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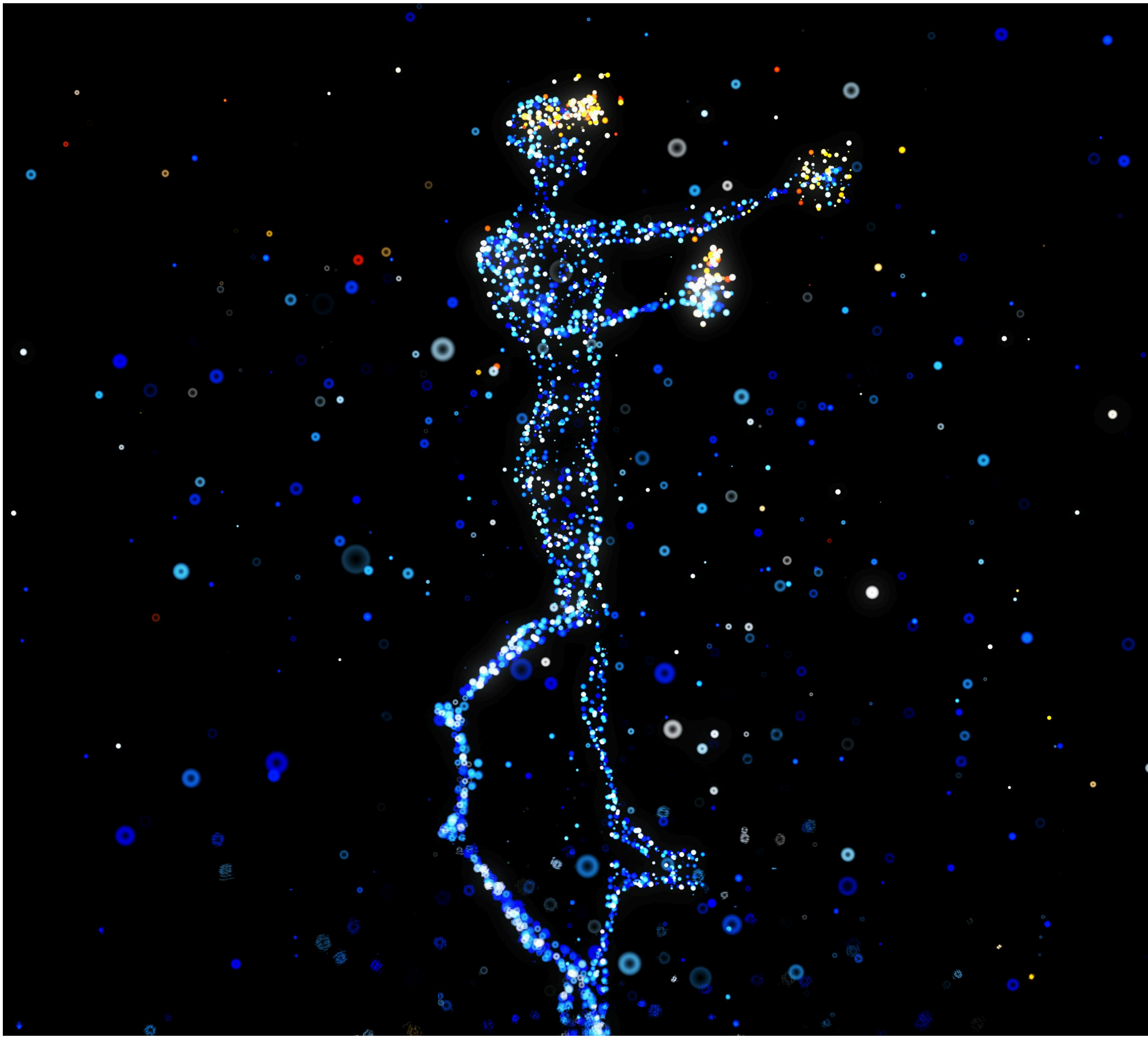

FUTUREM

Horace Mann's Tech Trend Journal

From the Editor

Dear Reader,

Welcome to the first 2025-2026 issue of Futurem.

Entering our second year of exploring tech trends within the HM community, we're excited to share that the publication has not only grown in contributors, but in depth and perspective. With articles now spanning a broad range of emerging fields, this issue offers a nuanced view of the ideas shaping the world around us.

In this issue, we will investigate how AI video generation is transforming online interaction, explore the promise and vulnerabilities of quantum-encrypting, dive into the future of the growing field of nanotechnology, consider the growing rise and risks of the AI bubble, learn about quantum machine learning, observe how the intersection between tech and medicine can be seen through our tongues, and evaluate the recent Google monopoly Supreme Court case.

Futurem continues to be a space where questions drive discovery and where we look at emerging technologies not just through excitement or fear, but through nuance, context, and curiosity.

I am incredibly grateful to all the contributors and editors who shared their ideas and made for a successful start to the second year. Special thanks to Ms. Bahr, Ms. Feng, and Sr. Dalo, for their continued support.

My hope is that this issue sparks new conversations, fresh perspectives, or even give you access to topics you have never heard before. As always, stay curious, stay critical, and most importantly—stay ahead of the trend.

Happy reading!

Ciana Tzuo

Ciana Tzuo

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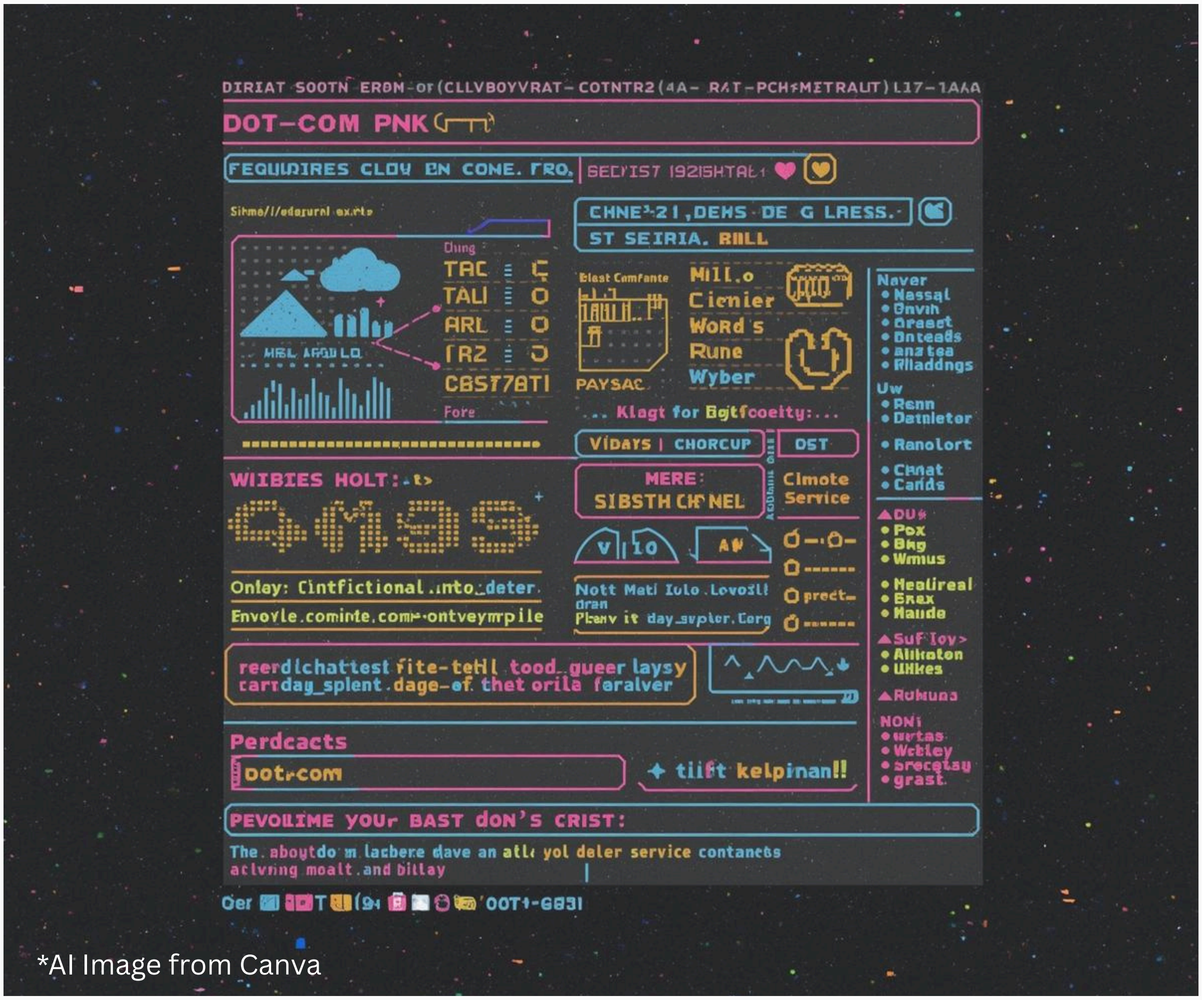
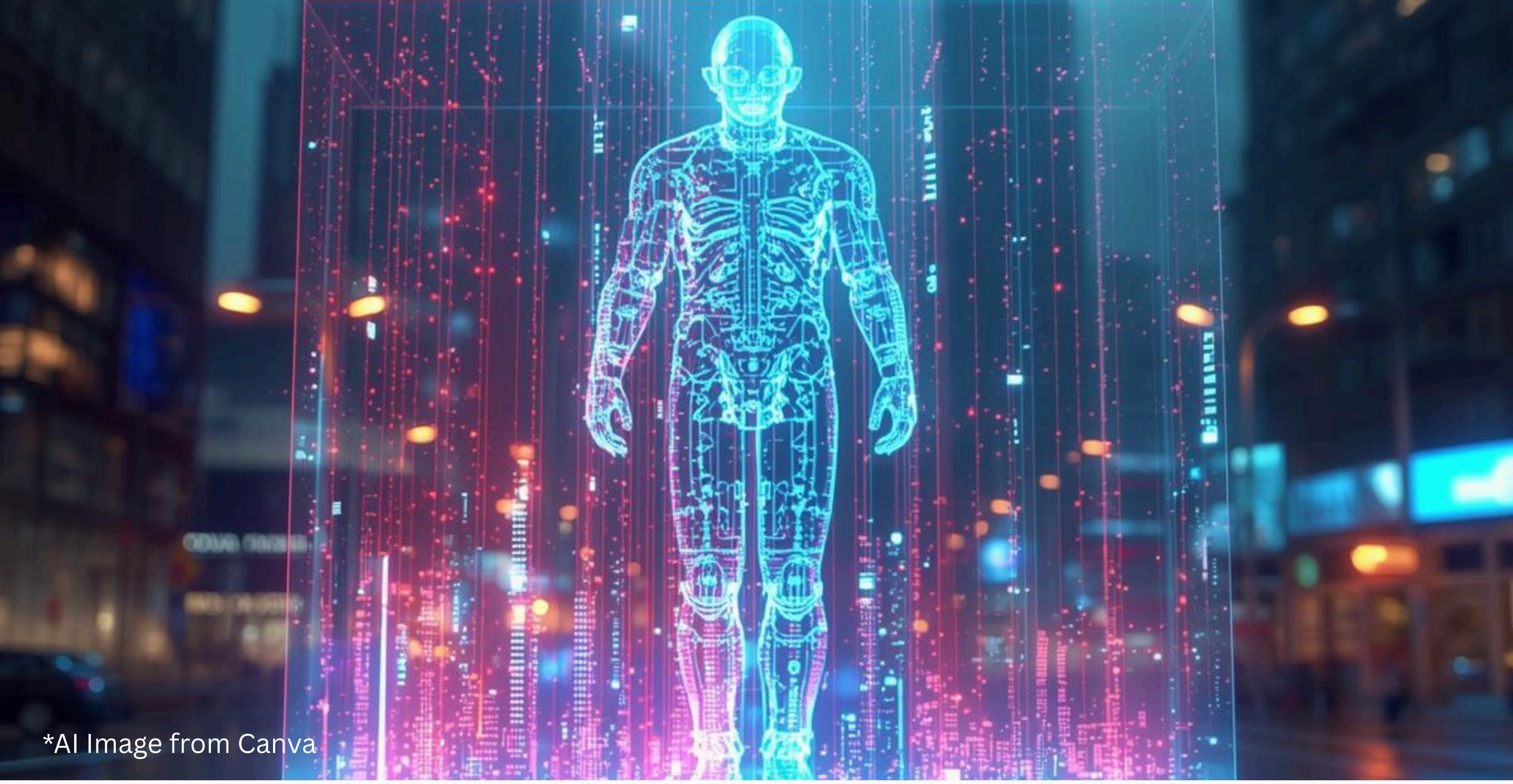


*AI Image from Canva



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THE RISE OF AI VIDEO GENERATION & ITS DANGERS ON SOCIAL MEDIA

SULI KUMBLE

If you've been on social media recently, you've probably come across some sort of Artificial intelligence (AI) generated content. Whether it's a satisfying clip of glass being cut, Jake Paul putting on makeup, or Queen Elizabeth freestyle rapping, AI-generated videos are flooding feeds, making it harder than ever to tell what's real and what's fake. With the recent, and rapid, rise of new AI video generation tools, like OpenAI's Sora, anyone can now create realistic videos with the click of a button. While this technology opens new creative possibilities, it also fuels misinformation, exploitation, and growing distrust online. As the technology rapidly evolves, its realism threatens to erase the line between fact and fiction, leaving audiences unsure of what to believe.

If you've been on social media recently, you've probably come across some sort of Artificial intelligence (AI) generated content. Whether it's a satisfying clip of glass being cut, Jake Paul putting on makeup, or Queen Elizabeth freestyle rapping, AI-generated videos are flooding feeds, making it harder than ever to tell what's real and what's fake. With the recent, and rapid, rise of new AI video generation tools, like OpenAI's Sora, anyone can now create realistic videos with the click of a button. While this technology opens new creative possibilities, it also fuels misinformation, exploitation, and growing distrust online. As the technology rapidly evolves, its realism threatens to erase the line between fact and fiction, leaving audiences unsure of what to believe.

Photo by Mariia Shalabaieva on Unsplash

As AI video models become more sophisticated, the idea of trusting what we see online is further dissolving. These tools can now generate lifelike facial expressions, realistic lighting, and natural motion, making it nearly impossible for viewers to distinguish AI-generated videos from real footage. While photographs were once considered the most reliable source of truth, the rise of photoshop gradually caused them to be manipulated and faked, and now, similarly, videos —long regarded as even more trustworthy—are also being overtaken by AI-generated content. Short clips of public figures, news events, or ordinary people can be easily and convincingly fabricated, erasing the traditional boundary between reality and digital creation. Any advice on spotting AI videos quickly becomes outdated, as models improve at an unprecedented pace. As a result, visual evidence can no longer be trusted, leaving audiences skeptical of both real and fake videos. "Seeing is no longer believing," and the consequences extend beyond minor confusion, transforming how people evaluate information online, and eroding trust online in general.

The real-world consequences of AI-generated videos are already alarming, affecting ordinary creators, public figures, and audiences. On TikTok, some creators have found their words copied by AI-generated accounts, producing videos that mimic their speech, mannerisms, and even stutters. One creator, whose content was replicated in this way, described the experience as a violation of privacy, noting that others could profit from these videos while she had no control over her own digital identity. Beyond impersonation, AI-generated videos are being used for harassment and exploitation, inflicting psychological harm and reputational damage across diverse contexts. Deepfakes and AI-generated content are also deployed to manipulate public perception. AI-generated videos are used to fabricate political statements, manipulate elections, and mislead viewers about economic or social events: such as fake clips of President Trump announcing nonexistent medical programs or Barack Obama being arrested in the Oval Office.

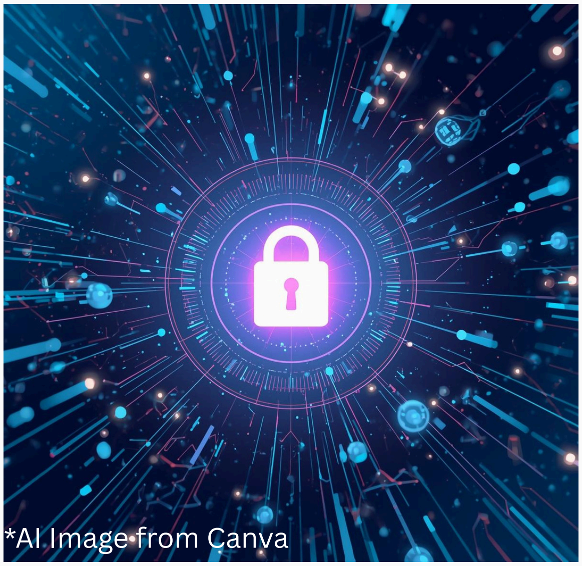
Harvard Business School Information Technology, 2025

The legal and institutional safeguards for addressing these harms are lagging behind technological developments. Copyright infringement, personal rights, and consent issues have already arisen with AI-generated videos. Even when platforms attempt to flag AI-generated media, creators can edit out watermarks, and moderation systems are overwhelmed by the sheer quantity of AI content. As a result, harmful or misleading videos often spread faster than platforms can react. Current laws are not designed for AI and fail to address questions like who owns an AI-generated image or whether using someone's face or voice without permission counts as identity theft. Until legal systems and social media platforms catch up, AI-generated videos will continue to spread, deepening public distrust in what we see online. Without stronger regulation and accountability, people will remain vulnerable in a digital world where real cannot be distinguished from fake.

AI-generated videos are reshaping the way people perceive content online. What began as a technological breakthrough that seems to encourage creativity has quickly become a tool for misinformation, exploitation, and confusion. As fake content spreads faster than systems can contain it, the trust once placed in images and videos continues to fade. Addressing this crisis will require stronger policies, public awareness, and ethical responsibilities from both creators and platforms. If action isn't taken soon, the line between truth and fabrication may disappear entirely.

Protecting Information in the Quantum Age: New Frontiers in Cryptography

NICHOLAS TONG



The entire digital world relies on the transfer of information being protected with modern encryption. This encryption system has been implemented over the course of 20 years, and secures the world and individuals from cyberattacks. Unfortunately, with the advent of quantum computers, current encryption methods will be rendered useless. While quantum computers are still in their infancy, a sufficiently powerful one that could be built in a few years could easily reach government secrets, bank transfers, and even your private data.

This article explains how our current encryption systems work, how the nature of quantum computers poses a direct threat towards classical encryption methods, and proposed post-quantum encryption methods that combat these new developments.

Modern Encryption

Before learning about how quantum computers break current encryption, it is necessary to know how current encryption systems work. Public-key encryption (PKE), also known as asymmetric encryption, is a method that allows two parties to communicate securely. It revolves around two keys, a public key that anyone can access and use to encrypt messages, and a private key that is kept secret and used to decrypt messages. That way, instead of sharing a secret key with everyone you want to talk to beforehand, one can publish a public key for others to use, knowing they can only decrypt the message with their private key.

Classical computers use RSA encryption, the most widely used PKE system because of both its simplicity and computationally difficult nature. This complexity stems from how it utilizes problems in number theory, like finding the prime factors of a large composite whole number. While these problems are easy for regular computers when the numbers are relatively small, they become exponentially difficult as the number increases.

At the most basic level, RSA encryption uses the difficulty of factoring the product of two large prime numbers. RSA starts by having your computer choose two very large secret prime numbers, usually hundreds of digits long, and multiply them together. From this giant product, your computer builds two keys: a public key that everyone can see and a matching private key only for yourself. Anyone can use your public key to send a message that only you can read with a matching private key.

When someone wants to send something, the computer mixes the message with the public key and generates gibberish, with no obvious way back to the original message. This gibberish is then reverted back to the message with the private key, ensuring that no attackers can eavesdrop. To figure out your private key, attackers would have to pull apart the huge public number into two primes, and with trial and error computer algorithms, check each prime one by one, which usually takes an absurd amount of time for classical computers. This is why RSA is considered safe against most classical computers.

How do Quantum Computers Break RSA?

However, this is where quantum computers come in. In a similar way to how conventional computers are made up of classical bits that operate on 0s and 1s, quantum computers are made up of quantum bits, or qubits. Just like a bit, a qubit has a state. But whereas the state of a bit is 0 or 1, the state of a qubit, in simplified terms, can exist in a superposition of states, meaning anywhere between 0 and 1 simultaneously. This property, combined with entanglement, allows quantum computers to perform some calculations exponentially faster than binary, transistor-based computers can. In fact, a sufficiently capable quantum computer would be able to sift through all of the potential prime factors simultaneously, rather than one by one. In turn, this would allow the quantum computer to arrive at an answer to RSA encryption exponentially faster. Shor's algorithm, developed by Peter Shor, is a quantum algorithm that efficiently factors large integers by using quantum Fourier transforms and other phenomena, rendering RSA encryption useless once sufficiently powerful quantum computers are used.

With the current race to build the fastest quantum computers around the world, many intelligence agencies see the danger quantum computers pose in exposing national secrets. The goal of post-quantum cryptography is to design cryptographic algorithms that are secure against both classical and quantum computing strategies. It requires other mathematical problems that are extremely difficult even for quantum computers.

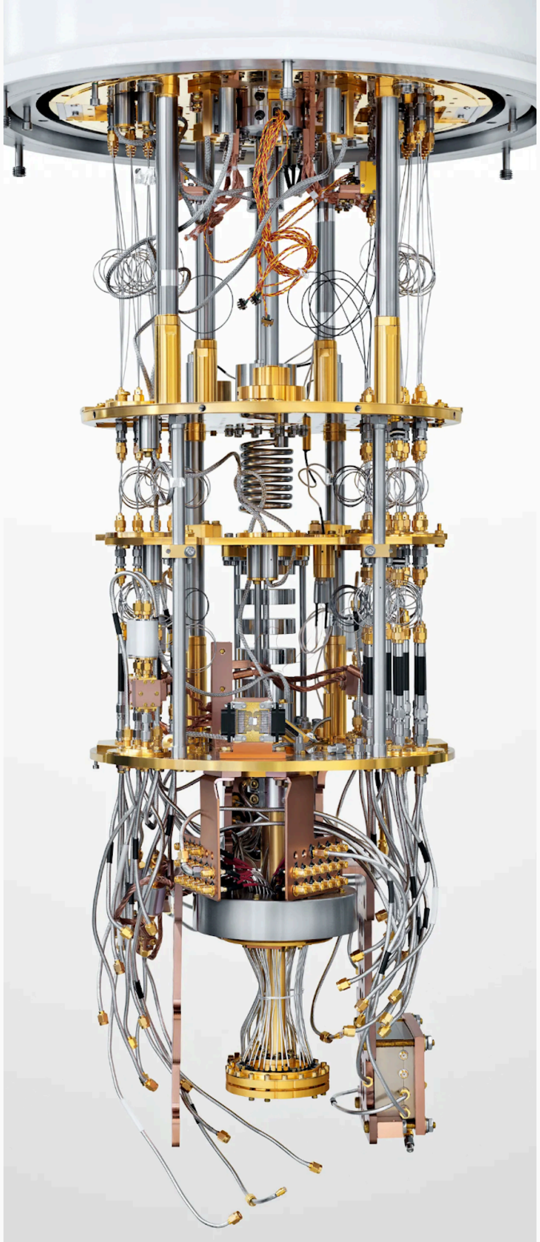


Photo by Justin Fantl, UW Magazine, March 2021

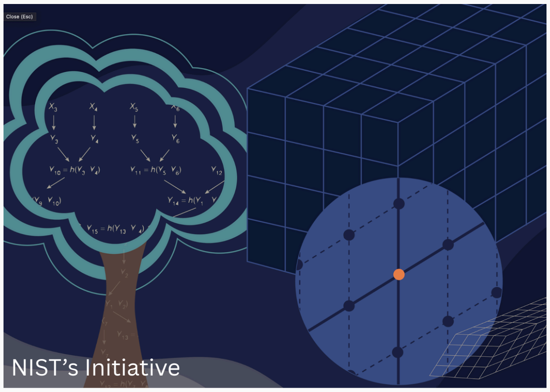
Lattice-Based Cryptography

The current best idea to combat quantum computer decryption is lattice-based cryptography. Lattices are multidimensional “grids” of points, and the security comes from how hard it is to find very specific “points” on that grid. Even with powerful quantum computers, the best known methods for finding those special points are still painfully slow, which is why these methods are promising for a post-quantum world. You can imagine a lattice as a grid of points extending infinitely in all directions, similar to a 3 dimensional (3D) grid but with many more dimensions. Lattice-based cryptography sets up problems like “find the shortest path between special grid points” or “find the closest grid point to this random spot”, and these problems get exponentially harder with a larger number of dimensions.

Learning With Errors (LWE) is a particularly hard type of lattice problem that cannot be solved by both classical and quantum methods. It is like being given a bunch of equations with the right answers slightly “smudged” by random noise, and only the hidden numbers that produced them can remove the noise.

In an LWE style encryption system, the public key is a bundle of numbers that everyone can see, along with a version that is blurred with small errors. The private key is a hidden pattern (secret vector) that explains how those blurred numbers were generated, and how to revert the errors back to the original. When someone encrypts data for you, they mix your public information with random errors to create ciphertext, so attackers won't be able to easily tell which parts of the messages were encoded. Because only you know the private key, or hidden pattern, your device can essentially “subtract out” most of the structure in the ciphertext and see what is left over. For an attacker that does not know the secret key, every piece of ciphertext becomes a noisy equation on a multi-dimensional lattice, with the only way to crack it being to manually solve those nearly impossible hard lattice problems. Current evidence suggests that these problems remain intractable even for quantum computers, which is why schemes like LWE and related lattice problems are frontrunners for future encryption standards.

Hash-Based Cryptography



Another prominent post-quantum method is Hash-based cryptography. Hash-based cryptography relies on cryptographic hash functions, which are mathematical algorithms that convert any input data into a fixed-length string of characters, called a hash. These hashes and their functions have these properties:

- The same input always produces the same hash.
- Hashes are one-way, so it is computationally infeasible to recover the original input from its hash.
- Even a tiny change in the input drastically changes the hash.
- It is incredibly hard to find two different inputs that produce the same hash output.

Hashes are also a crucial part of how the bitcoin/ethereum/crypto blockchain works, but that topic is best explained in a future article.

Essentially, a cryptographic hash function takes any digital input of any length — like a password, a file, or even an entire movie — and compresses it into a short digital "fingerprint" of fixed size. Crucially, the process only goes one way — from data to fingerprint. Using the fingerprint alone, you cannot work backwards to recover the original data, and you should not be able to find a different input that produces exactly the same fingerprint. That's why hashes are already used to check integrity (whether or not a file has been changed), to store passwords safely, and inside many modern encryption and blockchain systems.

Hash-based digital signatures combine many smaller, one-time signature schemes (OTS) using a tree structure such as the Merkle tree to sign multiple messages securely. This allows it many crucial functions:

- Generate many random secret keys.
- Compute their hashes to form leaf nodes of the Merkle tree.
- The root hash of this tree functions as the public key.
- To add a digital signature to a message, reveal the signature from one OTS and corresponding authentication path through the tree.

Code-Based Cryptography

One more significant post-quantum encryption method uses code-based cryptography, where something called the McEliece cryptosystem, which uses the difficulty of decoding a random linear error-correcting code, encrypts user data. The public key is a matrix representing the code, and decoding without a secret key is extremely difficult, even for quantum computers with millions of qubits (the best model so far has 6100 qubits at Caltech).

The idea is to disguise your message by passing it through a coding recipe and then adding a bit of carefully chosen noise. This recipe is a specific way to scramble messages, and the noise is there to make the scrambled result look random to those who don't know this private recipe. The encrypted result is what gets sent over the network. Without knowing the private recipe and exactly how the noise was added, it is effectively impossible to reconstruct the original message from the public ciphertext. But the legitimate receiver who does know the secret private key, can undo the scrambling, ignore the small noise, and recover the message reliably.

Current classical encryption systems like RSA are vulnerable to quantum computers that can efficiently solve factoring problems at a large scale. This has prompted many new post-quantum encryption techniques based on math problems that are difficult for both quantum and conventional methods. These make sure that encryption and digital signatures remain secure by relying on problems believed to be unsolvable at a feasible scale by quantum computers. This forward thinking is essential for protecting data in the future from even more powerful quantum computers.

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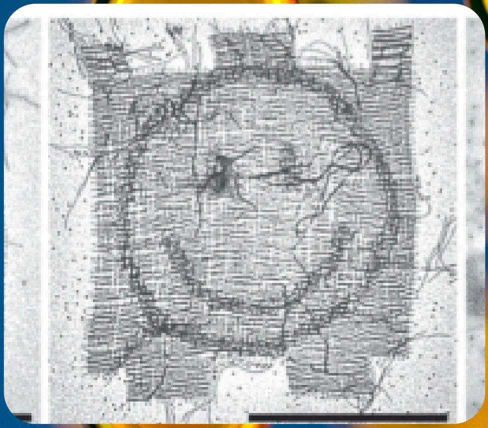
How Nanotechnology Is Transforming Modern Medicine

CAROLINE KAM

Have you heard of nanotechnology? It is a field of science focused on the design and application of particles and devices as small as molecules. Nanotechnology-based tools have become crucial for healthcare and biomedicine. These tools have made their way into advancing cancer diagnosis, targeted drug delivery, and pharmaceutical manufacturing. For instance, researchers utilized peppermint extract and created nanoparticles found to destroy cancer cells without affecting healthy tissue. These particles have also improved the results of radiation therapy by preventing the process from leaving traces of toxicity which may be utilized for safer drug formulations and cancer treatments.

In addition to the development of nanoparticles, nanotechnology has been used in the making of DNA origami by creating long strands of DNA that are folded into any desired pattern with nanoscale precision. Initially proposed in 2006 by Rothemund, Will Shih and his lab developed a crisscross origami sheet which they found to help in developing cancer vaccines. In short, these origami sheets give dendritic cells synthesized strands of DNA, triggering danger signals which are passed onto T-cells. These T-cells then multiply rapidly in order to fight against the mass of cancer cells. DNA origami has also been studied in biocatalysis where it was found to be able to trigger chains of enzymatic reactions. In addition, researchers have found that DNA origami is useful in drug delivery as designing such structures can lead to low cytotoxicity, unique programmability, and enhanced biodegradability. In regards to unique programmability, scientists have found that small compounds with therapeutic effects, such as protein drugs, could be loaded onto the origami nanocarriers. One major challenge of these nanostructures is the difficulty of maintaining such structure in physical conditions. Currently, researchers are developing a tool to design the technology with improved stability.



Other developments in the field of nanotechnology are nanorobots, regenerative medicine, and tissue engineering. IFL Science claims that nanorobots are being tested in animals' bloodstreams to destroy cancer cells. In addition, some scientists believe that nanorobots could be utilized to monitor plaque and fat levels in bloodstreams, helping address dietary issues. One drawback of the research of nanorobots is the usage of healthcare money to develop and test their efficacy. Similarly, while regenerative medicine can be used to help restore, maintain, and improve body functions, one pushback of this medicine is the stability of success. Since patients' bodies respond differently to regenerative therapies, results can vary heavily. Tissue engineering is another emerging scientific area where nanotechnology is being used to repair or replace cells, tissues, and organs through combining cells and biomaterials to produce materials which resemble the body's natural tissues. While an innovative method, there are many issues such as biocompatibility and the ability to vascularise properly.

The nanotechnology market is on the rise as the technology is implemented into the industrial, healthcare, and energy fields: used in projects such as creating and testing durable construction materials, discovering new ways of drug delivery, as well as researching ecologically friendly hydrogen fuel cells. Qualified Health announced its $30 million mission to develop the base for generative AI in healthcare, showing the increased attention and dependability we have on nanotechnology. In addition, MIT developed seven new companies that will support START.nano which is focused on bringing nanotechnology to the forefront of the market.

However, there are drawbacks in developing and funding nanotechnology, one of which is the toxicity of researching nanoparticles. While they have been shown to have low cytotoxicity in drug delivery, nanoparticles can rest in areas of the respiratory system and the brain for humans and animals when exposed to them for long periods of time. This is also a concern as they may prove to be an issue for the health of the environment. Another downside is, as mentioned earlier, the cost of researching nanoparticles is large. While money is one prominent issue in funding the studies, the abundance of natural resources is also important to consider. If commercializing nanotechnology is a goal, the amount of such resources may decrease and potentially affect the wellbeing of humans and the environment.

Picture credit Sigest Consulting

ARTIFICIAL INTELLIGENCE & MARKET OVERVALUATION: LESSONS FROM THE DOT-COM ERA

EMILY LI

Have you realized how AI seems to be implemented in every company and is continuously being hyped up as it advances? This over-confidence in the market of AI-powered products has resulted in a theoretical AI bubble, where investments in companies, driven by enthusiasm for the technology, are significantly higher than their actual profits and business models justify. Some finance experts have predicted that the AI bubble will pop soon. As a result, the economy may significantly drop because companies that are using AI technologies are being valued more highly than they actually are.

AI has been rapidly changing the world by providing new technologies to fields like medicine and science, and by making people's lives more efficient and productive. New AI innovations are bringing a lot of excitement and hope for innovation to society and companies. Large companies, such as Nvidia and AMD, have made hundred billion dollar agreements with OpenAI, while Amazon and Meta continue to increase their spendings on AI technologies. This is called the scaling hypothesis, where companies invest more into AI technologies, increasing the scale, data, and computing power to get more results out of the new technology. However, many experts are predicting that many of these investments are not based, leading to the formation of an AI bubble that is set to eventually pop, resulting in an economic recession. AI may not be able to deliver the predicted outcomes for their companies, leading to investors losing money in stocks as the valuations of these companies are solely based on increase in productivity and efficiency to reduce their cost and workforce.

Startups Magazine

Economic experts are comparing the current situation to the Dot-com bubble crash in 2000, finding similarities that may predict a similar crash with AI. The Dot-com bubble was caused by an influx in the founding of early internet (dot-com) startup companies and huge investments in them fueled by the novelty of the internet. This is a parallel to the current situation with AI, where companies are overinvesting in AI and hoping for the new technology to bring in higher efficiency and productivity to justify the costs. The rapid and ubiquitous integration into many companies and startups and the exorbitant amount of funding these companies are bringing in mirror the early context of the Dot-Com bubble crash. Looking back at history, concerns about an AI bubble seem based.

There are also many immediate considerations for companies regarding the implementation of AI. One such consideration is how companies should incorporate logical and productive AI into the current workforce with its existing employees. While this problem requires a lot of time and consideration, in many cases, it has been sidelined or ignored, creating fear among workers of AI disrupting the flow of the workforce. Ensuring proper integration of AI into companies highlights another paradox of AI. If AI disrupts the existing structure too quickly, then the company may not have the infrastructure or the resources to sustain the new technology innovations. However, if companies don't implement AI fast enough, then other competing companies may surpass them. Downsides to this dilemma for companies could lead to cascading implications to the global economy, affecting the future of workforce, education, and technology innovations. Assuming companies are not able to adopt AI at scale and match investor's expectations, there will be further impacts to jobs and the economy. Underforming AI will lead to companies spending more money in AI research and more hope for investors, trapping the system in a cycle and inflating the AI bubble till it bursts with monumental consequences. In conclusion, the AI bubble is something you should definitely be aware of, as we continue to assess the pace of AI advancement and monitor the risk of an AI bubble.

Quantum Fisher Information as a Source for Machine Learning

KATHERINE ZHU

Over the past decade, researchers have increasingly explored quantum machine learning (QML), attempting to harness quantum systems to learn, infer, and generalise from data. Such models, implemented through parameterized quantum circuits or quantum neural networks, promise exponential speedups for certain tasks such as quantum state classification, kernel-based learning, and sampling problems that are believed to be intractable for classical algorithms. However, QML faces a familiar challenge: ensuring that a model not only fits its training data but also generalizes new, unseen inputs.

This issue becomes even more significant in the quantum setting where training data consist of quantum states which can exist in many configurations simultaneously (a property called superposition). Parameters correspond to physical operations, and optimization landscapes are embedded within high dimensional manifolds. A growing body of research suggests that a fundamentally geometric quantity—the Quantum Fisher Information (QFI)—may be the key to understanding and improving the learning capabilities of quantum models.

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In classical statistics, the Fisher Information Matrix (FIM) quantifies the level of sensitivity to which a probability distribution reacts to changes in an underlying parameter. The QFI serves a similar role in the space of quantum states. For a parameter-dependent quantum state, the QFI measures how distinguishable nearby states are when these parameters vary infinitesimally. Mathematically, the QFI defines a Riemannian metric, a method of measuring extremely small distances between neighbouring quantum states. This Quantum Fisher Information Metric (QFIM) allows for a model that quantifies the expressivity of quantum models: if small parameter changes produce large, easily detectable shifts, the QFIM is large; otherwise, it is small.

Recent studies extend this intuition into a concrete theory of learning through the Data Quantum Fisher Information Metric (DQFIM), which evaluates the QFIM averaged over a training dataset of quantum states (Haug & Kim, 2024). The DQFIM essentially measures how much of the model's potential "learning space" is actually activated by the data, providing a rank that reflects the number of independent directions in which the model can transform the inputs.

This geometric framework provides a powerful way to describe when and how a quantum model can learn effectively. The rank of the DQFIM determines the model's effective dimension and the number of independent ways in which the model can adjust its parameters to affect the data. When this rank becomes saturated, the model is said to be overparameterised, containing more parameters than are necessary to fit the training data. Interestingly, this analysis shows that overparameterization is not necessarily harmful in the quantum setting as it is in classical machine learning (ML), and instead often marks the onset of generalization — provided the training data is sufficiently rich. In classical ML, this overparameterization often raises the risk of over fitting, where the model memorizes examples instead of learning general patterns, whereas in QML, when the DQIM reaches full rank, the model still has the flexibility to explore all directions relevant to the data without necessarily losing generalization ability as they operate in exponentially large Hilbert spaces (the mathematical space of all possible quantum states).

Beyond generalization, the geometry of quantum models also connects directly to broader aspects of trainability, sample efficiency, and robustness. It has also been shown that the Quantum Fisher Information (QFI) and its data-dependent extensions serve not only as theoretical tools but also as practical indicators of how well a quantum model can learn under realistic conditions (Caro et al., 2022; Haug & Kim, 2024; Wilde, 2025).

Image, Futurism, credit: AMNH

For instance, Caro et al. (2022) demonstrated that the generalization performance of parameterized quantum models scales with both the number of tunable gates and the quantity of available training data, establishing explicit generalization bounds tied to how much of the model's parameter space is effectively explored during training. Consequently, circuits in which only a limited subset of parameters substantially affect the output can generalize more efficiently from smaller datasets, as the model's "active" subspace remains compact and structured. These findings align closely with the DQFIM framework, where the effective dimension, quantified by the rank of the DQFIM, corresponds to how much of the model's potential learning capacity is activated by the data.

Additionally, the DQFIM has been used to show that symmetries in either the model architecture or the dataset can constrain the reachable learning directions, effectively lowering the model's capacity (Haug and Kim, 2024). These results suggest that introducing asymmetries—for instance, through more diverse training data or modified circuit architectures—can increase the DQFIM rank and thus improve generalization. In some cases, a higher rank is even associated with better out-of-distribution generalization, allowing a well-structured overparameterized quantum model to generalize new types of inputs beyond those seen during training.

More recently, Wilde (2025) expanded this geometric framework by formulating Rényi-based Quantum Fisher Information metrics, a family of information measures derived from generalized distance measures between quantum states, known as alternative quantum divergences. Beyond data and architecture considerations, these Rényi-based metrics are able to preserve the desirable properties of the standard QFI, such as monotonicity and contractivity under quantum channels, while offering greater flexibility for analyzing sensitivity, robustness, and learning dynamics in noisy or task-specific quantum systems.

Together, these developments establish a unified geometric perspective on QML learning and generalization, grounded in the QFI and its data-dependent extensions. By framing learning as the exploration of a curved quantum information manifold, the DQFIM provides a way to quantify the effective dimensions and expressivity of quantum circuits, bridging the gap between abstract quantum geometry and practical learning performance. These developments thereby position QFI-based geometry as a foundational tool for the next generation of quantum learning, capable of explaining, predicting, and guiding the behaviour of increasingly complex quantum models.

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Decoding the Tongue: How AI Detects Disease Through Color Analysis

SOFIA CAFAGNA

In a futuristic world, we can envision a visit to the doctor as completely painless, with a simple scan providing our health status in under a minute. We wouldn't need to visit several different doctors to ensure that we do not have serious ailments. Instead, we would be in and out in less than 10 minutes. Luckily, this futuristic world is slowly becoming our reality. One way scientists have begun to make medicine easier and more accessible is by analyzing our tongues. Although not very well known, the color, saturation, and texture of this muscle often reflect the status of our health. By implementing the use of artificial intelligence (AI) to analyze the color of our tongues, we can help ensure our wellbeing in a non-invasive and efficient way.

The utilization of checking the tongue for a complete medical diagnosis originated in traditional Chinese medicine. Traditional Chinese Medicine, or TCM for short, is a type of medicine originated in China and has been practiced for over thousands of years. It consists of several medicinal, physiological, and physical approaches to treat diseases and other ailments. As part of a complete medical diagnosis, TCM practitioners have always checked patients' tongues, attentively observing its coating, color, and texture.

A healthy tongue has a light to dark pinkish hue with small nodules, or papillae, all over it. However, a different colored tongue often reflects underlying health issues or neglect of the muscle. Several examples of unhealthy tongue colors include yellow, purple, black, blue, and gray tongues; each has a different meaning. To illustrate, a yellow tongue often means poor oral hygiene, while a black tongue is due to the buildup of keratin, a protein found in hair, causing food debris to cling to the tongue. A black tongue can often cause poor oral hygiene and even diabetes. In fact, it is known that diabetes, COVID, anemia, asthma, and cancer can all be detected based on the color of your tongue.

Armed with this powerful knowledge, scientists have begun to build and test machine-learning artificial intelligence models to identify possible diseases or conditions based on how a patient's tongue appears. However, one drawback to identifying the color of one's tongue is the incorrect perception of the appearance due to different lighting conditions. Essentially, depending on the lighting, the AI can incorrectly classify the tongue's color. To counteract this, two scientists, roboticist and joint chair of sensor systems at the University of South Australia Javaan Chahl and medical engineering professor at the Middle Technical University in Iraq Ali Al-Naji, created a specific lighting system using machine-learning AI to accurately identify different colored tongues.. The scientists set up a kiosk where patients would place their heads inside a box lit by LED lights with stable and modifiable wavelengths in order to maintain a constant environment. Then, the scientists collected over 5,000 images of different colored tongues to train the AI system to recognize different colored tongues in varying light conditions.

Despite the promising results, there are still several drawbacks to the tongue technique. First, in order to make an extremely accurate and usable AI model for doctors to use on patients, the scientists must compile a massive database of thousands of photos in order to create the most accurate version. However, this is not an easy task. The scientists must find volunteers to take a photo of their tongue and then access their medical records to see how accurate the AI is, something not everyone is very keen to do. Additionally, although tongue color is a helpful indicator of overall health, it is only part of a medical diagnosis; it cannot stand alone. As a result, we may be able to incorporate it into modern medicine, but we cannot rely solely on the results. On the other hand, if we are able to include this technology in our everyday medicine, this could serve as a crucial and non-invasive way to detect serious illnesses, helping improve our lives for the better.

*AI Image from Canva

MONOPOLY OR MERIT? WHY GOOGLE FACED THE BIGGEST TECH TRIAL IN DECADES

CIANA TZUO

Imagine a world where one company controls nearly all the information you find online. In many ways, we live in that world today. Google, the tech giant synonymous with search, handles billions of queries a day and amasses data from Youtube, Android Maps, and more. This treasure trove of data helps Google continually improve its services and attract even more users, a self-reinforcing cycle that competitors can't easily match. Regulators call this 'data dominance,' and they worry it is giving Google an almost unbeatable advantage. Now, Google's dominance is under the legal spotlight. In a landmark U.S. antitrust trial, the Department of Justice (DOJ) accused Google of abusing its monopoly power in online search and advertising. The trial has been closely watched around the world, seen as a test of whether one company's control over data and access can unfairly choke competition.

The case formally began in October 2020, when the DOJ (joined by attorneys general from several states) sued Google under federal antitrust laws. The heart of the government's case was that Google illegally maintained its monopoly in general search. The DOJ argued that Google used unfair tactics to stay number one, especially through exclusive deals that entrenched its search engine as the default choice for most consumers.

The case went to trial in September 2023 in a federal courtroom in Washington, D.C., presided over by Judge Amit Mehta. It was often described as the biggest U.S. monopoly trial in tech since Microsoft's in the 1990s.

One of the most prominent accusations was that Google struck massive agreements to be the default search engine on a wide array of devices and browsers. For example, Google pays Apple and other companies huge sums each year (reportedly in the double-digit billions) to ensure Google Search is the preset option on iPhones and other popular search engines. DOJ lawyers said these default deals function as a powerful barrier against rivals, preventing alternative search engines such as Microsoft's Bing or privacy-focused DuckDuckGo from having a fighting chance to reach users. "Defaults are powerful, scale matters and Google illegally maintained a monopoly for more than a decade," DOJ attorney Kenneth Dintzer said in court. Google arrangements 'froze out' competing search providers.

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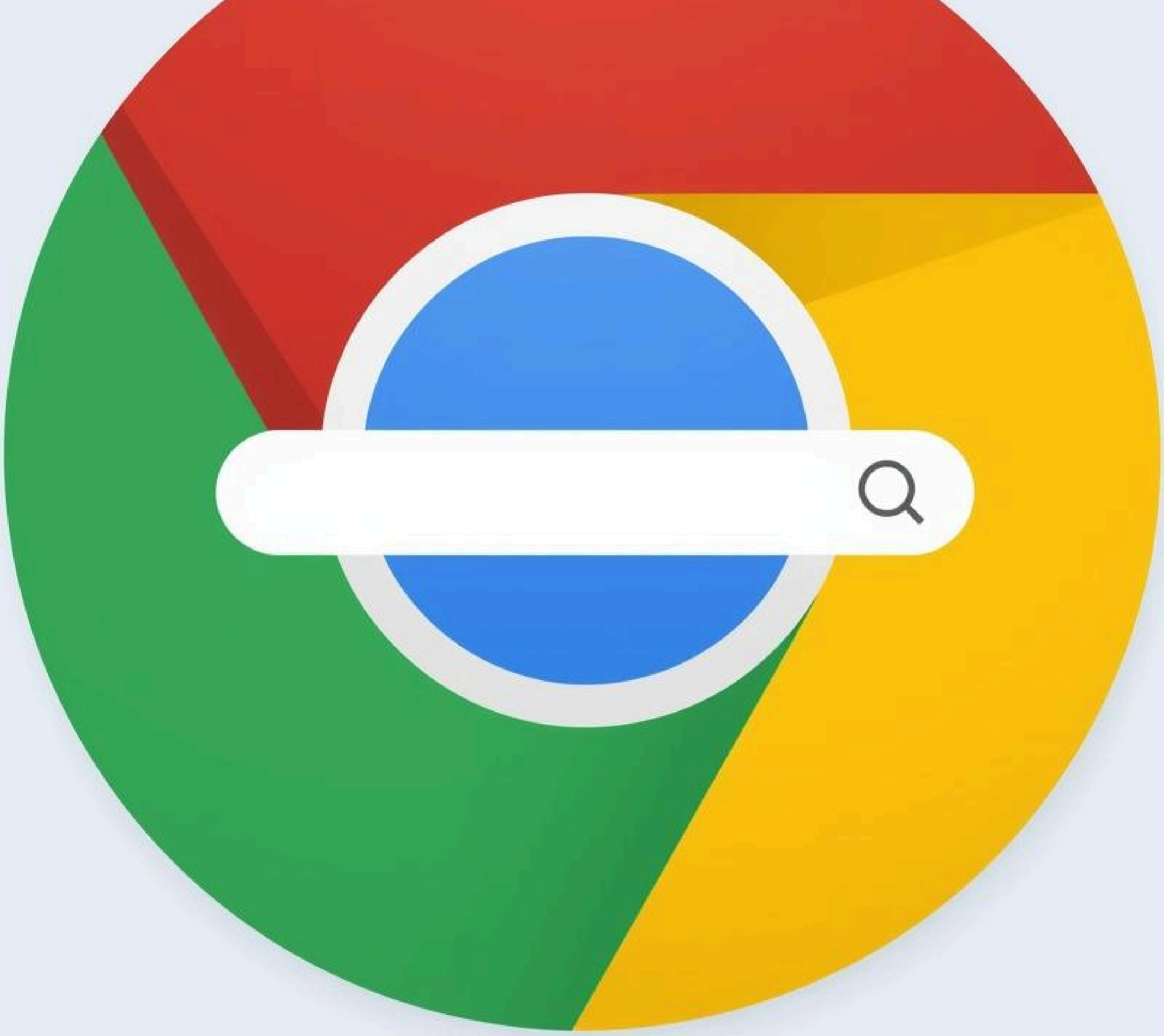
Another focus was Google's conduct with its Android mobile operating system. Android runs the majority of the world's smartphones. The DOJ pointed out that Google required Android device makers to pre-install Google's own apps (like Search, Chrome, Youtube, etc.) and set Google as the default search engine, as a condition of licensing the Google Play app store.

This bundling ensured Google's search engine became the built-in choice on essentially all Android phones. Internal documents showed Google viewed "default status" on phones as hugely valuable and the DOJ argued the company went to great lengths to secure it. In one instance, Samsung tried launching a smartwatch using a custom OS, only to switch back after Google signaled it violated Android terms. The government's contention was that Google's tactics were not just aggressive business moves but anticompetitive barriers designed to lock out potential challengers.

Google's defense, on the other hand, painted a very different picture. The company insisted that its success isn't due to any illegal scheming but because consumers genuinely prefer Google. Google's lawyers noted that nothing prevents users from going to a different search engine if they truly wanted to. Any iPhone user can change their default to Bing, and any Android user can download an alternative search app. "Unhappy consumers…need just "a few easy clicks" to replace the Google app from their devices or … [open] Bing, Yahoo or DuckDuckGo in a browser to use an alternative search engine," Google's lawyer John Schmidtlein said. Schmidtlein emphasized that people stick with Google by choice. Google also pointed out that it won its default position on merit. For instance, it was chosen as the iPhone's default in part because Apple found Google to deliver the best user experience. Far from stifling competition, Google argued, the tech landscape is teeming with it. The company cited Amazon (where many users start product searches) and specialized services like Expedia or Yelp as alternative ways people find information. Even within search, Google's attorneys suggested that competition was "one click away," and warned that penalizing Google for its success could ultimately harm consumers.



GadgetsToUse, Hari Narayanan

Over weeks of testimony, prosecutors presented evidence of Google executives fretting about losing default status and documents detailing the enormous payments to partners. One particularly eye-popping figure emerged: Google was paying Apple an estimated $18 billion in 2021 for the privilege of being the default search engine on Apple devices. (Google's lead lawyer visibly cringed in court when an expert accidentally mentioned the confidential number.) The government argued such sums demonstrated a self-perpetuating monopoly, showing how valuable and anticompetitive these arrangements were: Google's defaults perpetuate a 'feedback loop' that begets more users, more data, and even more dominance.

By the end of 2024, Judge Mehta issued a verdict finding that Google had violated antitrust law, specifically, that it illegally monopolized the markets for general search services and search advertising. In other words, Google's grip on search was deemed not just the product of having a great search engine, but of anti-competitive tactics that kept that grip strong. This ruling set the stage for a second phase focused on what to do about it.

*AI Image from Canva

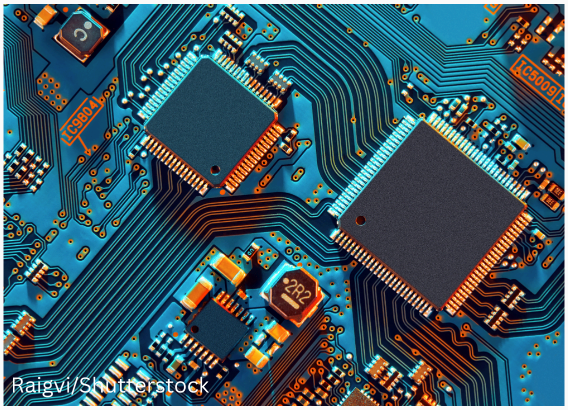
Crucially, however, Google won a reprieve on the most important proposals. Judge Mehta rejected calls to strip Google of key assets. Google won't have to sell its Chrome browser, the judge ruled, nor divest control of the Android operating system. Mehta wrote that predicting the future of tech is "not exactly a judge's forte," and pointed to recent competition from AI chatbots as a reason for humility in crafting a remedy. Products like OpenAI's ChatGPT, he noted, "pose a threat to the primacy of traditional internet search", meaning Google's dominance might already be under pressure from new technology.

However, despite the decision, the legal fight is not over yet. Google quickly signaled it would appeal the verdict, a process that could take years and wind its way up to the Supreme Court. Until the appeal, many remedies (like data sharing) won't be implemented immediately. Still, the trial and ruling have already made history. They mark the first major U.S. court judgment limiting a tech giant's market power in a generation, settling a precedent that even the most dominant internet companies can be held accountable. As Attorney General Pamela Bondi put it, "This decision marks an important step… we will continue our legal efforts to hold companies accountable for monopolistic practices."

TECH TREND REPORT

Known Magazine Africa, Bandile Mathebula

The coming year is defined by an explosion of engineered intelligence and physical innovation. In compute, Nvidia's Rubin and Blackwell Ultra architectures are setting the pace for next-generation AI, supported by breakthroughs in autonomous algorithm discovery via Google DeepMind AlphaEvolve. The race for quantum dominance is escalating, driven by new 3D wiring architectures and the urgent need for quantum-safe cryptography. Simultaneously, we are witnessing the commercialization of biology through advanced bio-printing and synthetic biology platforms, while materials science is revolutionizing energy storage with Structural Battery Composites (SBCs) and the launch of off-Earth manufacturing missions. This convergence of high-performance compute, quantum readiness, and engineered matter is rapidly transitioning frontier research into real-world capability.


Raigvi/Shutterstock

Compute and Chips

- Nvidia Rubin and Blackwell Ultra AI architectures, unveiled at GPU Technology Conference (GTC) 2025, sets new AI compute targets beyond current GPU lines and builds towards new innovations in simulations and physical AI
- QpiAI Indus 25-Qubit Quantum Computer (India) is India's first full-stack quantum computer with superconducing qubits
- Google DeepMind AlphaEvolve is a new LLM-driven algorithm discovery system that autonomously iterates and optimizes algorithms


SQuaD – Quantenkommunikation in Deutschland)

Quantum Computing & Sensing

- QuantWare VIO-40k 3D Quantum Wiring Architecture will greatly increase qubit density over traditional planar designs
- Research breakthroughs integrating quantum photonics (single-photon waveguides, detectors, gates) in a chip is a key step to scalable quantum communication and computing
- New techniques out of Canadian research efforts are making real progress on mitigation quantum errors correction

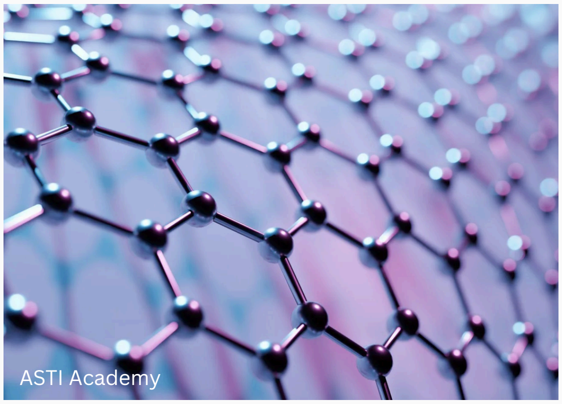
Space and Off-Earth Exploration

- UK Company Space Forge launched ForgeStar-1 to attempt to make advanced semiconductor crystals in microgravity
- The world's largest digital astronomy camera Vera C. Rubin Observatory with a 3.2-billion-pixel LSST Camera complete construction this year, enabling unprecedented sky surveys and data for future astrophysics research


NASA Safety and Mission Assurance (2022)

Biotech & Health Tech Realizations

- CELLINK's bioprinting technologies are continuing to develop to print complex human tissue structures for drug testing and regenerative medicine
- Synthetic biology platforms such as Ginkgo Biowords are programming cells and designing custom organisms for commercial applications in industries like agriculture and pharmaceuticals



Materials & Clean Tech

- Structural battery composites (SBCs) and innovations in weight-bearing materials can make energy storage lighter and more efficient
- Research and advancements in materials for osmotic power systems that generates power using the salinity of two water sources

Cybersecurity and Systems

- With quantum computing inching closer to practical workloads, quantum-safe cryptography innovations have become necessary innovation topics
- New AI-enhanced edge compute security tools have debuted to fight treats at edge points, reducing cloud dependency and improving real-team security

Image, Vocal

Robotics and Automation

- New Agile Robots like the Unitree R1 demonstrate increasingly capable motion and agility
- Progress in the rise of autonomous machines that coordinate adapt and collaborate in real world physical setting

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