (23%), and AlphaFold (585%). This expansion has important implications for scientific discovery.

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**10. AI research recognized by two Nobel Prizes.** In 2024, AI-driven research received top honors, with two Nobel Prizes awarded for AI-related breakthroughs. Google DeepMind's Demis Hassabis and John Jumper won the Nobel Prize in Chemistry for their pioneering work on protein folding with AlphaFold. Meanwhile, John Hopfield and Geoffrey Hinton received the Nobel Prize in Physics for their foundational contributions to neural networks.

## CHAPTER 6:

### Policy and Governance

**1. U.S. states are leading the way on AI legislation amid slow progress at the federal level.** In 2016, only one state-level AI-related law was passed, increasing to 49 by 2023. In the past year alone, that number more than doubled to 131. While proposed AI bills at the federal level have also increased, the number passed remains low.

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**2. Governments across the world invest in AI infrastructure.** Canada announced a \$2.4 billion AI infrastructure package, while China launched a \$47.5 billion fund to boost semiconductor production. France committed \$117 billion to AI infrastructure, India pledged \$1.25 billion, and Saudi Arabia's Project Transcendence includes a \$100 billion investment in AI.

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**3. Across the world, mentions of AI in legislative proceedings keep rising.** Across 75 countries, AI mentions in legislative proceedings increased by 21.3% in 2024, rising to 1,889 from 1,557 in 2023. Since 2016, the total number of AI mentions has grown more than ninefold.

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# Report Highlights

## CHAPTER 6:

### Policy and Governance (cont'd)

**4. AI safety institutes expand and coordinate across the globe.** In 2024, countries worldwide launched international AI safety institutes. The first emerged in November 2023 in the U.S. and the U.K. following the inaugural AI Safety Summit. At the AI Seoul Summit in May 2024, additional institutes were pledged in Japan, France, Germany, Italy, Singapore, South Korea, Australia, Canada, and the European Union.

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**5. The number of U.S. AI-related federal regulations skyrockets.** In 2024, 59 AI-related regulations were introduced—more than double the 25 recorded in 2023. These regulations came from 42 unique agencies, twice the 21 agencies that issued them in 2023.

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**6. U.S. states expand deepfake regulations.** Before 2024, only five states—California, Michigan, Washington, Texas, and Minnesota—had enacted laws regulating deepfakes in elections. In 2024, 15 more states, including Oregon, New Mexico, and New York, introduced similar measures. Additionally, by 2024, 24 states had passed regulations targeting deepfakes.

## CHAPTER 7:

### Education

**1. Access to and enrollment in high school computer science (CS) courses in the U.S. has increased slightly from the previous school year, but gaps remain.** Student participation varies by state, race and ethnicity, school size, geography, income, gender, and disability.

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**2. CS teachers in the U.S. want to teach AI but do not feel equipped to do so.** Despite the 81% of CS teachers who agree that using AI and learning about AI should be included in a foundational CS learning experience, fewer than half of high school CS teachers feel equipped to teach AI.

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**3. Two-thirds of countries worldwide offer or plan to offer K–12 CS education.** This fraction has doubled since 2019, with African and Latin American countries progressing the most. However, students in African countries have the least amount of access to CS education due to schools' lack of electricity.

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# Report Highlights

## CHAPTER 7:

### Education (cont'd)

#### 4. Graduates who earned their master's degree in AI in the U.S. nearly doubled between 2022 and 2023.

While increased attention on AI will be slower to emerge in the number of bachelor's and PhD degrees, the surge in master's degrees could indicate a developing trend for all degree levels.

#### 5. The U.S. continues to be a global leader in producing information, technology, and communications (ICT) graduates at all levels.

Spain, Brazil, and the United Kingdom follow the U.S. as top producers at various levels, while Turkey boasts the best gender parity.

## CHAPTER 8:

### Public Opinion

**1. The world grows cautiously optimistic about AI products and services.** Among the 26 nations surveyed by Ipsos in both 2022 and 2024, 18 saw an increase in the proportion of people who believe AI products and services offer more benefits than drawbacks. Globally, the share of individuals who see AI products and services as more beneficial than harmful has risen from 52% in 2022 to 55% in 2024.

**2. The expectation and acknowledgment of AI's impact on daily life is rising.** Around the world, two thirds of people now believe that AI-powered products and services will significantly impact daily life within the next three to five years—an increase of 6 percentage points since 2022. Every country except Malaysia, Poland, and India saw an increase in this perception since 2022, with the largest jumps in Canada (17%) and Germany (15%).

**3. Skepticism about the ethical conduct of AI companies is growing, while trust in the fairness of AI is declining.** Globally, confidence that AI companies protect personal data fell from 50% in 2023 to 47% in 2024. Likewise, fewer people today believe that AI systems are unbiased and free from discrimination compared to last year.

**4. Regional differences persist regarding AI optimism.** First reported in the 2023 AI Index, significant regional differences in AI optimism endure. A large majority of people believe AI-powered products and services offer more benefits than drawbacks in countries like China (83%), Indonesia (80%), and Thailand (77%), while only a minority share this view in Canada (40%), the United States (39%), and the Netherlands (36%).

# Report Highlights

## CHAPTER 8: Public Opinion (cont'd)

**5. People in the United States remain distrustful of self-driving cars.** A recent American Automobile Association survey found that 61% of people in the U.S. fear self-driving cars, and only 13% trust them. Although the percentage who expressed fear has declined from its 2023 peak of 68%, it remains higher than in 2021 (54%).

**6. There is broad support for AI regulation among local U.S. policymakers.** In 2023, 73.7% of local U.S. policymakers—spanning township, municipal, and county levels—agreed that AI should be regulated, up significantly from 55.7% in 2022. Support was stronger among Democrats (79.2%) than Republicans (55.5%), though both registered notable increases over 2022.

**7. AI optimism registers sharp increase among countries that previously showed the most skepticism.** Globally, optimism about AI products and services has increased, with the sharpest gains in countries that were previously the most skeptical. In 2022, Great Britain (38%), Germany (37%), the United States (35%), Canada (32%), and France (31%) were among the least likely to view AI as having more benefits than drawbacks. Since then, optimism has grown in these countries by 8%, 10%, 4%, 8%, and 10%, respectively.

**8. Workers expect AI to reshape jobs, but fear of replacement remains lower.** Globally, 60% of respondents agree that AI will change how individuals do their job in the next five years. However, a smaller subset of respondents, 36%, believe that AI will replace their jobs in the next five years.

**9. Sharp divides exist among local U.S. policymakers on AI policy priorities.** While local U.S. policymakers broadly support AI regulation, their priorities vary. The strongest backing is for stricter data privacy rules (80.4%), retraining for the unemployed (76.2%), and AI deployment regulations (72.5%). However, support drops significantly for a law enforcement facial recognition ban (34.2%), wage subsidies for wage declines (32.9%), and universal basic income (24.6%).

**10. AI is seen as a time saver and entertainment booster, but doubts remain on its economic impact.** Global perspectives on AI's impact vary. While 55% believe it will save time, and 51% expect it will offer better entertainment options, fewer are confident in its health or economic benefits. Only 38% think AI will improve health, whilst 36% think AI will improve the national economy, 31% see a positive impact on the job market, and 37% believe it will enhance their own jobs.