

DIALOGUES

On AI, society, and what comes next

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Josh Woodward · Kent Walker · Kyla Scanlon · Leta Sobierajski · Lila Ibrahim · Martin Baily · Matthew Gunkel
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Google

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Produced by Atlantic Re:think, the creative marketing studio at *The Atlantic*—independently of *The Atlantic's* editorial staff—in partnership with Google.

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DIALOGUES

On AI, society, and what comes next

VISUALS

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ON THE COVER:

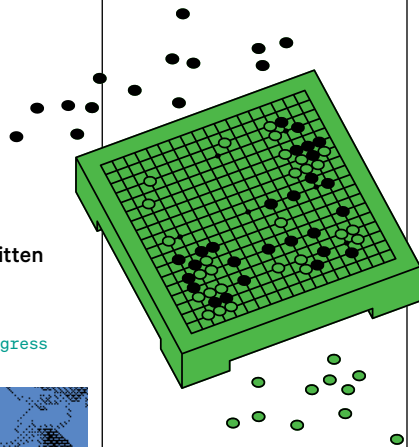
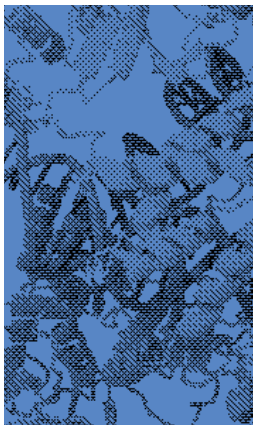
Borja Colom is a multidisciplinary artist from Madrid, Spain. In his ongoing series of paintings, two of which are featured here, he seeks to transform the canvas into a window—a threshold through which the viewer and the surrounding environment can interact with the image. Each is presented as a transitory place—a prelude to imagination—where every door or path may lead to an unknown space brimming with potential.

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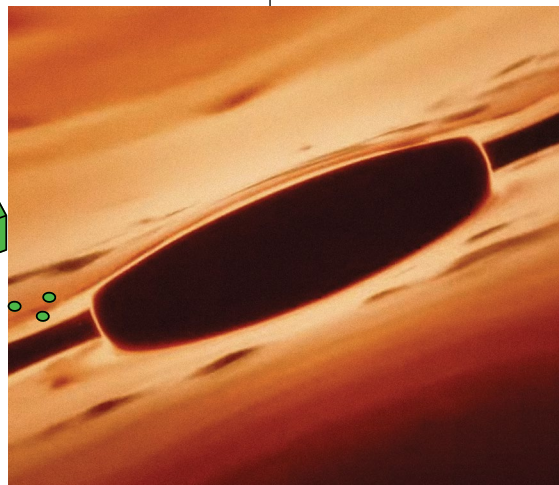
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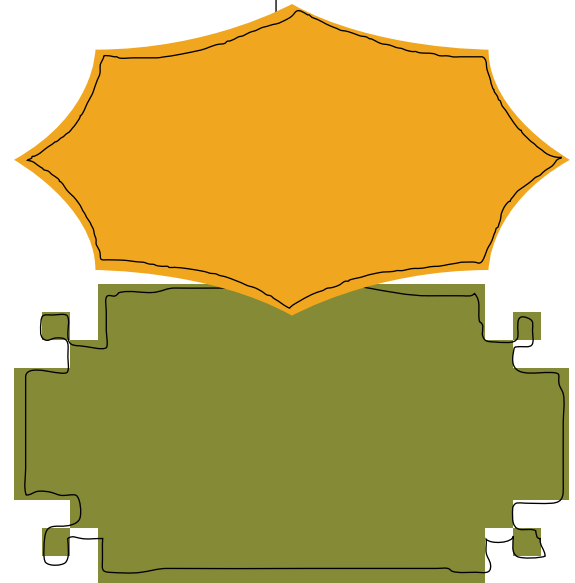
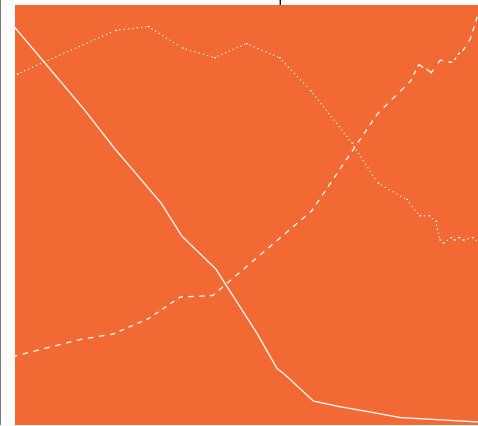
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The

A conversation with James Manyika about the year AI capabilities accelerated, the importance of collaboration, and what it means to be both bold and responsible

→
Photography by
Christie Hemm Klok

Moment

Threshold

Something shifted in AI over the past year. The pace changed. Capabilities that researchers expected to arrive gradually started appearing in rapid succession, each one raising the ceiling on what these systems could do in the real world.

James Manyika, Google's senior vice president of Research, Labs, Technology & Society, has spent the year helping to drive that acceleration, and he's equally focused on what will need to keep pace: the social, economic, and institutional infrastructure needed to integrate these capabilities effectively and responsibly.

This issue of *Dialogues* explores what happens when AI capabilities move into the world—across scientific discovery, economic transformation, and how we learn.

Dialogues **The pace of AI development this year has been extraordinary. What stands out to you in terms of the major technological thresholds we've crossed? Have any of those surprised you or your colleagues at Google?**

Manyika Surprised? No. But some of the things I would point to have been real milestones. Thinking models have become remarkably good, achieving new benchmarks in performance and the ability to reason. We've also seen video and image models reach new heights. In our case, just seeing the response to Veo 3, along with the quality and performance of video and images themselves, has been quite remarkable.

The other thing, which was a first this year, was the first set of world models—in our case, Genie 3—which can generate and process physical worlds in real time. In that same vein, we now have Gemini Robotics 2.0. For the first time, these vision-language-action models can work with and manipulate robotic systems, allowing you to essentially just talk to the robotic systems without having to program them. I think these are significant advances that are bending the curve.

There's also been much progress in AI-adjacent areas: Since the last time we talked for this volume, we saw AI-enabled breakthrough progress in quantum computing. We achieved what's called "below-threshold error correction" with our Willow chip. This means the rate of logical errors decreases exponentially as more physical qubits are added to encode a logical qubit—solving a major issue that challenged scientists for nearly 30 years. More recently, we announced Quantum Echoes. This is the first time in history that any quantum computer has successfully run a verifiable algorithm that surpasses the ability of supercomputers and is also intractable via classic heuristic methods.

Running on our Willow quantum chip, Quantum Echoes demonstrated a proof-of-concept application in Hamiltonian learning to probe and successfully learn an unknown parameter in a many-body quantum system using NMR (nuclear magnetic resonance) data. This paves a path toward useful applications, such as learning the structure of quantum systems from molecules to magnets to black holes.

As remarkable as all of this is, there's still so much more to do in terms of capabilities and performance.

Dialogues **Given all that, it's becoming clear that these AI systems can make expert-level decisions, often in real time. How does that reality inform how Google designs AI from the outset?**

Manyika It's important to design these tools for collaboration from the outset because they can enable people to be remarkably productive and creative. You may have seen some of our tools like AMIE (Articulate Medical Intelligence Explorer), which are designed to assist medical practitioners in diagnosis, or even Veo, which we've designed from the ground up to assist filmmakers and storytellers.

Dialogues **What does this approach to building collaborative or assistive AI reveal more broadly about the AI future that Google is envisioning?**

Manyika We're trying to build with the understanding that these tools can help automate tasks, but their impact will be more consequential in an assistive capacity. This topic of automation versus collaboration is one that the MIT economist David Autor and I explored in some detail in an article in *The Atlantic*. Focusing more on collaboration rather than just automation is important because it benefits not just workers, but also the economy and productivity growth. You want workers and people in the economy—whether they're individuals, small businesses, or large companies—to leverage these tools to become more productive, create new outputs, new value-added products, and innovations. The International Labour Organization (ILO), for example, in a broad study across 140 countries, showcased that the assistive effect of these tools is six times the displacement effect.

So I think if we get this right, where we focus on assisting workers and others in the economy, and on expanding and improving innovations and outputs—that will create a virtuous cycle that should benefit the economy and everyone in it.

“You want workers and people in the economy—whether they're individuals, small businesses, or large companies—to leverage these tools to become more productive, create new outputs, new value-added products, and innovations.”

Dialogues **What should readers understand about this specific moment in AI that we find ourselves in?**

Manyika First, the technical and scientific progress is moving at a breathtaking pace. At the same time, though, it's one thing for the technology to move fast, but I think adoption in the wider economy is going to be a little slower than that. It'll be faster than in the past but still slower than the pace of technological innovation. So it's important to note that while the pace of innovation is remarkable, the pace of adoption and transformation will have to catch up. Adoption in the wider economy is one of the factors that will be critical if we are to realize AI's potential to enable productivity growth and economic gains. In addition to adoption, the other factor needed will include complementary co-investments, transformation of processes and workflows to fully capitalize on AI's capabilities, training and enabling workers to fully utilize AI, ensuring the app-

lication of AI to productivity-enhancing use cases in the respective sectors. In other words, the economic gains from AI will not be automatic; nor are they guaranteed.

Second, it's worth recognizing that we're in a moment where we should be extraordinarily bold. The possibilities of this technology benefiting people, the economy, science, and society are enormous. At the same time, it's also important to be extremely responsible because we know this technology comes with all kinds of complications, challenges, and even risks. That's why this idea of being bold and responsible—for us as developers, for individuals using these technologies, for companies deploying this technology, and for policymakers—is even more important for everyone to keep in mind.

The Future Is Written in the Past

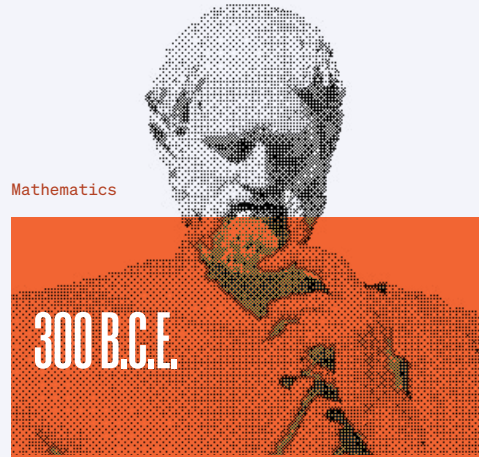
Today's breakthroughs in protein folding, quantum computing, disease detection, weather prediction, and mathematical reasoning would not be possible without AI and also stand on centuries of scientific progress.

Follow a line to track breakthroughs in distinct fields across time, building on the innovations that came before.

Across history, technological leaps have rarely emerged in isolation. They are built upon centuries of curiosity, invention, and radical shifts in how we understand the world. Today's breakthroughs in science are no exception. Whether advancing clean energy, forecasting storms, making medicine more precise, or cracking mathematical problems once thought unsolvable, these innovations are rooted in intellectual revolutions that came long before.

This timeline traces five of Google's contributions to scientific breakthroughs—in life sciences, quantum physics, health care, climate, and mathematics—against the backdrop of their historical and scientific lineages. Each is linked to a foundational moment in human discovery, followed by waypoints that mark key advances on the path to the present.

What is unique about AI is that it is not only a breakthrough itself but also a general-purpose technology that will accelerate future advancements and human ingenuity, building on the past to shape what comes next.



Mathematics

300 B.C.E.

The Birth of Deductive Geometry

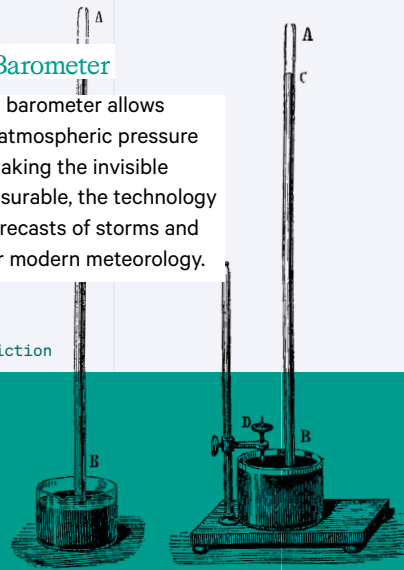
Euclid, the ancient Greek mathematician, compiles the fragments of mathematical knowledge developed over centuries by the Babylonians and the Egyptians into *Elements*, his classic treatise that formalizes geometry into a comprehensive deductive system.

Invention of the Barometer

Evangelista Torricelli's barometer allows scientists to measure atmospheric pressure for the first time. By making the invisible forces of weather measurable, the technology enables the earliest forecasts of storms and lays the foundation for modern meteorology.

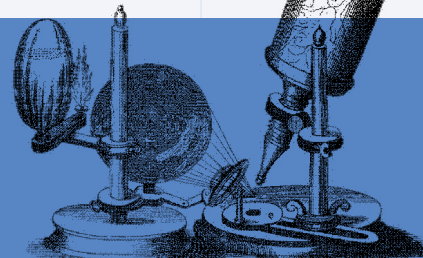
Weather and Climate Prediction

1643



Life Sciences

1590

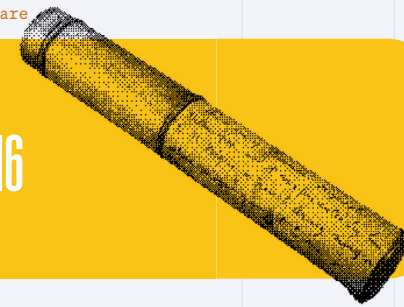


Invention of the Microscope

The microscope opens up an unseen world, allowing scientists to investigate for the first time the architecture of living things. The building blocks of life could now be observed directly, transforming philosophy into the experimental science of biology.

Health Care

1816



Invention of the Stethoscope

René Laennec invents the stethoscope and transforms bedside diagnosis. Suddenly, doctors are able to listen to the inner workings of the body noninvasively, which shifts medicine from external observation to systematic, evidence-based clinical examination.

1854

Boole's Laws of Thought

George Boole formalizes logical operations in algebraic form, the foundation of Boolean logic that powers modern computing and digital circuits.

1880s

Germ Theory Established

Louis Pasteur and Robert Koch prove that microbes cause disease, and revolutionize its prevention and treatment.

1895

Discovery of X-rays

Wilhelm Röntgen's discovery allows doctors to see bones and internal structures without surgery.



1896

First Weather Balloon

Meteorologists launch the first weather balloon to collect upper-atmosphere data and expand forecasting beyond Earth's surface.

Foundations of Quantum Mechanics

Werner Heisenberg and Erwin Schrödinger publish the foundational theories of quantum mechanics, describing how matter and energy behave in unexpected ways at the atomic scale. Their work leads to technologies such as the transistor, the laser, and the atomic clock.

Quantum Physics

1926



Invention of the Transistor

William Shockley, John Bardeen, and Walter Brattain create the transistor—a tiny device that amplifies and switches electronic signals—and usher in the modern computing era.

The Idea of a Quantum Computer

Richard Feynman proposes the concept of a “quantum computer,” suggesting that only quantum systems themselves can efficiently simulate the complexity of the quantum systems in nature.

Macroscopic Quantum Effects

John Clarke, Michel Devoret, and John Martinis demonstrate that macroscopic electrical circuits can behave according to quantum mechanics, laying the groundwork for today’s superconducting quantum computers.

Quantum Supremacy

In 200 seconds, Google’s Sycamore processor performs a computation that would have taken the best supercomputers thousands of years to perform. The achievement demonstrates the “beyond classical quantum advantage”—when a quantum computer outperforms the fastest classical machines on a specific task.

Discovery of DNA Structure

James Watson and Francis Crick discover the double helix—leveraging Rosalind Franklin’s X-ray diffraction images of DNA—to reveal how genetic information is stored and copied.

First Protein Structure Determined

John Kendrew and Max Perutz map myoglobin—a protein found in muscle that stores oxygen—and demonstrate how molecules fold into intricate, functional forms.

Completion of the Human Genome Project

Scientists sequence the entire human genome, providing doctors and scientists with a functional blueprint of life.

AlphaFold

Google DeepMind’s AlphaFold makes a breakthrough on the 50-year-old “protein folding problem.” By accurately predicting the 3D shapes of proteins, AlphaFold reveals the protein universe of nearly every known protein on the planet. Scientists are using AlphaFold to accelerate meaningful progress on global challenges, from developing new malaria vaccines in record time to accelerating tuberculosis research.

Willow Chip

Google’s Willow chip becomes the first system to achieve below-threshold quantum error correction, reducing errors exponentially as it scales. It performs a benchmark computation in less than five minutes that would take a top supercomputer 10 septillion years. Willow represents the clearest path yet toward practical, commercially relevant quantum computing by, for example, enabling more advanced fusion reactor simulations and next-generation battery design.

First Weather Satellite

TIROS-1 transmits real-time images of Earth’s cloud cover from orbit and fundamentally changes weather observation and forecasting.

Climate Modeling Begins

Scientists build early computational models to simulate atmospheric circulation, marking the start of modern climate science.

First MRI Scan

The first magnetic resonance imaging scan offers unprecedented views of soft tissue—brain, muscles, organs—and reshapes diagnostic medicine.

AI Model for Diabetic Retinopathy

Teams from Google Research partners with Aravind Eye Hospital and Rajavithi Hospital to explore how AI could help reduce preventable blindness brought on by eye diseases such as diabetic retinopathy, a leading cause of preventable blindness. To reach more patients who lack screening access, the teams develop an AI model to help detect this complication that has since supported more than 600,000 screenings in clinics around the world.

WeatherNext Graph (2023), NeuralGCM (2024), WeatherNext Gen (2025), Weather Lab (2025)

Google’s suite of AI weather models (WeatherNext) helps redefine forecasting. WeatherNext Gen uses generative AI to predict multiple weather scenarios up to 15 days before they happen. NeuralGCM blends physics and machine learning to model Earth’s atmosphere faster and more precisely than existing models. Most recently, Google launched an experimental cyclone model and is partnering with the U.S. National Hurricane Center to support its forecasts and warnings during cyclone season.

AlphaGeometry (2024), AlphaProof (2024), Gemini Deep Think (2025)

In 2024, Google DeepMind’s AlphaGeometry and AlphaProof systems achieved a silver-medal standard at the International Mathematical Olympiad. More recently, Gemini’s 2.5 Pro model, equipped with Deep Think, achieved a gold-medal performance at this year’s International Mathematical Olympiad, perfectly solving five of the six problems and scoring 35 points.

A SNAPSHOT OF CURRENT THINKING

FEATURING

DEMIS HASSABIS

CO-FOUNDER & CEO,
GOOGLE DEEPMIND

JAMES MANYIKA

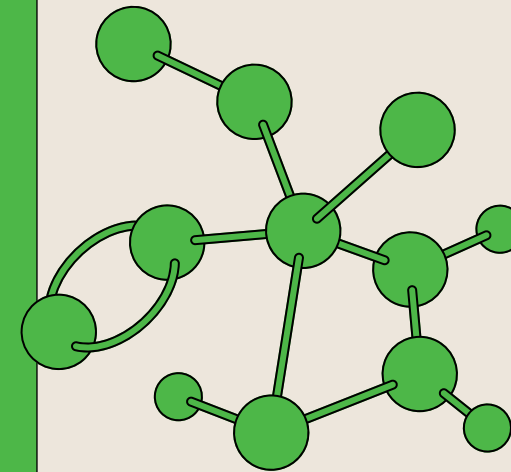
SENIOR VICE PRESIDENT, RESEARCH,
LABS, TECHNOLOGY & SOCIETY, GOOGLE

SHANE LEGG

CHIEF AGI SCIENTIST,
GOOGLE DEEPMIND

Artificial general intelligence is a term that's been around for more than two decades—but there is still debate about how far away it is, what it might be capable of, or even exactly what it is. But questions that felt comfortably theoretical even a few

years ago are now beginning to require more practical answers. We asked three leaders at Google and Google DeepMind to explain where the technology stands, what breakthroughs are still needed, and what is still unknown.



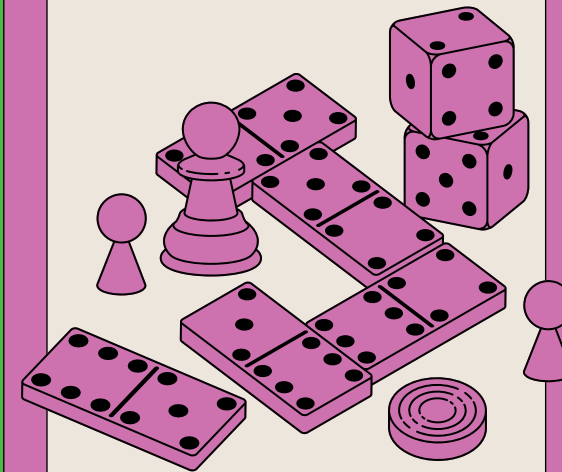
ON ADVANCING SCIENCE

I've always been most passionate about building AI to help us answer fundamental questions about the universe and solve critical societal problems in medicine, materials, and energy. Whether by processing data, coding, or generating novel insights, AI could prove to be the ultimate tool to accelerate scientific discovery. It can find structure and reveal abstractions in huge amounts of data, allowing scientists to interpret patterns that would otherwise be very difficult for people to see. As these systems approach AGI, they could usher in a new golden age of scientific discovery that pushes forward the frontier of human knowledge.

DEMIS HASSABIS

CO-FOUNDER & CEO, GOOGLE DEEPMIND

ON DEFINING AGI

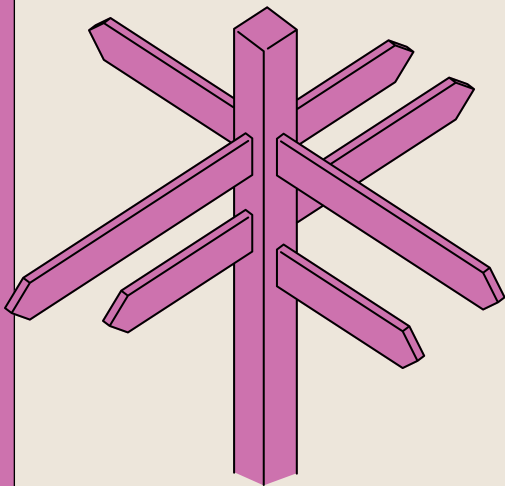


We've long defined AGI as a system exhibiting all the cognitive capabilities that humans have. But intelligence is a spectrum with different levels of capability, and two in particular warrant being called out: what we call minimal AGI and full AGI. Minimal AGI should be able to at least do all the cognitive things that people can typically do. It could solve simple logic puzzles, come up with new jokes, and learn a game after a few minutes of instruction. Minimal AGI would open up countless applications, including universal assistants, personalized learning, and help in tackling scientific challenges. That doesn't necessarily mean we'd be done, though, because there are people who can do extraordinary things beyond what is merely typical in some domains. Full AGI would be a system capable of the full extent of what human intelligence can achieve, from paradigm-shifting scientific theories on par with Einstein's special relativity to elegant inventions like the game of Go to masterworks of art.

SHANE LEGG

CHIEF AGI SCIENTIST, GOOGLE DEEPMIND

ON SHARED TERMINOLOGY

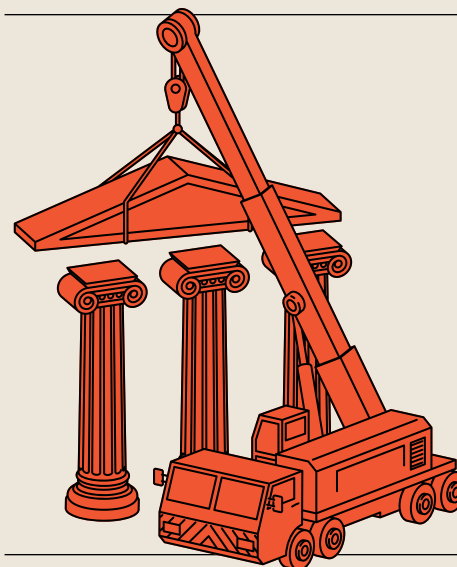


When I first proposed adopting the term *AGI* in early 2002, we weren't overly concerned about reaching an agreement on its definition—the technology was still decades away. That is no longer the case, and we urgently need a common language so we can speak cogently about this technology and understand its potential impacts. The lack of consensus on a definition has created so much hype about AGI and confusion about its potential impact that is distracting society from the important work of preparing for it.

SHANE LEGG
CHIEF AGI SCIENTIST, GOOGLE DEEPMIND

“WE URGENTLY
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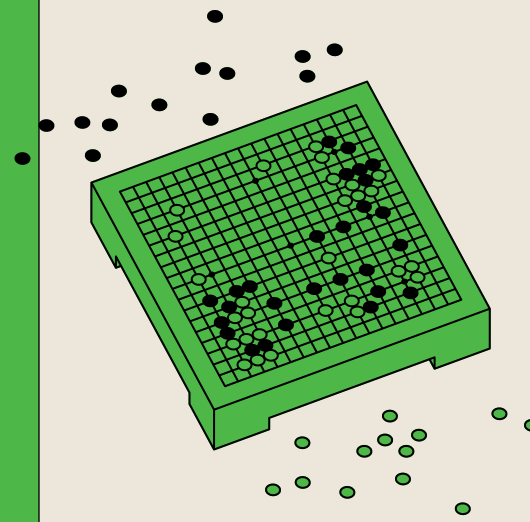
ON PREPARING FOR AGI



On the one hand, we should think about the exciting possibilities that this is going to enable us to do. With more capable and more general systems, we should be able to tackle some of humanity's greatest challenges and opportunities. How do we collectively ensure that we deliver on things that motivate us in the first place about pursuing AGI—powering prosperity, advancing science, improving lives, and progressing humanity? We should prepare to fully capitalize on that when we get there. On the other hand, we have to think about the risks and complexities. How do we govern such technology responsibly? How do we make sure it's safe and aligned with human values and preferences? Then I think there's a third thing to think about, which is, How do we reimagine and adapt our systems, our institutions, and ourselves as individuals in the age of AI? This will require us to think about not only what could be lost but what could be gained. These are some quite profound questions that we're going to need to prepare for and think about when we get there.

JAMES MANYIKA
SENIOR VICE PRESIDENT, RESEARCH, LABS,
TECHNOLOGY & SOCIETY, GOOGLE

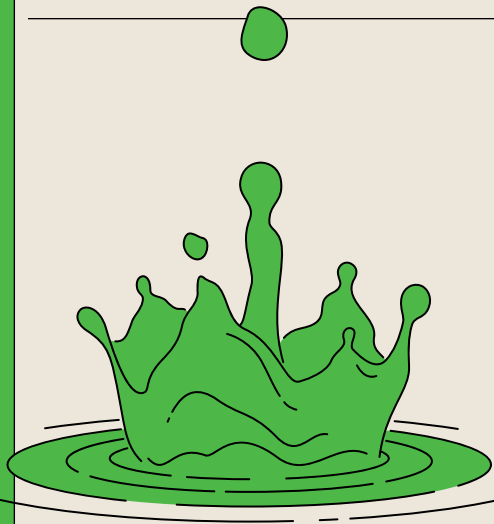
ON THE MISSING PIECES



AI systems today have some impressive capabilities, but they are “jagged intelligences” in that they lack consistency across the board. They can fail at relatively trivial tasks and they don't continually learn. They also aren't capable of true creativity or originality, which is an important benchmark for AGI. Can a system propose a novel and meaningful scientific hypothesis, not just prove an existing one? Can it invent a game as elegant as Go, not just master it? That is much more difficult. We don't fully understand how humans come up with creative ideas, and we certainly haven't cracked it yet in AI.

DEMIS HASSABIS
CO-FOUNDER & CEO, GOOGLE DEEPMIND

ON WORLD MODELS

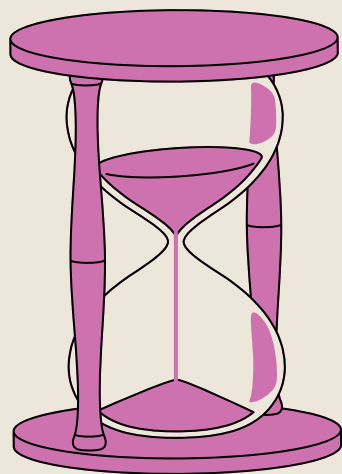


We are building what we call “world models,” or models capable of understanding how the physical world works. If we want AI systems to plan and reason in the real world—whether in robotics or as a helpful assistant on your devices—they need to understand the physical setting. One way to demonstrate a system’s understanding is by showing it can generate realistic videos and interactive worlds. The videos our models are generating now suggest they have some notion of intuitive physics, such as how liquids flow, reflections in glass, or the shadows cast by objects. We think a world model is necessary for understanding causality and will prove to be a critical component of an AGI system.

DEMIS HASSABIS

CO-FOUNDER & CEO, GOOGLE DEEPMIND

ON THE ARRIVAL OF AGI



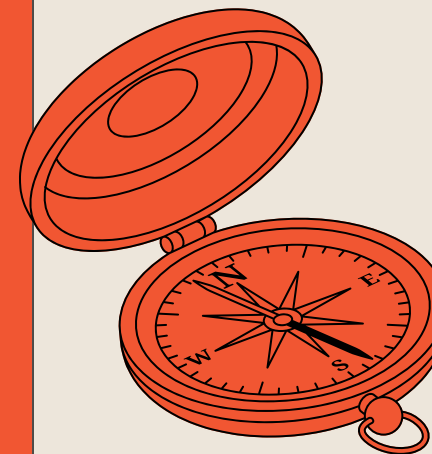
What might surprise many people is that AGI won’t likely arrive in a single, dramatic moment. Our imagination is shaped by portrayals of artificial intelligence as being suddenly “switched on.” The reality is it will be a much more gradual and maybe even subtle emergence reflecting the continuum of intelligence and evolving from the AI systems we have today. The surprise isn’t a sudden arrival, but that we might one day realize the world’s most complex problems are being solved at an incredible speed.

SHANE LEGG

CHIEF AGI SCIENTIST, GOOGLE DEEPMIND

“HOW ARE WE GOING TO GRAPPLE WITH THE OPPORTUNITIES, THE COMPLEXITIES, THE ADAPTATION CHALLENGES, AND WHAT IT WILL MEAN TO BE HUMAN IN THE AGE OF AI?”

ON WHAT’S STILL UNKNOWN



One type of question is a technical, scientific one: What additional research breakthroughs are going to be needed to build more capable and more useful systems? Because it’s not clear to me that simply scaling what we’re doing—as much as that is helping us make progress—will be sufficient to build more capable systems. I find myself thinking a lot about what are some of the additional innovations and breakthroughs needed. But I’m also asking more philosophical questions: When we get there, whenever we get to that point—which I think is still a ways away—how are we going to grapple with the opportunities, the complexities, the adaptation challenges, and what it will mean to be human in the age of AI?

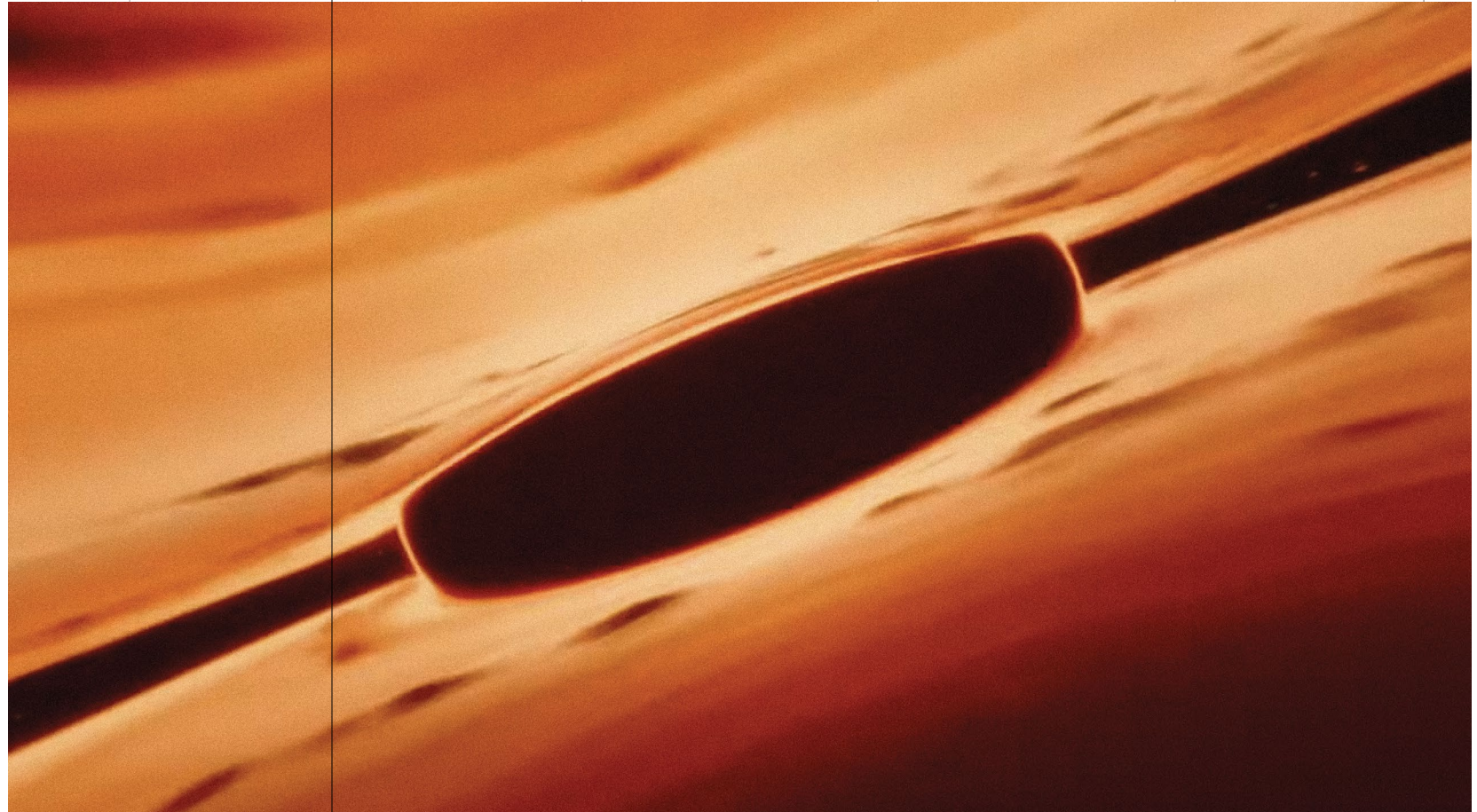
JAMES MANYIKA

SENIOR VICE PRESIDENT, RESEARCH, LABS,
TECHNOLOGY & SOCIETY, GOOGLE

The Art of the *Experiment*

The arrival of any new medium has always been a catalyst for artistic change, and generative AI is the latest tool to reshape creative boundaries. For experimental creators, new tools represent an opportunity to experiment and a chance to evolve their practice. The three profiles that follow feature artists who've built careers on their craft: using film stock, physical materials, and the irreplaceable presence of human performers. They've also built careers on restlessness and experimentation. When it comes to the latest developments in generative AI, they approached it the way artists have always approached new tools—with equal parts curiosity and skepticism, seeing what breaks and what works.

Their recent projects show what happens when traditional artistic vision meets technology that's still being figured out. The process isn't always clean, and the results don't follow predictable paths, but that's precisely why these artists remain worth watching: They're more interested in what's possible than in what's proper.



Ancestra
Darren Aronofsky &
Eliza McNitt, 2025

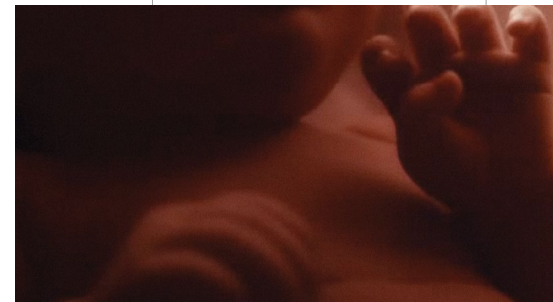
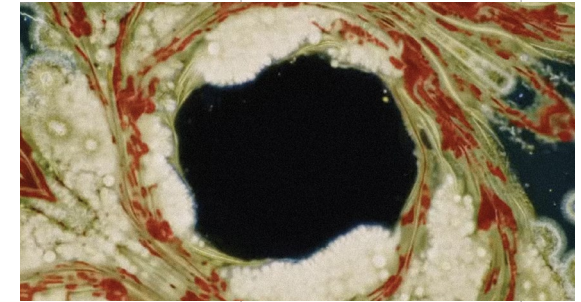
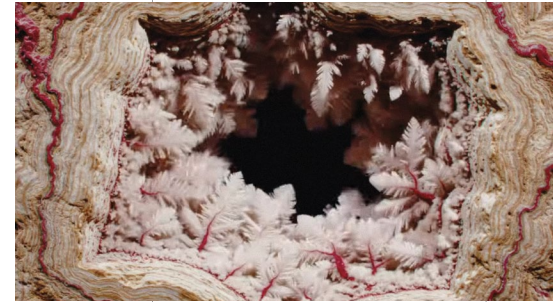
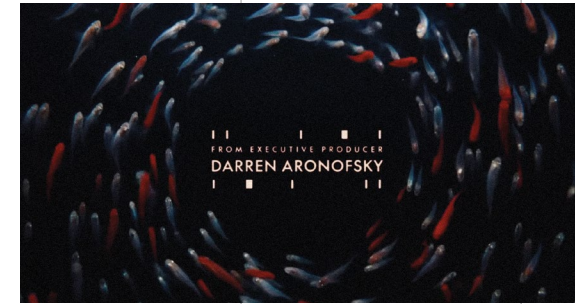
Darren Aronofsky

About the artist: Darren Aronofsky has spent his career pushing filmmaking technology to its limits, from the disorienting hand-held camera shots in *Pi* to the visceral body horror of *The Wrestler*. His new venture, a creative technology company called Primordial Soup, continues to innovate moviemaking by partnering directly with the people building the technology. The studio partnered with Google DeepMind to explore what becomes possible when filmmakers work alongside AI researchers during development.

About the work: *Ancestra*, directed by Eliza McNitt, is the first project from this partnership. The short film tells the story of a mother and child at the moment of birth, drawing on McNitt's experience of being born with a heart condition.

Traditional options for depicting an infant in film—like using a doll, a CGI baby that risks looking uncanny, or a real infant on set—all have drawbacks and are time-consuming for directors. Instead, the Primordial Soup team fed McNitt's childhood photographs into a Google image-generation model and created an AI infant that looked like her. The team filmed the actress, Audrey Corsa, holding empty air, then added AI-generated footage of the baby into her arms. For a shot that travels through the interior of a human body, McNitt mapped the exact camera path she wanted on a 3D anatomical model, then used Veo, Google's state-of-the-art video-generation model, to transform that technical 3D model into footage with cinematic texture and lighting. The process involved visual-effects artists, animators, and engineers working in extended collaboration, expanding the range of what a small team could practically achieve.

Google's Veo is a state-of-the-art AI video-generation model that creates high-quality, cinematic videos from text or image prompts. Simply describe what you have in mind or upload a photo, and watch your ideas come to life, with audio.



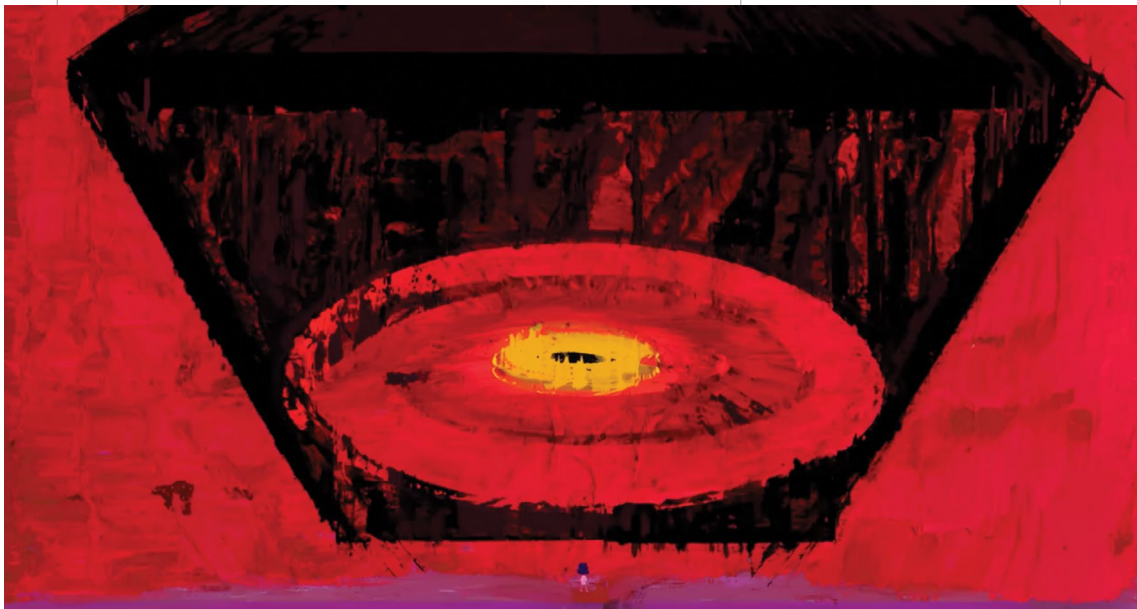
Ancestra
Darren Aronofsky &
Eliza McNitt, 2025

Connie He

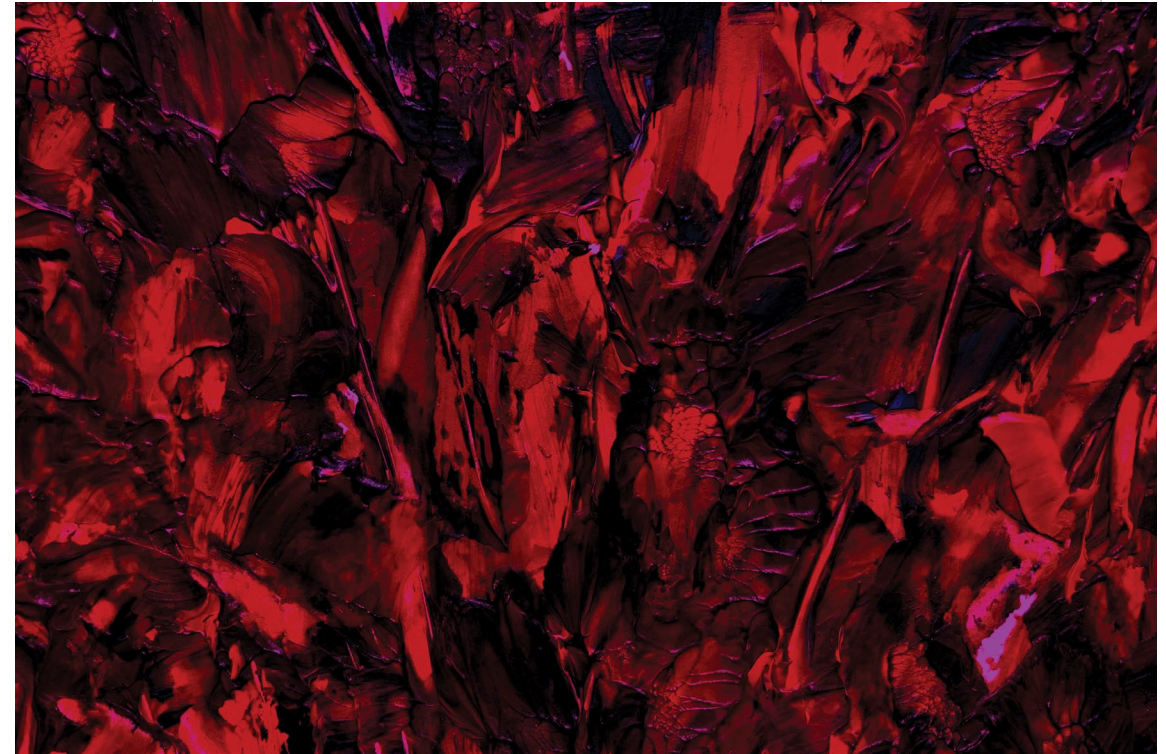
About the artist: Connie He is an animation director and story artist. Her professional background includes work on animated feature films such as *Inside Out 2* and *Dream Productions* at Pixar from 2021 to 2024, while her first short film, *Watermelon: A Cautionary Tale*, is a viral success, with more than 200 million views on YouTube.

Her love for art was fostered by her father, a professional painter, who taught her from a young age to use it as a vehicle to express ideas that we have no words for. “I remember the first time he showed me an abstract expressionist painting,” she says. “I was blown away by how much emotion I could feel in the brushstrokes and the colors. I’ve been chasing the visceral feeling of those paintings my entire career in animation.”

However, painterly styles are notoriously difficult to achieve in a typical computer graphics workflow, especially ones with the thick, gritty brushstrokes that she aspires to. While this style is physically possible, a five-minute film would require 7,200 hand-painted frames (assuming the standard 24 frames per second), making it prohibitively time-consuming and unrealistic for production. Instead, He saw the potential of AI to help bring this monumental task to life, leading her to adopt this technology early.



Still from a forthcoming project
Connie He, 2025



Still from a forthcoming project
Connie He, 2025

By using Veo, Imagen, and Music AI Sandbox, she and her team have been creating an animated short in an innovative collaboration between artists and technology reminiscent of the early days of Pixar, showing just how powerful these tools can be when combined with creativity and artistic vision. “The look our 45-person film crew has achieved has never before been seen on film and would absolutely not have been possible without AI assistance.”

In addition to working with Google’s generative media models, such as Veo and Imagen, He and Grammy-winning composer Yung Spielberg have used Music AI Sandbox, a set of experimental tools that help artists generate fresh instrumental ideas, craft vocal arrangements, or simply break through a creative block.

Wade and Leta

About the artist: Wade Jeffree and Leta Sobierajski are a Brooklyn-based design duo who create large-scale interactive installations. Their work emphasizes accessibility and participation—they want people of all ages and backgrounds to engage physically with what they make. When Google approached them about using generative AI to develop a public sculpture, their first reaction was skepticism. “Since most people are creatures of comfort, sometimes you’re scared to try something new,” they explained. But they’ve also built their practice on experimentation. “We’d rather embrace new technologies than push them away as a way to help us create new work and for us to not remain stagnant in what our processes are.”

About the work: *Reflection Point*, unveiled at Rockefeller Center’s plaza, is a mirrored maze with bold geometric shapes designed for visitors to walk through and explore. The sculpture grew out of Wade and Leta’s collaboration with Google Labs, which began in May 2024. They used Google’s image-generation tools throughout the design process—not as a replacement for their usual workflow of sketching and model-making, but as a way to generate unexpected visual directions quickly.

The generative AI tools helped Wade and Leta create “fantastical and extremely diverse ideas”—enough visual possibilities that it forced them to take creative turns they wouldn’t have otherwise considered. By uploading reference images of subjects and scenes they found compelling, the generated variations pushed beyond what they might have conceived on their own. “That’s why we’re engaged with the technology: because it could allow us to take a right turn where we would typically go left.” They’d sketch by hand, build physical models, then return to the AI tools to test new approaches. The installation was on view through July 2025.

Artists can create captivating images in seconds with the Gemini app. From work to play and anything in between, the Gemini app can help you generate and refine images and bring your imagination to life.

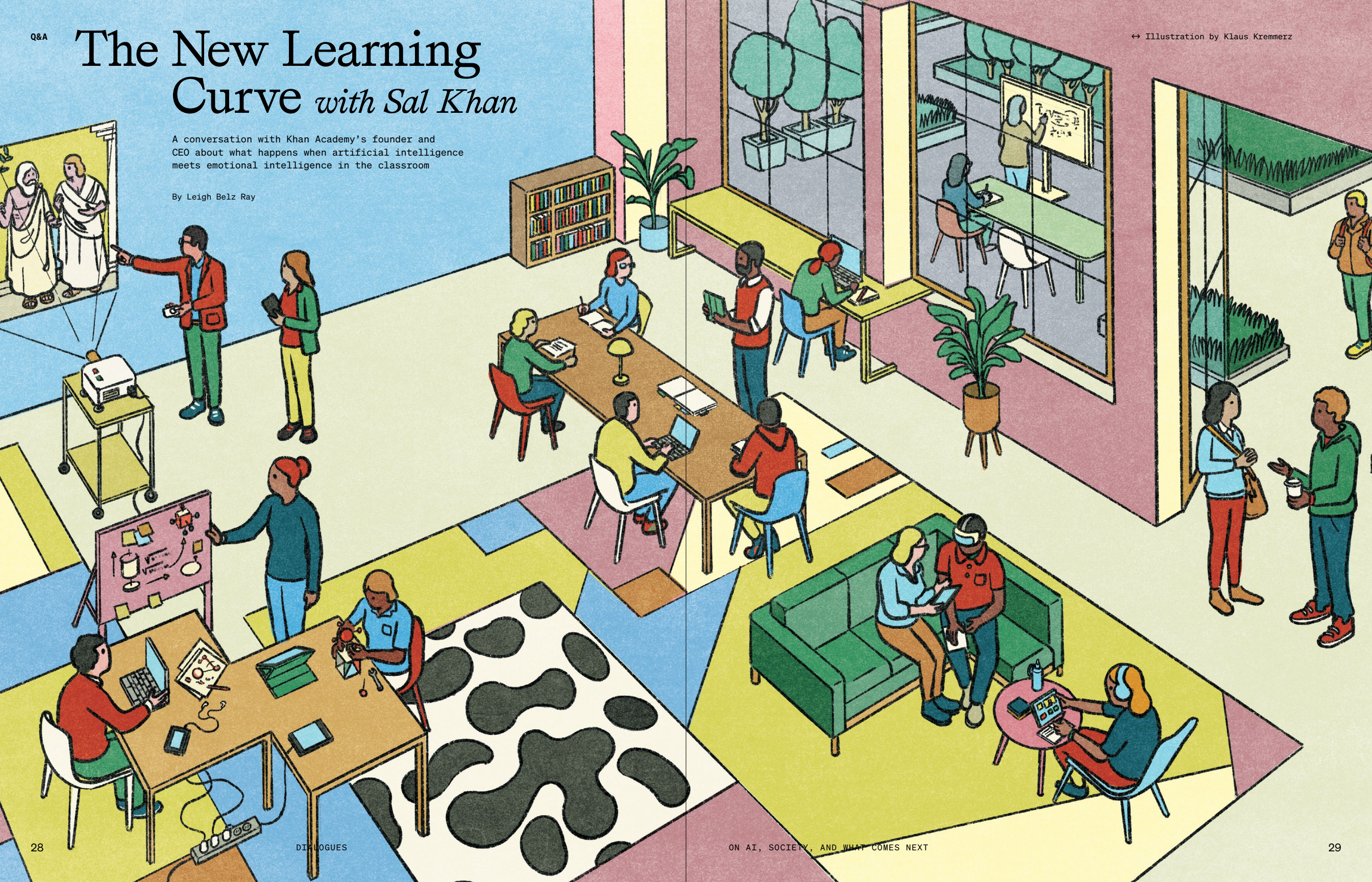


Reflection Point
Wade and Leta,
Rockefeller Center, 2025

The New Learning Curve *with Sal Khan*

A conversation with Khan Academy's founder and CEO about what happens when artificial intelligence meets emotional intelligence in the classroom

By Leigh Belz Ray



In just a few short years,

Leigh
Belz Ray

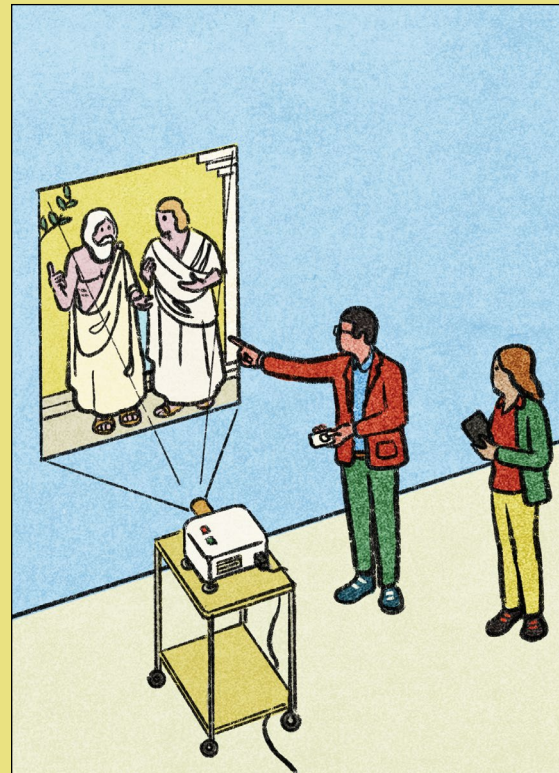
Let's start with the broad future vision: What does AI-augmented learning look like versus the traditional classroom experience?

Sal Khan

I always like to take a step back and think about—AI aside—what does ideal learning look like? If you were to go back 2,300 years, Alexander the Great would have had Aristotle as his personal tutor. And what would he have done? Well, he would have personalized it. If young Alexander was ready to speed up, he would have sped up. If young Alexander was having trouble, he would have doubled down.

He would have been able to motivate based on what was engaging for the young prince. And he would have been constantly assessing the student, not just on the things that you could measure in, say, a multiple-choice exam, but on other traits like the ability to communicate, sense of humor, and resilience.

Fast-forward to now, and we've had to make a ton of compromises in the name of mass public education at a reasonable cost. Everyone has to move in lockstep. AI holds the potential for more personalization, customization of content, and richer forms of assessment that can broaden but still be reasonably standardized.



AI has gone from pilot program to classroom staple.

Eighty-six percent of nearly 4,000 students surveyed said they now use AI in their studies, according to the Digital Education Council's 2024 Global AI report.

"I've talked to a lot of students," says Sal Khan. "All of them are using it." And, he says, that's a great thing.

Khan is the founder and CEO of Khan Academy, the nonprofit educational platform he started in 2008 after the viral success of his bite-size math tutorial videos on YouTube. The platform spent more than a decade democratizing education through a library of free video lessons before Khan turned his attention to AI. An early proponent of agentic AI's capabilities to customize, tutor, and monitor student progress, Khan's AI-enhanced learning platform will be used by 2 million students and teachers this year alone. We spoke to Khan about the evolved classroom and how to prepare the next generation for our AI-driven future.

Our conversation has been edited for length and clarity.



BeLz Ray

If every student will have the ability to learn at their own pace, how will the classroom experience and the role of teachers change?

Khan

When I reflect on the teachers that made a real difference in my life, I remember the conversations. They looked in my eye, they believed in me—or they told me that I needed to step up. It was them being coaches in the best sense of the word.

Things like grit, resilience, personal development, social-emotional skills, these things don't show up in your SAT score. Your SAT score might be a by-product of some of them, though. And so in a world where teachers get things taken off their plate in terms of grading papers, lesson planning, and doing the minutiae, it will help the teacher be that much better of a coach.

And, historically, there was a time in the 19th century, when textbooks came out, that some teachers were up in arms. They thought that they had to be the source of the knowledge. And textbooks had them questioning: "What's my role?" Well, now there's not a teacher alive who doesn't find some value in a textbook.

“AI holds the potential to offer more personalization, customization of content, and richer forms of assessment that can broaden, but still be reasonably standardized.”

“Communication skills, sense of humor, salesmanship, relationship building, and trust have always mattered, but they’re going to matter even more in an AI world.”

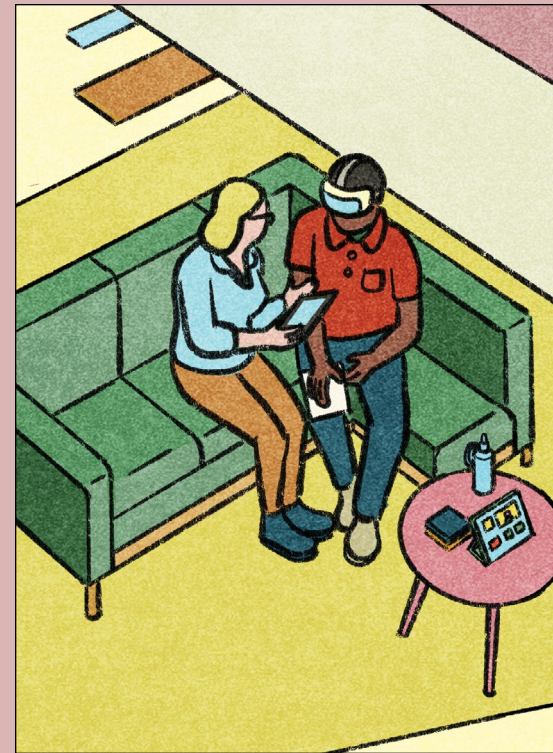
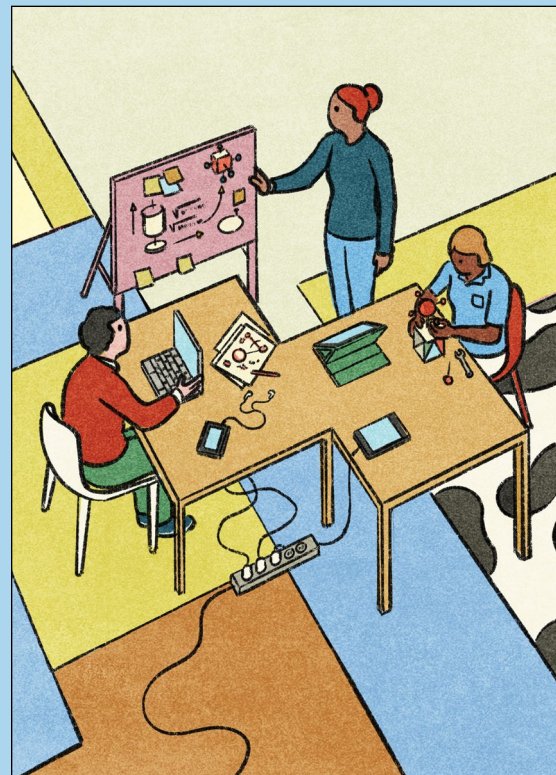
BeLz Ray **The other side of the equation is how this changes learning goals for the student. If large language models are able to handle complex problem-solving, what skills become more central for students to graduate with?**

Khan I’ve called myself a “traditionalist plus.” I actually do think that math, reading, writing, and content knowledge—the context of how things fit together—is as important as ever, maybe more important. We’ve seen over and over again, the people who have that knowledge are better users of the internet, better users of search. And they’re also better users of AI.

The one thing we’ve seen is how many students have almost atrophied in terms of the ability to ask good questions. And some of it is they’re not used to asking the questions, but some of it is they don’t have enough context to be able to ask a good question.

I also think there’s going to be just a general muscle, which I’ve called “cool entrepreneurship.” The tools are evolving so fast. And the people who are going to do well aren’t afraid to say, *Hey, maybe I can take tool A, mix it with tool B, and then do a layer of my secret sauce on top of that and get an output that’s way better than before.*

And then some of the things that are old school—that have always been super important but have never shown up on a transcript—are communication skills, sense of humor, salesmanship, relationship building, and trust. They’ve always mattered, but they’re going to matter even more in an AI world.



BeLz Ray **What are some myths you’ve heard about the role of AI in education that you’d like to dispel, based on your experience scaling Khan Academy’s platforms globally?**

Khan One of the myths is that professors think they can detect AI use. You can’t. There are some companies that claim they have AI detectors, but it’s snake oil. I’ve talked to a lot of students who are getting falsely accused.

A second is that I think schools are lying to themselves when they say that they can just have an honor code and everyone’s going to follow it.

And then the last myth is that somehow AI is going to undermine everything. But, as we talked about, you can [focus on] in-person learning, push the students to do more, and use AI tools to make the process transparent.

The last thing I’ll say is there’s no running away from this. It’s there. So you’ve got to adapt—you’ve got to improvise.

BeLz Ray **The idea of parents looking to “future-proof” their children by encouraging high-agency skills over conformity has been in the news recently. Can you talk a bit about how we can encourage learners to use AI to be more well-rounded?**

Khan Step one is to have really solid traditional skills. And step two is encouraging creative, not prescriptive, use of these tools. I’ve seen, over the last 30, 40 years, people who are just training their kids to jump through the next hoop perfectly. But the hoops are gonna change. And when [those kids are] in their mid-20s and 30s, their parents aren’t there to tell them which hoop to go through, much less optimizing how they jump through them.

When I was in college, I did some improv comedy, and now I think about how valuable that was. Because we’re all going to have to improv our way in the next 10, 20 years. That’s really the answer: more improvisation, more agency, more learning to engage with other human beings, even when it’s hard. I think the improvisers, the risk-takers, and the people-people are going to do really well!

AI, Productivity, and Jobs *with Martin Baily*

The noted Brookings economist discusses how—and how quickly—a new technology can transform the economy.

By Nathaniel Penn

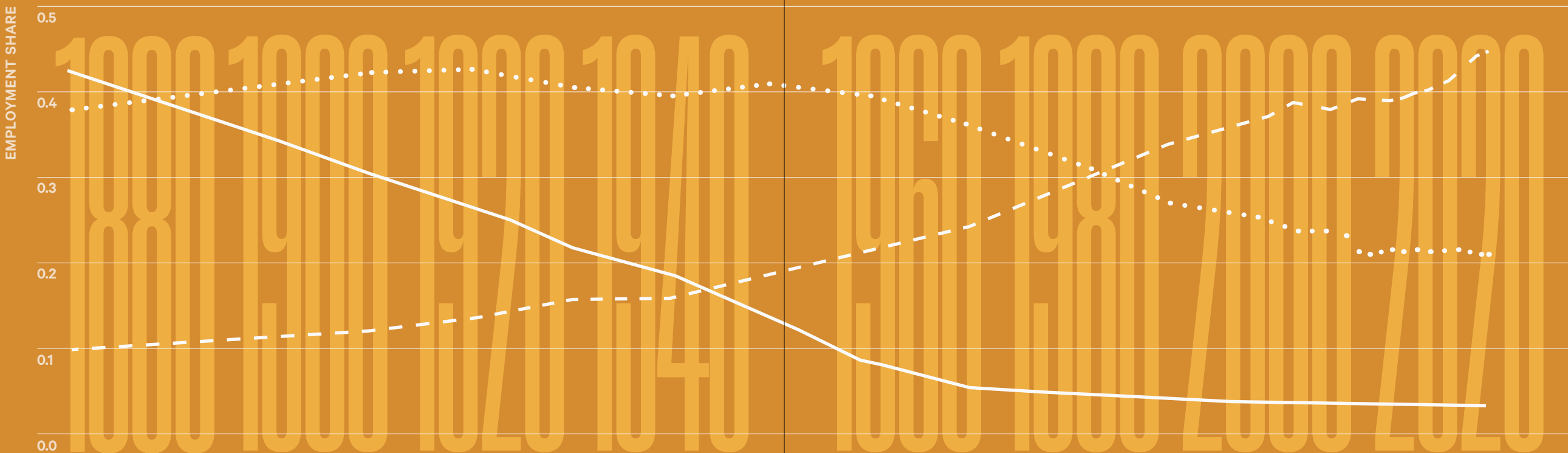
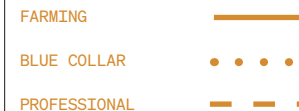
No new technology has ever been poised to transform the global economy as AI appears to be. Though studies suggest that AI could bring about many positive, widespread benefits, predicting its exact impacts is challenging. As adoption increases, we are faced with new questions: How will AI impact the workforce? How productive can an AI-enabled workforce be? What impact will increased productivity have on the economy?

Martin Baily, a senior fellow emeritus at the Brookings Institution and a former chairman of the Council of Economic Advisers, is a noted economist, thought leader, and adviser to industry. He has written extensively on productivity and AI. In a recent conversation about AI's effects on the economy, he weighed in on some of these questions and helped us to envision AI's potential impact on the global economy.

Technology reshapes jobs over time. Computers and the internet have reduced blue-collar roles while increasing jobs in professional fields—just as farm work dropped as production became more mechanized, creating new factory jobs.

Source: Deming, D. J., Ong, C., & Summers, L. H. (2025). Technological disruption in the labor market (NBER Working Paper No. 33323). National Bureau of Economic Research.

CHANGE IN EMPLOYMENT SHARE





Electricity and other past GPTs needed decades to increase productivity because the infrastructure for them hadn't yet been built. AI—accessible via the internet, almost from the start—could boost productivity faster than any predecessor.

Source: Crafts (2021), NBER, BEA. Data as of December 31, 2023.

← YEARS UNTIL PRODUCTIVITY IMPACT

“History tells us that previous technological changes took many years before there was a significant impact on productivity.”

Nathaniel Penn You've posited that generative AI is a general-purpose technology (GPT). History shows that GPTs (such as the steam engine and electricity) eventually create more jobs than they eliminate after being widely adopted. What do you see as the likeliest timeline to widespread adoption of AI in the public and private sectors?

Martin Bailly Gen AI is being developed at a dazzling pace, with rapid improvements in algorithms and massive investment in computing infrastructure. However, the pace of AI diffusion and productive use will be slower than the media often suggests.

History tells us that previous technological changes took many years before there was a significant impact on productivity. The development of the electric motor and the dynamo (electricity generator), for example, took decades for widespread adoption and required businesses to redesign their business processes. With AI, we can expect an initial period of experimentation followed by organizational change and complementary innovation and investment.

Penn What effects do you believe AI adoption will have on the unemployment rate, and over what time frames would you expect these effects to peak and dissipate, respectively?

Bailly For the past 50 years or so, the biggest labor-market problem has been the relative decline in the demand for workers without college degrees or special skills. The decline in production-worker jobs in manufacturing is one aspect of this. There is conflicting evidence about whether AI will worsen this problem or whether its impact will be on more skilled workers, like computer coders or paralegals. An optimistic view is provided by Deming, Ong, and Summers (2025), who point out that historically there have been huge structural changes in the U.S. labor market, but that employment has remained strong as new jobs have replaced the ones that have been lost.

My judgment is that the impact of AI on productivity will take 20 years or more. I do not see much impact on the unemployment rate, but the labor market could be impacted in other ways.

Penn A recent paper from the University of Pennsylvania's Wharton School has very tentatively projected an AI-driven bump in productivity and GDP of 1.5 percent by 2035, nearly 3 percent by 2055, and 3.7 percent by 2075. What are your thoughts on these projections? To put these numbers in perspective, is there a precedent for this kind of growth in U.S. economic history, and if so, when did we last see it?

Baily Productivity growth is the key to overall economic growth and broad improvements in living standards. It has been growing at 1.5 percent a year lately, much slower than in some past periods. Faster productivity growth, if its benefits are applied well, would be a big help, generating greater resources to deal with poverty, the budget deficit, and the environment. There is a huge range of estimates of the likely impact of AI on productivity.

Is AI comparable to the light bulb, an important innovation that raised productivity but had essentially a onetime effect, or is it like the dynamo, which led to a series of knock-on innovations, such as electric motors and more efficient factory organizations, that had a bigger and longer-lasting impact on productivity? Then again, AI could be like the microscope, an innovation that greatly enhanced the technology of research itself and eventually paid off in stronger productivity.

To me, AI looks like both the dynamo (a GPT) and the microscope (called "an invention in the method of invention"). That suggests its long-term impact on productivity could be substantial.



of employment growth over the past 80 years is explained by the technology-driven creation of new positions.

See next spread for detailed breakdown of new positions.

“AI looks like both the dynamo (a general-purpose technology) and the microscope (called ‘an invention in the method of invention’). That suggests its long-term impact on productivity could be substantial.”

Penn Different countries and regions are taking vastly different approaches to AI workforce policy. What early evidence do we have about which interventions (e.g., retraining programs) actually work? What role should businesses play in managing this transition?

Baily The northern European economies and Germany have apprenticeship programs to provide workplace skills, and they have retraining programs for workers that lose jobs. Those programs worked well for a long time, but the downtrend in the share of jobs in manufacturing that all advanced economies face, together with a lack of tax revenue, has stressed this economic model. If AI really causes a major disruption to existing employment patterns, Europe will have difficulty responding. Facing discontent among their workforces, governments would probably decide to slow down the adoption of AI and pay a productivity penalty.

Penn Would the potential emergence of artificial general intelligence substantially alter the way you're envisioning AI's impact on productivity?

Baily Keep in mind that a constant flow of innovation is required just to keep our current productivity growth trend of 1.5 percent a year going. AI could just get folded into the current trend.

The U.S. labor force is now growing slowly and may start to decline because of the low birth rate and the decline in immigration. We do not need a lot of new jobs, but we do need jobs that fit the skills of our workforce. Gen AI may help if it can enhance the skills of not only the highly educated but also the workers who left school early. An important national priority is to direct government research dollars toward innovations in AI that help the workforce.

The majority of current employment is in job specialties introduced after 1940.

Historically, technology has created more roles than it has replaced.

Source: New Frontiers: The Origins and Content of New Work. 1940-2018. Autor et al., 2022.

EMPLOYMENT, BY NEW AND PREEXISTING OCCUPATIONS

- Jobs that existed in 1940
- Jobs that did not exist in 1940

% JOB GROWTH PER OCCUPATION SINCE 1940



What Can AI *Actually Do?*

We asked 12 scientists, artists, and thought leaders to share how AI enabled them to create, explore, or understand something for the first time.

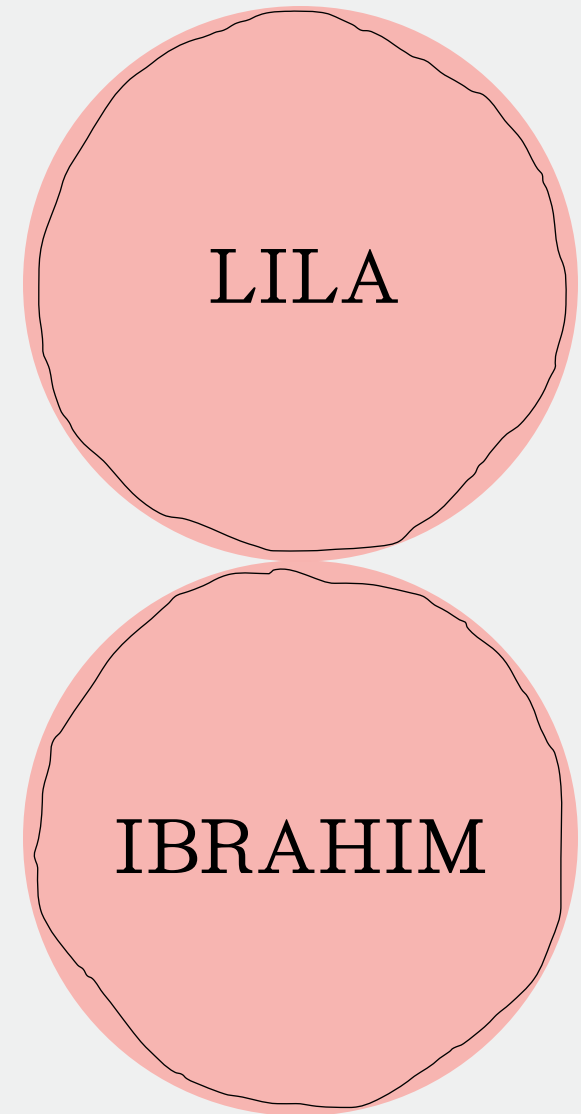
The best way to understand what AI does is to ask people what they're using it for. We reached out to thinkers across different fields with a simple question: How have you recently used AI to solve, create, or figure out something?

Their answers skip past the theoretical debates about what AI might mean for humanity and get straight to the practical reality of how it's already changing daily work. Some responses are surprising. Others unearthed new approaches to old problems. Together, they show what happens when curious people get access to a new tool and start testing its limits.



Futurist and founder of WAYE

As a futurist, my work is heavily data-driven, spanning early technological and scientific discoveries, economic trends, shifts in human behavior, and geopolitics. I spend much of my time tracing the early signals that could quietly reshape entire systems a decade from now. AI has expanded what's possible in that process. It helps me move through dense technical material much faster and, in many ways, lets me "converse" with the data in front of me. I also use AI to challenge my own thinking. Sometimes I'll ask it to assume the role of a leader I'm engaging with who holds strong assumptions, to see how my ideas might land or where they might meet resistance.



Chief Operating Officer, Google DeepMind

Our team at Google DeepMind uses AI as a collaborator; it assists our work so we can apply our human expertise to decision-making. For example, employees use Gemini to gain fresh perspectives through the creation of "AI teammates"—each with unique prompts assigning different viewpoints. One might challenge assumptions, while another might focus on user experience. It's an amazing tool that helps our team quickly explore ideas, pressure-test thinking, and increase the impact of our work.



YASMIN GREEN

CEO of Jigsaw

Imagine everyone featured in this issue was together speaking at once. It would be impossible to make sense of that conversation—until now. Our team at Jigsaw has used AI to facilitate groundbreaking online conversations, including hosting one of the largest town halls in U.S. history in Kentucky. We then scaled this technology from county to country through our We the People initiative, engaging a microcosm of America. Thousands of participants spoke, listened, and responded to one another on the country's founding ideals. A remarkable 92 percent said they felt represented in the conversation.



JENNIFER DOUDNA

Nobel laureate, CRISPR pioneer,
Innovative Genomics Institute founder

For years, vast genomic data sets held answers we couldn't reach—too big, too complex, too slow to analyze. AI has changed that. In our labs at the Innovative Genomics Institute, we're now uncovering new CRISPR genome editors that were hiding in plain sight, and identifying new therapeutic targets for genetic diseases. Experiments can be designed more quickly, and we spend less time in the lab going down dead ends. We can finally explore the full landscape of biology within our data, accelerating new therapies and improved crops and advancing biomanufacturing. AI is clearly a powerful tool that has expanded what we can explore, but human curiosity and creativity still drive every discovery.



KYLA SCANLON

Economic commentator and author of *In This Economy?*

I've been able to understand the value of communication in facilitating ideas. I like to talk to the various chatbots about an idea and find them useful for refining some of the stuff I can't quite articulate yet. And then I enjoy chatting to humans about those ideas and refining them even more. I find the entire process complementary.



JOSH



WOODWARD

Vice President, Google Labs, Gemini, & AI Studio

I'm amazed by how quickly new AI tools can translate ideas into images, videos, slides, and web interfaces. At work, we use Flow to create quick videos and Stitch to prototype new interfaces. It allows us to explore a wider creative space in less time. Gemini's personalization and image editing have also gotten especially powerful. I can edit photos simply by describing the changes I want and even create a custom bedtime storybook for our kids.



ROBYN SCOTT

Co-founder and CEO of Apolitical

There are few training challenges more high stakes than supporting government AI adoption. Public budgets are squeezed everywhere, and generative AI presents an efficiency opportunity estimated to be worth \$1.75 trillion. Apolitical is the world's largest network of public servants: Our training and tools are integrated into government workforce platforms supporting 40 million public servants globally. Our course AI assistant provides instant responses, drawing from our course materials and community insights. It will soon assess assignments, giving government officials instant and personalized feedback on their work—all contextualized to the public sector. Prior to generative AI, this was impossible.



CARRIE THARP

Vice President, Global Solutions & Industries,
Google Cloud

AI is now focused on making advanced technology accessible to everyone and gaining a comprehensive understanding of various data types. Our models can process social media content, call-center conversations, videos, spoken words, text, and images all at once. This enables us to accurately gauge how consumers feel about products, brands, or specific subjects. With AI, businesses can speed up innovation, resolve issues faster, offer more personalized customer service, gain important insights into quality, and ultimately build stronger relationships with customers.



KENT

President of Global Affairs, Google and Alphabet

AI is giving our Global Affairs team a new superpower: the ability to look around corners and anticipate what's coming next. Tools like Gemini Deep Research and NotebookLM make work like sifting through thousands of policy documents or news alerts a lot less time-consuming. That means we get to spend more of our time on the human side of the job—focusing on strategy, talking to people, and making those tough calls that need a personal touch.



WALKER



MIRA LANE

Vice President, Technology & Society, Google

For me, as an artist, AI has unlocked the ability to explore the latent space of human aesthetics. It's like having a direct interface with our collective visual subconscious. Artists have always experimented with new technologies. This time is no different. Now, I can navigate the vast, interconnected network across images, styles, and concepts humanity has created. This allows me to create art that mixes abstract qualities as concrete ingredients and engage in a dynamic dialogue with the machine. How amazing is that?



MATTHEW
GUNKEL

Chief Information Officer,
University of California, Riverside

What I find most revolutionary is how AI is augmenting the role of our educators. By automating the analysis of learning patterns, AI provides a holistic map of a student's academic journey—revealing where they excel and where they may stumble. This frees our faculty to do what they do best: mentor, inspire, and engage students in the higher-order thinking that truly prepares them for the future. It allows us to understand not just what a student is learning, but how, advancing pedagogy and enabling a more profound and impactful mentorship.



REFIK
ANADOL

Media artist, director, and co-founder
of Refik Anadol Studio and Dataland

Artificial intelligence has opened a new space for creativity, one that connects technology, nature, and human imagination. For the first time, I can collaborate with nature itself by transforming vast data sets of winds, corals, glaciers, or rainforest ecosystems into living sculptures and paintings. These works are conversations between machine perception and the natural world, revealing patterns of beauty and fragility we could never see before. Through AI, art becomes a shared language with nature and a complex dialogue between data, light, and life itself.



Stories from our first two issues on AI, society, and what comes next are available online.

TYPEFACES

Dialogues is typeset in *Affairs* (SM Foundry), *Coign* (Colophon Foundry), as well as *Calibre* and *Söhne Mono* (Klim Type Foundry).

PRINTED IN THE U.S.A.

This magazine is a certified carbon-neutral publication, printed by Green Earth Enterprise using vegetable-based ink on recycled paper. To offset the environmental impact of this print production, Green Earth Enterprise engages with local firms to plant useful trees in Central America.

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